Proceedings of the 45th Assembly Helsinki, Finland, June 4–7, 1990

1. Fracture healing and applied strain

J. Kenwright[1] and A. E. Goodship[2]

Nuffield Orthopaedic Centre[1], Oxford, and Bristol University[2], England

The influence of varying rate, and timing of application of strain to healing fractures were investigated in a sheep tibial osteotomy with a 3 mm gap to simulate unfavourable conditions.

Methods: Using this model in the sheep tibia, cyclical mechanical stimuli were imposed across the fracture through a miniature servo-hydraulic actuator attached to the external fixation frame. The stimulus was applied for short periods (17 minutes) each day. The influence of different controlled regimes of mechanical stimulation was assessed in groups of six animals. The rate of mineralisation of the osteotomy was measured using dual photo-absorption densitometry; the rate of increase in fracture stiffness was measured in vivo from strain gauges.

Results: Stress protection inhibition of healing seen with the rigid frame configuration, was significantly reversed in terms of the rate of mineralisation of the gap and restoration of fracture stiffness when using a stimulus regime with an initial displacement of 1 mm, a force of 200 N and a strain rate of 400 m per sec. The stimulus was most effective if applied in the first six weeks.

Conclusions: In this controlled fracture model a close relationship was seen between mechanical loading and bone healing; early application of very short periods of appropriate loads of applied strain magnitude, and strain rate at high physiological levels maintained healing.

2. Bone healing responses to axial loading under external fixation

Hannu T. Aro[1], Edmund Y. S. Chao[2]

Department of Surgery, University Central Hospital of Turku[1], Finland, and Biomechanics Laboratory, Department of Orthopedics[2], Mayo Clinic/Mayo Foundation, Rochester, MN, USA.

Theoretically, axial compression is the most desirable form of loading during fracture healing. Using a canine model, the present investigation was performed to quantitate the effects of early physiologic dynamic compression on fracture healing and remodeling under external fixation.

Material and methods: Eight mixed breed dogs were used. Bilateral transverse midtibial osteotomies were stabilized under rigid external fixation. One osteotomy of each animal was subjected to dynamic compression by release of the fixator telescoping mechanism (axial dynamization) at 2 weeks while the other side remained unchanged and served as the control. The mechanical and histomorphometric quality of bone union between the two sides was compared at 12 weeks.

Results: Analysis of sequential radiographs showed no significant differences in the total amount of periosteal callus and in its remodeling. Both osteotomies reached the torsional strength and stiffness of the intact tibia by 12 weeks. Dynamic compression reduced interfragmentary gap and resulted in cortical contact healing. The control osteotomies united through a gap-type cortical healing mechanism. Both sides showed low intracortical porosity and high intracortical new bone formation. No statistical differences were observed in quantitative two-phase bone scanning and in osteotomy-site microsphere blood flow.

Conclusions: Axial dynamization of an external fixation device may not provide significant benefits if fracture union is progressing uneventfully under stable mechanical conditions.

3. The quantification of bone tissue regeneration after electromagnetic stimulation

B. Jonsson, H. Mallmin, F. Buch and P. Kalebo[1]

Department of Orthopaedics, University Hospital, Uppsala and Department of Radiology, The Eastern Hospital[1], Gothenburg, Sweden

A titanium implant of the type "Bone Harvest Chamber" (BHC) was used to analyze the effect of electromagnetic stimulation on osteogenesis.

Material and method: The BHC was inserted with a minimal surgical trauma in the proximal tibial metaphysis in six adult lop-eared rabbits and osteointegration occurred after four weeks. Bone tissue could then be harvested on repeated occasions—every third week—without killing the animals. The regenerated bone tissue was analyzed with microradiography and densitometry. Two groups of six rabbits each were studied. One group was stimulated with a 72 Hz elec-

tromagnetic field. Bone tissue was harvested from each tibia six times under the stimulation period and twice after the stimulation had been switched off. The other group had the same harvest procedure from one leg but without stimulation.

Results: The electromagnetic stimulation produced a consistently high osteogenetic activity compared with the control group. After cessation of stimulation, the osteogenetic activity diminished rapidly.

4. Effect of growth hormone on periosteal new bone formation in rabbits

Olle Nilsson, Otte Brosjö, Anders Ehrnberg, Peter Låftman and Lennart Strömberg[1]

Department of Orthopaedic Surgery, and Departments of Surgery and Experimental Surgery[1], Karolinska Hospital, Stockholm, Sweden

In a previous study periosteal new bone formation following plate fixation was increased in growth hormone (GH)-treated animals, while the biomechanical properties of the diaphyseal bone was not affected. The present investigation was performed to further analyze the effects of GH on the periosteum.

Materials and methods: The femur diaphysis of 40 adult rabbits was mechanically stimulated to periosteal new bone formation by application of a nylon cerclage band. The bone mineral content, isotope (45-Ca and 3-H-proline) incorporation, and biomechanical properties of the femurs in GH-treated and control animals was studied at 4 and 8 weeks postoperatively. GH was given as daily i.m. injections of recombinant human growth hormone (Somatonorm®, KABI AB, Stockholm, Sweden) 0.5 IU per kg body weight. The control animals received saline solution as placebo treatment.

Effects of the cerclage band: The mid-diaphysis of cerclage-treated femurs displayed an 7–9% increase in BMC in all groups ($p < 0.05$). 45Ca and 3H-proline activities were increased by 58 and 42% respectively at four weeks, and by 38 and 33% at eight weeks ($p < 0.05$). The mechanical properties of the cerclage treated bones were not significantly affected compared to the contralateral side.

Effects of recombinant human growth hormone: The BMC was relevated 1–2% further at four and eight weeks in cerclage treated bones. Uptake of the two isotopes was not affected by GH-treatment. The maximum torque capacitv of the cerclage treated bones was increased 25% by GH-treatment at four and eight weeks ($p < 0.05$). The stiffness of the GH-treated bones increased similarly.

Conclusion: Human recombinant GH further enhances the anabolic effects of plastic cerclage bands applied to the femur diaphysis of adult rabbits, resulting in increased bone mineral content and bone strength.

5. Effects of physeal distraction on the vascular supply of the physis

Anne Alberty, Jari Peltonen and Veyo Ritsila

Hospital of the Invalid Foundation, Helsinki, Finland

After experimental physeal distraction growth disturbance can occur; the cause of which is unclear. Damage to the vascular supply of the physis during distraction could explain the disturbance in growth. Epiphyseal vessels supply the proliferative and germinative zones of the physis, metaphyseal arteries end at the last intact transverse septum, leaving the hypertrophic zone avascular (1). The epiphyseal vessels are related to growth in length and metaphyseal vessels to calcification and ossification of the metaphysis (2).

Material and methods: In the first study a unilateral fixator was fixed to the distal femur in 13 rabbits using four 2 mm fixation pins. A sham operation (fixation pins without apparatus) was performed in the contralateral femur in 7. In the second study, a circular apparatus was used in 14 rabbits, the other side being sham operated. Four 1 mm Kirschner wires were used for fixation. The effects of distraction on the vasculature were studied by microangiography using barium sulfate (Micropaque®) after 4, 9 and 21 days of distraction, immediately and after 6 weeks. After fixation in formaline, decalcination and embedding in paraffine and beeswax, sections of 500 μ were studied by contact microradiography.

Results: The nonoperated controls showed good filling of both epiphyseal and metaphyseal vessels. In the first study disturbances in capillary filling were seen both on the epiphyseal and metaphyseal side, the epiphyseal side being more affected. Similar changes occurred to a lesser extent also in the sham operated bones. Preliminary results from the second study showed capillary filling to be more regular, both in distracted and sham operated bones. The perichondrial vessels seemed intact.

Conclusion: The occurrence of lesions in both the sham operated and distracted bones in the first experiment, suggests that at least part of the lesions were due to the trauma caused by the fixation pins.

References

1. Brighton C T. Structure and function of the growth plate. Clin Orthop 1978; 136: 22–32.
2. Trueta J, Amato V P. The vascular contribution to osteogenesis. III. Changes in growth cartilage caused by experimentally induced ischaemia. J Bone Joint Surg 1960; 42-B: 571–87.

6. Axial tension and nerve function during leg lengthening

A. H. R. W. Simpson and J. Kenwright

Nuffield Orthopaedic Centre, Oxford, England

Limb lengthening procedures and operations to correct deformity are frequently associated with impairment of muscle function and occasionally with nerve palsy.

It is hypothesized that when a segment of a limb is lengthened the nerves could accommodate by: a) sliding from adjacent segments of the limbs or taking a shorter course by bow-stringing across joints; b) stretching in an elastic manner; c) growing new nerve tissue.

Methods: In groups of New Zealand white rabbits an osteotomy was created in the tibia and stabilised by external fixation (Orthofix M100). Metal markers were fixed to the nerve and nerve strain was monitored radiographically; during different regimes of rate and amount of distraction; nerve function was monitored using electrophysiology.

Results: When a leg was distracted acutely at rates equivalent to those used in clinical practice for correction of deformity, the soft tissue tensions could rise to very high levels which fell rapidly over the first three hours. In acute lengthening (up to 4%), the nerve accommodated by sliding from other limb segments; with further increase in length the nerve stretched throughout the whole limb segment being lengthened. At strains of under 10% the nerves continued to function; however at strains immediately over 10% the nerves continued to conduct for 48–72 hours and then function was lost.

7. Joint cartilage repair using allogeneic bone matrix

L. Dahlberg and A. Kreicbergs

Departments of Orthopedics, University Hospital Lund and Karolinska Hospital Stockholm, Sweden

Demineralized allogeneic bone matrix (DABM), placed heterotopically in musle, results in the formation of an ossicle after a preceding chondral phase (1, 2). To determine whether the nonvascular synovial environment would prevent bone formation, but permit and retain cartilage differentiation, we transplanted DABM to cartilage defects in rabbit knees.

Material and methods: In 32 knees of 18 adult rabbits, a 15 mm^2 defect was created into the cancellous bone in the intercondylar femoral groove. The defects were filled with DABM prepared from rabbit long bones (3). Before implantation, DABM was placed in a muscle pouch of the abdominal wall for 4 days (10 defects) or 19 days (8 defects). In another 10 defects DABM was inserted directly. Four defects were left unfilled serving as controls. All animals were killed after 6 weeks. The distal femora were excised, fixed, demineralized, and analyzed histologically.

Results: Cartilage-like repair tissue was observed in the vast majority of defects. However, there was a great variability in all experimental groups. In general, DABM previously placed in the abdominal wall appeared to yield higher cartilage differentiation than those directly inserted. The only consistent findings were bone formation in the marrow of distal femur and, notably, the absence of bone differentiation towards the joint surface.

Conclusions: 1) DABM in joint cartilage defects in the rabbit yields a highly variable type of repair tissue.

2) DABM implanted in muscle for 19 days, permitting recruited stem cells to reach a chondral differentiation before transplantation, seems to give better cartilage repair tissue.

3) Formation of bone otherwise induced by DABM in vascular tissue, such as muscle and marrow, appears to be prevented by synovial environment.

References

1. Urist M R. Science 1965; 150: 893–9.
2. Reddi A H. In: Mechanics of growth control, pp 435–46. Thomas Springfield, 1981.
3. Urist et al. Clin Orthop 1969; 53: 243–83.

8. Immunohistochemical ultrastructural studies on articular cartilage

O. Svensson[1], D. Heinegård[2], H. Hedlund[1] and F. P. Reinholt[3]

Departments of Orthopaedics[1] and Pathology[3], Karolinska Institute, University Hospital, Huddinge, and Physiological Chemistry[2], University of Lund, Sweden.

The mechanical properties of articular cartilage can mainly be ascribed to the combined properties of collagen II and the large, aggregating proteoglycan (PG-LA). Our study was focused on the matrix proteins which are considered to have specific roles in matrix assembly.

Materials and methods: Bovine joint cartilage was fixed in 0.3% glutaraldehyde and 0.3% paraformaldehyde for 2 h, embedded at 228 °K in a polar resin, and polymerized by UV-light. Ultrathin sections were incubated with polyclonal antibodies against fibromodulin or the second globule of the PG-LA core, and for detection, protein A coated with 10-nm gold probes was used. Micrographs were taken with a stratified random sampling technique; immunolabeling was estimated semiquantitatively.

Results: Material reacting with the G-2-domain of the large proteoglycan appeared in close proximity to the collagen fibrils. Labeling was lowest in the superficial zone. There was no major difference between labeling in the territorial and in the interterritorial compartments.

Fibromodulin reactivity was most intense in the midpart of the cartilage. Within each zone, labeling was rather evenly distributed, apart from a striking lack of reactivity in the juxtacellular, territorial compartment.

Discussion: The co-localization of collagen and the G-2-domain of the core protein may indicate an interaction between the two. In this context it is of special interest that this part of the core protein is localized between the hyaluronic acid-binding region and the keratan sulfate-rich region, having a rather specific, highly repeated structure. This may be involved in specific interactions with other matrix constituents.

The in situ-association collagen/fibromodulin corroborates earlier in vitro studies suggesting that this matrix protein may be important for collagen fibrillogenesis. Moreover, the scant labeling close to the chondrocytes may indicate that the molecules form the complex extracellularly.

9. Verapamil increases bone volume and osteopenia in female rats but has the opposite effects in male rats

Eva Samnegård and Göran Sjödén

Department of Orthopedics, University Hospital, Huddinge, Sweden

In vitro verapamil inhibits the intestinal absorption of calcium (1). In hypertensive patients treated with verapamil, serum alkaline phosphatase (s-ALP) was increased and isoenzymes of skeletal origin appeared, suggesting increased bone turnover (2). The aim of our study was to investigate whether the effects of verapamil on bone mineral content, urinary Ca excretion and intestinal Ca absorption were sex dependent.

Material and methods: Adult male and female Sprague-Dawley rats weighing > 300 g were given verapamil 0, 0.075 or 0.75 mg/mL (Isoptin®, Knoll AG) in drinking water and a low Ca diet (0.1% Ca, 0.5% P). In the middle of the experiment, the rats were kept in metabolic cages and urine was collected. After 12 weeks the intestinal Ca absorption was measured by everted-gut-sac-technique, blood was collected and the left tibiae were dissected free of soft tissue, weighed and ashed.

Results: All rats increased in body-weight and seemed to thrive. Female rats given verapamil had reduced levels of ALP ($p < 0.01$) and the amount of bone ash/volume was significantly lower than controls. In male rats s-ALP was slightly increased, and the amount of bone ash/volume was increased. Intestinal Ca absorption was reduced only in male rats ($p < 0.05$).

Discussion: Verapamil has been reported to affect PTH levels and vitamin D metabolism (2). This is the first report that effects on bone mineral content differs between sexes. Possible explanation is that sex hormone production or excretion are affected by verapamil.

Conclusions: Verapamil affects bone tissue and Ca homeostasis differentlyin male and female rats.

References

1. Wrobel J et al. Eur J Pharm 1977; 45: 385–7.
2. Sjödén G et al. J Int Med 1990. In press.

10. Effects of cyclosporin A on experimental new bone formation in rats

Anders Ekelund and Olle Nilsson

Department of Orthopaedics, Karolinska Hospital, Stockholm

Demineralized bone matrix contains an osteoinductive factor, bone morphogenetic protein (BMP), that induces undifferentiated mesenchymal cells to proliferate and differentiate into cartilage and bone. The present study was performed to study the importance of immune reactions on bone induction at allo- and xenotransplantation.

Methods: Heterotopic new bone formation was induced by implanting allogeneic (rat) or xenogeneic (rabbit) demineralized bone matrix into the abdominal wall of growing Sprague-Dawley rats. The rats were treated with 0.5 mg or 2 mg cyclosporin A (CsA) /kg bodyweight, or placebo for 4 or 8 weeks. The amount of induced bone was measured as ash weight and bone turnover by 45-Ca activity of the implants.

Results: Cyclosporin treatment enhanced bone induction in allogeneic matrix by 40–50% at 4 weeks, while there was no difference from the control group at 8 weeks. Xenogeneic matrix induced virtually no bone in control rats at 4 weeks, while the net formation of bone was increased 4–5 times in both CsA treated groups at 4 weeks. The bone formation rate in xenogeneic matrix was equal to allogeneic implants in CsA treated groups.

Table. Results, Abstract 9

Sex	n	Conc. (mg/mL)	Length (mm)	Volume (cm^3)	Ash/volume (mg/cm3)	s-ALP (µkat/L)	Ca-abs
	6	0.75	44.5 ± 0.7	0.583*± 0.026	0.620**± 0.014	1.60 ± 0.55	2.46*± 0.86
Male	6	0.075	45.1 ± 0.8	0.641 ± 0.032	0.580 ± 0.013	1.45 ± 0.40	4.03 ± 1.89
	6	0	45.2 ± 0.8	0.633 ± 0.031	0.578 ± 0.020	1.40 ± 0.21	5.28 ± 2.13
	6	0.75	40.7**± 0.5	0.429**± 0.034	0.667**± 0.036	2.58**± 0.81	10.24 ± 02.40
Female	6	0.075	40.3 ± 0.4	0.397 ± 0.017	0.713 ± 0.047	3.30 ± 0.55	8.05 ± 4.38
	6	0	39.7 ± 0.7	0.385 ± 0.010	0.742 ± 0.037	3.78 ± 0.48	10.91 ± 2.12

Conclusions: Immunologic reactions inhibit bone induction at transplantation of allogeneic or xenogeneic demineralized bone matrix. This effect can be counteracted by treatment with CsA.

11. Bone induction by composite of bioerodible polyorthoester and demineralized bone in rats

Eirik Solheim, Else Pinholt, Gisle Bang[1], Einar Sudmann[2]

Institute for Surgical Research, Rikshospitalet, University of Oslo, Oslo, Department of Oral Pathology and Forensic Odontology[1] and Hagavik Orthopaedic Hospital[2], University of Bergen, Bergen, Norway

Materials and methods: Alzamer® bioerodible polyorthoester, a local sustained drug release system, was used as a carrier for demineralized bone matrix (DBM) particles to prevent dislocation and provide sustained release. Two experiments were conducted in 137 Wistar rats to evaluate heterotopic bone induction in abdominal muscle (A) and regeneration of 4 mm calvaria defects (B) by implants of Alzamer®, DBM and composites of the two.

Results: In experiment A, composite of Alzamer® and DBM induced cartilage and bone at the same rate as DBM alone as evaluated histologically at week 1, 2, 3, 4, 6 and 8 and by 85-Sr uptake at week 4. Alzamer® alone caused no induction.

In experiment B, all defects filled with DBM or composite of polyorthoester and DBM were bridged by bone histologically and radigraphically by week 4. Defects witout any implant or filled with polyorthoester only, did not heal.

The polymer caused slight inflammation that subsided by three weeks. Only traces of the polymer could be detected at week four. The composite implant was technically easier to use than DBM alone.

12. Intramedullary reaming and nailing of rat femur

Kari Indrekvam

Surgical Research Laboratory, Haukeland Hospital, Bergen, Norway

In this study the immediate and long term mechanical and chemical effects of closed intramedullary reaming and nailing of unfractured femora were evaluated.

Material and methods: The right femora in 40 rats were intramedullary reamed and nailed with steel-nails. 8 animals were evaluated immediately, 3, 6, 12, and 24 weeks postoperatively. In vivo strain, in vitro mechanical properties, and chemical constituents (hydroxyproline, calcium, phosphorus) of both femora were measured.

Results: Immediate results presented as the ratio operated/ intact femur were (median with 0.25 and 0.75 fractiles): in vivo peak strain 0.54 (0.41–0.70) ($p < 0.05$), stiffness 0.83 (0.75–0.88), maximum bending stress 0.69 (0.57–0.88) ($p < 0.05$), hydroxyproline 0.91 (0.86–0.99) ($p < 0.05$), calcium 0.99 (0.91–1.04), phosphorus 0.94 (0.90–1.02), and mineralization 1.07 (0.97–1.14).

From three weeks on, no variables differed from 1.00, except in vivo peak strain which was reduced throughout the study.

Conclusion: Intramedullary reaming and nailing of the rat femur immediately caused weakening of the bone, but normal mechanical and chemical values were regained within 3 weeks. With the nail in place in vivo deformation was reduced throughout the experimental period of 24 weeks.

13. Significance of immunological factors in healing of bone transplantation: An experimental study in the rat

Carlos Saro Moncloa and Gudmund Blomgren

Department of Orthopaedic Surgery, Karolinska Institute, University Hospital, Huddinge, Sweden

The purpose of this study was to evaluate the bone induction capacity of cortical bone autografts and allografts used in Cyclosporin treated and untreated rats.

Materials and methods: Eighty rats were included in the experimental groups. They were ramdomly divided into four groups of twenty rats, where the donor/recipient pairing constituted a histocompatibility barrier (Wistar versus Sprague Dawley).

The following groups of rats were used versus fresh autografts:

Group I. Fresh allografts.

Group II. Frozen allografts.

Group III. Immunosuppression + frozen allografts.

Group IV. Immunosuppression + fresh allografts.

In each rat 5 mm of the diaphysis of the tibia were resected bilaterally, and the bilateral defects were reconstructed by implants (auto- and allografts) of resected segments and stabilized using 0.8-mm intramedullary fixation (Kirschner wire).

Frozen allografts were stored at -70 °C for at least 3 weeks.

Cyclosporin A treated rats received 10 mg/kg/d subcutaneously during 14 days after transplantation.

The animals were followed radiographically and after killing the transplanted bones were collected for histopathological and biomechanical evaluation.

Results: No significant difference were found between fresh or frozen allografts and fresh autografts radiographically or by testing the torsional strength of the transplanted segments. Immunological suppression by Cyclosporin A had no significant effect on the radiolgraphical healing or the mechanical strength of the allografts.

14. A comparative experimental study of bone induction by composites of demineralized bone and Absele®, Tisseal® or bioerodible polyorthoester with or without gentamicin

Else Pinholt, Eirik Solheim, Gisle Bang[1], Einar Sudmann[2]

Institute for Surgical Research, Rikshospitalet, University of Oslo, Oslo, Department of Oral Pathology[1] and Forensic Odontology, and Hagavik Orthopaedic Hospital[2], University of Bergen, Bergen, Norway

A biodegradable carrier is warranted both for demineralized bone matrix (DBM) particles to prevent dislocation and as a delivery system to provide sustained release of bone inductors and drugs.

Materials and methods: We have evaluated the heterotopic osteoinduction of composites of DBM and Alzamer® (bioerodible polyorthoester local sustained drug release system) with and without gentamicin, Absele® (collagen/fibrine bone sealant) and Tisseal® (fibrine sealant) implanted in the abdominal muscle of 180 male Wistar rats.

Results: Composites of Alzamer® with or without gentamicin and DBM induced significantly more bone than composites of Absele or Tisseal and DBM as evaluated by 85-Sr uptake at week 4 ($p < 0.002$). There were no significant differences between composites of Alzamer with or without gentamicin and DBM and DBM alone. The composites of Alzamer with or without gentamicin and DBM were technically easier to use than the other composites or DBM alone.

Conclusion: Bioerodible polyorthoester seems to be preferable to collagen/fibrine bone sealant and fibrine sealant as a carrier for DBM.

15. Enlarged parathyroid glands in hypocalcemia—hyperplasia or hypertrophy?

O. Svensson[1], S. Mengarelli-Widholm[2], A. Wernerson[2], and F. P. Reinholt[2]

Departments of Orthopaedics[1] and Pathology[2], Karolinska Institute, University Hospital, Huddinge, Sweden

Hypocalcemia triggers an immediate release of stored parathyroid hormone. However, upon prolonged stimulus or disease the parathyroids may enlarge, but until quite recently it has been difficult to ascertain whether this is due to increased cell number or cell size.

Materials and methods: Weanling rats were given diets with normal (1%) or low (0.08% or 0.02%, respectively) Ca content for 28 days. Total volume of the parathyroids was estimated from serial sections. Volume density of secretory cells was calculated according to conventional stereological techniques, whereas cell number and cell size was estimated by the disector method (J Microsc 1984; 138: 127-42).

Results: The experimental groups developed moderate and severe hypocalcemia, respectively. The parathyroids were enlarged with a proportional growth of parenchyma and interstitium. Related to the body weight, the volume of secretory cells was highest in animals with severe hypocalcemia. In both groups the size of the parathyroid secretory cells was increased by 30–35%, whereas total cell number was unaltered.

Conclusion: Parathyroid cells have a certain nonsuppressible PTH secretion—i.e., hormone synthesis is a function of secretory cell mass and this might be important in secondary hyperparathyroidism. Our finding that increased gland size was due to cell hypertrophy rather than hyperplasia, suggests that hyperparathyroidism, at least theoretically, may be reversible and therefore amenable to drug therapy. The recent demonstration of the suppressive effect of 1,25-(0H)2D3 might, therefore, have future therapeutic implications.

16. The flexion-distraction strength of the spine and bone mineral content

P. Neumann, A.-L. Oswalder[1], P. Löwsund1, A. Nordwall and T. Hansson

Department of Orthopaedics, Gothenburg University, Sahlgren Hospital, Gothenburg, and Department of Injury Prevention[1], Chalmers University of Technology, Gothenburg, Sweden

The bone mineral content (BMC) has been shown to be a reliable predictor of
bone strength in compression and flexion (Hansson et al., 1980), disc properties (Keller et al., 1987), and spinal ligament properties (Neumann et al., 1989).

Our aims were to determine the ultimate strength during flexion-distraction loading and to determine the structural properties of the motion segment which decide this strength.

Material and methods: 16 fresh, intact lumbar spine motion segments were used for the study. The BMC was determined in both the vertebrae with DPA. Quasistatic loading was transferred to the rigidly fixed specimen through an adjustable metal bar. The load responses of the segment were measured by force and moment transducers (AMTI MC 12-6-1000). Dial gauges were used to measure horizontal and vertical displacement of the segments. The loading took place in increments of 80 N up to 320 N and then followed by further increments of 40 N until failure. Stress, stiffness, and energy absorption were calculated.

Results: Ultimate failure occurred suddenly and at a mean load of 150 Nm (± 11) in bending and 620 N (± 53) in shear. The maximum flexion angle just before failure was 20° (± 2.0) with a range of 16–22°.The horizontal as well as the vertical displacements recorded at the posterior part of the disc and determined at different parts of the load-strain curve showed the closest correlation to BMC at the yield point ($r = 0.87$). The bending moment, shear force, bending stiffness, and stress of the motion segment were all closely correlated to the BMC. The correlation coefficients between

ultimate bending moment and parameters like sex, age, weight, height, spinal level, specimen height, lateral disc diameter, mean disc height were low ($r < 0.50$).

Strain and creep were closely correlated to BMC which indicated that subjects with a higher BMC would withstand higher strains than subjects with lower BMC values of their spines.

17. Mechanical properties and strength retention of self-reinforced polyglycolide (SR-PGA) osteosynthesis implants

Jarkko Vasenius, Pertti Törmälä, Seppo Vainionpää and Pentti Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital and Biomaterials Laboratory, Institute of Plastics Technology, Tampere University of Technology, Finland

For the safe application of absorbable osteosynthesis implants the initial mechanical properties and strength retention of implants have to be well investigated. We have studied the SR-PGA osteosynthesis implants in three different environments.

Material and methods: SR-PGA rods 1.5, 2.0, 3.2 and 4.5 mm by 50 mm were manufactured by sintering polyglycolide sutures at elevated pressure and temperature and sterilized in ethylene oxide. The strength retention of 3.2 mm coated and uncoated SR-PGA rods were studied in distilled water at 37°C, in the subcutis and in the femoral medullary cavity of 84 rabbits. 28 rabbits were operated on to evaluate the strength retention of SR-PGA rods with different diameters in the subcutis. The follow-up periods were 1, 2, 3, 4, 5, 6 and 8 weeks. At each period five parallel rods of each type were tested. The bending modulus, bending strength and shear strength of the rods were measured.

Results: The initial bending and shear strength of the rods were 260–400 MPa and 165-250 MPa respectively. The bending modulus was 11–15 GPa. The initial bending and shear strength values did not correlate with the rod diameter. SR-PGA rods (3.2 x 50 mm) lost their strength considerably faster in the subcutis and in the medullary cavity than in the distilled water at 37°C. No significant difference was found in the strength loss of SR-PGA rods in the medullary cavity or in the subcutis. 3 weeks after implantation in the subcutis 1.5 mm rods retained 20 %, 2.0 mm rods retained 25 %, 3.2 mm rods retained 75 % and 4.5 mm rods retained 60 % of their initial shear strength. 1.5 and 2.0 mm rods lost their strength in 4–5 weeks, 3.2 mm rods in 6-7 weeks and 4.5 mm rods in more than 8 weeks. All rods lost their bending strength at a slightly higher rate than their shear strength.

Conclusion: SR-PGA rods can be safely used only in the fixation of fractures and osteotomies of cancellous bone where the fixation is not exposed to hard mechanical stress. To extend the indications for absorbable osteosynthesis implants new composites and structures are under evaluation.

18. The effects of delay on the distraction of an osteotomy

John Kenwright and Stephen White

Nuffield Orthopaedic Centre, Oxford, England

When using the Ilizarov technique for leg lengthening several variables are said to enhance healing. In the present study the independent influence of delay before distraction is investigated.

Material and methods: Diaphyseal osteotomies were created in the tibia in 24 adult rabbits and fixation made using external skeletal fixation. Distraction was applied at 0.5 mm daily immediately in one group and after an interval of 7 days in the other group. In vivo monitoring was made of tensile stress; serial radiographs were taken; at 42 days in each group microangiography and histomorphometry were performed.

Results: In the delayed distraction group the volume of mineralised callus was at least twice that found in the immediate distraction group ($p < 0.01$). In the delayed distraction group there was more proliferative vascular invasion by medullary vessels and more callus formation with less fibrous response.

Conclusions: Delay in itself is an important factor promoting osteogenesis in distracted osteotomies; its effects are associated with increased vascularity and callus formation in the osteogenic zone.

19. Effect of indomethacin and prostaglandin E_2 treatment on early hemodynamics after rabbit osteotomy

J. Keller, H. Shu-Zheng, E. Stender Hansen, P. Kjærsgaard-Andersen and C. Bünger

Institute of Experimental Clinical Research and the Orthopedic Hospital, University of Aarhus, Aarhus, Denmark

The aim of the study was to investigate the influence of indomethacin and prostaglandin E_2 on early hemodynamics after osteotomy.

Material and methods: Fourty white rabbits were randomized in 4 groups of 10 rabbits. Group 1 served as control, group 2 were treated with indomethacin (10 mg/kg/day), group 3 were treated with prostaglandin E_2 (1 mg/kg/day), group 4 infused with prostaglandin E_2 in lower aorta just before killing (20 ng/kg/min for 20 min). In all rabbits an unilateral mid-tibial osteotomy was performed and stabilized with an intramedullary K-wire and a plaster cast. Four days after osteotomy the animals were anesthetized and regional blood flow (RBF) was measured with the microsphere technic. In group 4 RBF was measured before and after infusion of prostaglandin E_2. The plasma volume (PV) and extracellular fluid volume (ECV) were assesed by the distribution space of 125-I fibrinogen and 51-Cr EDTA. Subsequently, the rabbits were killed and the legs dissected into standardized specimens.

Results: Compared to control leg the RBF was unchanged in the osteotomized tibial diaphyseal bone, reduced in the bone marrow and increased in the anterior tibial muscle. The PV was significantly reduced in osteotomized diaphyses and bone marrow, but unchanged in the muscle. The ECV was unchanged in the osteotomized diaphysis, but increased in marrow and muscle. Neither indomethacin nor prostaglandin E_2 treatment caused any change. RBF was unchanged after prostaglandin E_2 in the osteotomized leg, but increased elsewhere.

Conclusion: The study revealed no effect of indomethacin and prostaglandin E_2 on early hemodynamics after osteotomy although prostaglandin E_2 treatment increased RBF in non-traumatized areas.

20. Effect of clonodine on experimental fracture healing

Ali Baktir, Eyüp S. Karakas, Turan Ökten, Selim Kurtoglu and Ahmet Can

Departments of Orthopaedic Surgery and Pathology, Erciyes University, Kayseri, Turkey

Clonidine, an a-adrenergic agonist, stirnulates Growth Hormone (GH) release in various species, including human. Previous reports have evaluated that clonidine is a potent pituitary GH releasing agent.Stimulation of GH release by administration of L-Dopa accelerates healing of bone fractures. The purpose of this study was to clarify the effect of clonidine treatment on fracture healing.

Material and methods: Standardized tibial fractures were produced in right hind-legs of rats. Seventy-two rats were divided into four groups of 18 animals. Half of each group received maintenance doses of clonidine intraperitoneally. The other half of them was used for control. Seven, 15, 28 and 56 days after the operation, the animals were killed respectively. The fracture healing was evaluated by radiographic, histo-quantitative and tensile force measurements. Before killing, the serum GH value of each animal was evaluated.

Results: There were no significant differences between the experimental and control animals at the end of first week. After the first week, radiographic examination and histo-quantitative analysis of new bone formation showed that the rats receiving clonidine had accelerated fracture healing compared with the control animals ($p < 0.05$). The tensile forces and the serum GH levels of the experimental animals were also significantly higher than those of the control rats ($p < 0.05$ and $p < 0.01$ respectively).

Conclusion: Some authors suggest that brain injury disturbs normal hypotalamic function and causes excessive secretion of dopamine.This neurotransmitter stimulates the secretion of GH which in turn accelerates healing of bone frac-

tures. Koskinen et al. (1978) described the successful treatment of 20 patients, suffering from delayed union or nonunion of long bone fractures using human GH. The results of this study emphasize the potential value of GH in the treatment of fractures.However, human GH is expensive, difficult to obtain and cannot be administered orally, whereas indirect stimulation of endogenous GH secretion by an orally administered drug like clonidine could overcome these problems.

21. Dichlormethylene biphosphonate and fracture healing

Markku Nyman, Pekka Paavolainen, Teddy Holmström and Risto Penttinen

The Orthopaedic Hospital of the Invalid Foundation, Department of Pathology, Helsinki and Department of Biochemistry, University of Turku, Finland

It is still an open question, whether biphosphonate therapy increases the risk for fractures or is beneficial to the healing fracture. Theoretically, the inhibition of osteoclastic resorbtion activity during callous fracture healing is interesting although the basic processes of interaction between osteoblasts and osteoclasts in callus still remains obscure.

Material and methods: The effect of clodronate (Bonefos®) treatment (50 mg/kg weekly s.c.) on healing fractures was studied in 165 adult rats as a double blind trial, analysing the fracture from 7 to 56 weeks with mechanical testing, histomorphometry and biochemical analysis.

Results: Clodronate did not retard the regaining of the strength in fracture and did not induce measurable changes in histoplanimetric analysis of the callus. The conterlt of hexosamines in callus increased with treatment. In the diphosphonate group, the mineral amount in callus continued to increase after consolidation of the fracture.

Conclusion: On biochemical basis it seemed evident that the maturing and remodelling of the callus tissue was retarded under clodronate therapy although this was not reflected in mechanical nor histoplanimetric results. In the light of these experimental results there is no reason to restrict the therapy—if it otherwise is indicated.However, the long term effects of clodronate on the mechanical properties of healing bone are not known.

22. Fixation of experimental osteotomies of the human patella with biodegradable material versus tension wire a.m. AO

Peter Lyndrup, Søren Andersen, Torben Sandberg Sørensen and Peter AIbrecht Olsen

Department of Orthopedic Surgery, Rigshospitalet, Frederiksberg Hospital and Gentofte Hospital, Hellerup, University of Copenhagen, Denmark

The intention was to study the initial tensile strength of osteotomies of the patella fixed with biodegradable PGA-rods.

Method: Experimental osteotomies on 12 pairs of human cadaver patellae were fixed with 2 crossing PGA-rods on one side and tension wire a.m. AO on the other side. The implanted PGA-rods had a diameter of 2.0 mm and a length of 50 mm. The rods are composed of selfreinforced, composite polyglycolic acids (PGA). PGA is metabolized via tricarboxylic acid cycle and gradually eliminated from the body as water and carbon dioxide' during approximately 3–4 months. Dual photon absorptiometry was applied on all specimens and BMC and BMD were recorded. The tensile strength was tested in an INSTRON Universal Test Machine.

Preliminary findings: The median tensile strength till start of dislocation was 48 (0–75) N for the AO method and 70 (20–125) N for the PGA method ($p < 0.0l$). The median tensile strength till dislocation gap of 1 mm was 120 (45–250) N for the AO method and 123 (60–385) N for the PGA methods ($p > 0.1$). We found no correlation between the tensile strengths and the BMC and BMD.

Future plans: The present study indicates that the initial tensile strength of osteotomies of the patella fixed with biodegradable PGA was comparable with that of tension wire a.m. AO. We intend to perform measurements in vivo including monitoring both tensile strength and flexural strength.

23. Bone hemodynamics—plasma skimmimg in the intraosseous microcirculation

Ebbe Stender Hansen, Kjeld Søballe, Dorthe Kjølseth, Tine Brink Henriksen, Shu-Zheng He, Vibeke Elisabeth Hjortdal, Jens Bülow and Cody Bünger

Departments of Orthopaedic Surgery and Clinical Physiology, Institute of Experimental Clinical Research, University of Aarhus, Department of Clinical Physiology, Bispebjerg Hospital, Copenhagen, Denmark

Introduction and methods: The microsphere (MS) method, which is widely used for the study of regional blood flow (RBF) in bone, assumes that MS after intracardial injection are evenly distributed in arterial blood and completely extracted during the first tissue passage proportional to RBF. Skimming of MS or arteriovenous (AV) shunting would vi-

olate these assumptions. We studied the occurrence of skimming and AV shunting in bones of the lower limbs in totally 32 young dogs. Tissue hematocrit (Hct) was studied (n 8) by means of 51-Cr-erythrocytes and 125-I-fibrinogen. The distribution of plasma flow was compared to the distribution of 15-μm 141-Ce-MS (n 16) by the uptake in tissues of 59-Fe-transferrin bolus-injected intracardially and trapped peripherally by circulatory arrest after 15 sec. AV shunting was studied (n 8) by simultaneous injection of 15-μm 141-Ce-MS and 50-μm 46-Sc-MS.

Selected results and comments: Hct varied from 0.25 in cortical bone and patella to 0.08 in metaphyseal spongiosa, where RBF also was low and VV large. The femoral epiphysis had lower central and higher peripheral RBF and Hct. These results are strongly suggestive of plasma skimming. The ratio between the uptake of bolus-injected 59-Fe-transferrin and 15-μm MS was 1 in cortex, patella, and subchondral epiphyseal bone, but 2 in central epiphyseal bone and 5–8 in metaphyseal spongiosa, consistent with both plasma skimming and AV shunting of 15-μm MS. The uptake of 50μm MS was found to be 2–3 times higher than that of 15-μm MS in metaphyseal spongiosa, slightly lower in patella and subchondral epiphyseal bone, and substantially lower in cortical bone. However, when whole bones or flow-compartments were regarded in toto, the overall uptake of 50-μm MS was 70% of that of 15-μm MS, which speaks against AV shunting in bone. The finding points to different rheologic behaviour of 15-μm MS and 50-μm MS in larger arterial truncs and demonstrates that the macroanatomic architecture of the bone vasculature influences the regional distribution of MS in bone.

Conclusion: The studies have demonstrated skimming phenomena in the bone microcirculation. The effect is most pronounced in cancellous bone with a large vascular volume, where the microsphere technique appears to underestimate RBF due to this effect.

24. The effect of hydroxyapatite during unstable mechanical conditions

Kjeld Søballe, Ebbe Stender Hansen, Helle B.-Rasmussen and Cody Bünger

Orthopaedic Hospital, Institute of Experimental Clinical Research, Institute of Pathology and Department of Connective Tissue Biology, University of Aarhus, Denmark

Finite element analyses of rigidly fixed tibial trays from knee replacements have predicted that differences in elasticity modulus between cancellous bone and metallic porous materials would cause displacement incompatibilities of as much as 150 microns at the periphery of the resected tibial plateau. We studied the influence of 150 microns movements between porous coated titanium and hydroxyapatite coated implants

Material and methods: A dynamically loaded unstable device producing 150 microns axial translation of the implants during each gait cycle was developed. Mechanically stable devices served as controls. Stable and unstable devices with porous titanium (Ti) and hydroxyapatite (HA) coating were inserted into the weight bearing regions of the medial femoral condyles in 14 mature dogs.

Results: Histological analysis after 4 weeks showed a thick fibrous membrane surrounding both Ti and HA coated implants subjected to micromovements, whereas bone ingrowth was obtained in mechanically stable implants. Histological analysis of the membranes showed islands of fibrocartilage surrounding unstable HA coated implants, whereas fibrous connective tissue surrounded unstable Ti implants. Collagen determination of the fibrous membranes showed significantly increased collagen content around unstable HA coated implants compared to those of Ti implants ($p < 0.05$). Shear strength of unstable Ti and HA coated implants was significantly reduced compared to the corresponding mechanically stable implants ($p < 0.01$). However, shear strength values of unstable HA coated implants was significantly greater than those of unstable Ti implants ($p < 0.01$) but also than those of stable Ti implants ($p < 0.05$). The greatest shear strength was obtained by stable HA coated implants which was increased ten-fold compared with the stable Ti implants ($p < 0.001$).

Conclusion: This study demonstrates that movements of 150 microns between bone and implant inhibit bony ingrowth and lead to development of a fibrous membrane. The stronger fixation of unstable HA coated implants compared to both unstable and stable Ti implants may be ascribed to the presence of fibrocartilage and the higher collagen concentration in the membrane around HA coated implants. The best anchorage and the greatest amount of bone ingrowth was obtained by mechanically stable implants coated with hydroxyapatite.

25. Blood perfusion and metabolism in canine tibial diaphysis following cementation with PMMA bone cement and inert bone wax

Jens Sturup, Jens Madsen, Erik Tøndevold, Jørgen Steen Jensen

Department of Orthopedics U, Rigshospitalet, University of Copenhagen, Denmark

In order to estimate bone injury following cementation with PMMA (polymethyl metacrylate) bone cement, a paired study on dog tibiae using inert bone wax as control, was performed.

Methods: Sixteen adult mongrel dogs were operated upon, using standard cementation procedures. After 1 week (2 dogs), 4 weeks (6 dogs) and 12 weeks (8 dogs), bone blood perfusion was measured quantitatively using Sc-46 labled microspheres and qualiatively using vital staining with disulfin blue. Bone metabolism was investigated with 99m-Tc autoradiography.

Results: In all but one case blood flow rates and bone metabolism in the bones filled with wax exceeded the values for the bones filled with PMMA. Median bone blood flow after 1 week was 3.3 mL/min/100g tissue compared with 5.9 mL/min/100g on the control side. The flow rose to 14.4 and 21.4 mL/min/100g after 4 weeks ($p = 0.03$), and declined to 5.5 and 7.7 mL/min/100g after 12 weeks. Disulfin staining and autoradiograms showed initially cortical necrosis which declined after 4 weeks and after 12 weeks no obvious necrotic areas could be recognized. Bones filled with PMMA showed less periosteal apposition and more necrosis than bones filled with wax.

Conclusion: As surgical invention including medullary filling were identical on the two sides it is concluded that the restrained blood flow and bone metabolism on the cemented side must be due to properties of PMMA-bone cement, such as a high exoterm and leakage of monomer during polymerisation.

26. Histological evaluation of cortical bone reaction to PMMA cementation

L. Nimb Jensen and J. Steen Jensen

Department of Orthopedics, Rigshospitalet, University of Copenhagen, Denmark

The aim of this study was to examine histologically the bone reaction in the tibial diaphysis of dogs following intramedullary filling with acrylic PMMA bone cement on one side and inert bone wax on the contra-lateral side, after identical surgical preparation of both sides.

Material and methods: Sixteen adult mongrel dogs (weight 20–30 kg) were intramedullary cemented. After 1 week (2 dogs), 4 weeks (6 dogs), 12 weeks (8 dogs) histology was investigated using undecalcified bone sections stained with Van Gieson picro-fuchsin/Stevenels blue or a modified hematoxylin-eosin.

Results: Application of conventional PMMA bone cement showed severe impairment of tubular bone, as judged by cortical necrosis, remodelling, periosteal apposition and membrane formation, as compared with the bones filled with bone wax. After 1 week cortical necrosis was more than two thirds of the endosteal cortex compared to one third on the control side. Osteoid bone formation was less pronounced on the cemented side compared with bone wax after 4 and 12 weeks. The periosteal apposition increased from 1 to 4 weeks in both groups. From 4 to 12 weeks no further periosteal apposition was seen. The apposition was in all cases thicker in the bones filled with wax than in those filled with PMMA. After 12 weeks a fibrous membrane of 60–70 µm, containing circularly oriented fibrils was observed on the cemented side. None or only few spots of fibrous tissue were detected at the interface between bone and wax.

Conclusion: We found that PMMA bone cement seriously influenced the viability of cortical bone and its remodeling as compared with inert bone wax.

27. Development of models for custom hip stem prostheses using three-dimensional CT and stereolithography

P. Benum, E. Andersen, 0. Hopperstad, R. Houtun, 0. Schnell-Husby, A. Nordby and T. Strickert

Orthopaedic Department and Department of Radiology, Trondheim University Hospital and The Norwegian Institute of Technology, Division of Production Engineering, The University of Trondheim, Norway

Due to the great variety of the configuration of the upper femur a relatively poor contact is obtained between a nonindividually produced noncemented femoral stem and the cortical bone. Since the degree of fit achieved at surgery is of great importance for the success of an implanted femoral stem, a program has been started to develop individually fitted stems by use of three-dimensional CT information and stereolithography (SLA). SLA is a new technology that forms designs or parts from CAD/CAM-generated solid or surface data. Cured by a laser beam in a vat of liquid photopolymer, the design emerges as a solid three-dimensional real part, without any tooling.

Methods: To determine the density level of the inner surface of the cortical bone, which is aimed as a contact area for the femoral stem, the following examination was performed: Cadaver femurs were scanned by CT before and after excochleation of the spongy bone of the upper femur. The inner contours of the excochleated femur at the various cross sectional levels as determined by CT were superimposed on the corresponding cross-sections of the nonexcochleated bones. The density level that gave a similar contour was chosen as an appropriate density level to describe the inner cortical surface. This level was found to be lower in the trochanteric and femoral neck area than below the lesser trochanter. A special data program was developed to generate coordinates for the internal contours of the cortical bone of the upper femur based on the CT scans and the chosen limits for density. These data were transferred to the CAD/CAM unit for design of the femoral stem model. Following the production of the model, the model was compared to a casted model of the excochleated femur.

Results: It was found that the SLA-produced models closely resembled the corresponding casted models. Further studies are performed to explore this method in cadaver specimens. This includes computer directed modification of the shape of the models to make insertion possible.

28. Infection susceptibility of titanium and bone cement implants: An experimental study in the rabbit.

Lennart Sanzen, Lars Linder and Per Gunnar Persson

Departments of Orthopedics, Malmö and Pathology, Linköping, Sweden

Material and method: In each upper tibial metaphysis in 20 rabbits eiher a pure titanium cylinder or a piece of bone cement was implanted. After three months 10^4, 10^6, or 10^8 *Staphylococcus aureus* were injected into each leg through central holes in the implants in three groups of animals. Serial radiograms were taken and after four weeks bacteriologic and histologic biopsies were obtained.

Result: Three animals died before the end of the experiment. In animals who received 10^6 or 10^8 *S. aureus*, radiographic changes of widespread osteomyelitis were found in about half of the legs. Some cultures were negative in spite of radiographic changes, more often in the titanium implant legs. Histology showed signs of osteomyelitis not limited to the bone-implant interface.

Conclusion: After a proper time for wound healing the bone around unloaded implants of both titanium and bone cement are fairly resistant to infection. In some cases healing of an induced infection seems possible.

29. Effects of variation in systemic blood pressure on intraosseous pressure, PO_2 and PCO_2

Thomas Kiær[1], Jørgen Grønlund[1], Birgit Jensen[1] and Eiliv Svalastoga[2]

Department of Physiology, Odense University[1], Department of Surgery, Royal Veterinary and Agricultural University[2], Copenhagen, Denmark

Several regulatory mechanisms have been shown to influence the intraosseous circulation.

Material and methods: The influence of general hypovolemia on bone circulation and possible regulatory effects was investigated by recording of intraosseous pressure, PO_2 and PCO_2 continuously by mass spectrometry in 8 rabbits. The bone of the femoral condyle was bilaterally and percutaneously cannulated and connected to a mass spectrometer and a pressure transducer. Hypovolemia was induced by repeated bleedings. After each bleeding the mass-spectrometer recordings of PO_2, PCO_2 and the arterial and intraosseous pressures were followed until steady state values were obtained.

Results: The intraosseous pressure and arterial pressure were found linearly related with intraosseous pressure 3.5 times lower. The intraosseous PO_2 decreased already after the first step of bleeding and decreased more than 50 percent of initial value after an average blood loss of 40 mL. The intraosseous PCO_2 showed a reciprocal pattern.

Conclusion: The experimentally obtained family of PO_2 curves corresponded to the curves obtained in a simulation model assuming the blood flow proportional to the intraosseous pressure. The intraosseous regulatory system can not counteract the effect of hypovolemia but seems not to be involved in limitation of flow either.

30. Partial meniscectomy using the Neodynium:YAG Laser: An in-vitro study

Derek R. Bickerstaff, Andrew Wyman, Robert W. Lainge, and T. W. D. Smith

Department of Orthopaedics, Northern General Hospital, Sheffield, England

CO_2 lasers, used in arthroscopic surgery, have design features making them cumbersome to use. We have undertaken an in-vitro study to investigate the effects of the Neodynium:YAG contact laser, which has potential advantages over CO_2 laser, on human meniscal tissue.

Methods: Twenty-four menisci removed during total knee arthroplasty were immersed in normal saline with a thermocouple, attached to the deep surface of the meniscus, which recorded the adjacent temperature at five second intervals. The menisci were then incised with the laser probe at powers of 25 and 30 watts. Histological sections were taken to measure the depth of meniscal coagulation and carbonization. An assessment was also made of the collagen architecture and the viability of chondrocytes at the cut surface. The area of meniscus on the cut surface was also measured using planimetry.

Results: There was no significant difference in the time taken to divide the meniscus at the 25 or 30 watt power settings (59.4 ± 6.5; 48.6 ± 4.0 respectively) but the energy per second expended at the higher setting was significantly greater ($p < 0.005$). The mean temperature on the deep surface of the meniscus was 46 ± 4 °C but rose exponentially attaining high temperatures only when the probe was immediately adjacent to the thermocouple. The depth of lateral tissue coagulation was minimal (105 ± 10 μm), with no significant difference between the two power settings. Viable chondrocytes and normal collagen architecture were seen adjacent to the coagulated tissue.

Conclusions: We have shown that the Nd:YAG contact laser can quickly divide meniscal tissue with minimal thermal damage to the surrounding healthy tissue. Although still experimental it has certain design features which make it more applicable than the CO_2 laser for use in arthroscopic surgery.

31. Element concentrations in normal and immobilization-induced necrotic rabbit muscles

Juha T. Laakso[1], Heikki Tikkanen[2] and Jarl-Erik Michelsson[3]

Mila Ltd.[1], Helsinki, Department of Clinical Chemistry[2], Helsinki University Central Hospital, Helsinki, Finland and Divsion of Orthopaedic Surgery and Traumatology[3], Surgical Hospital, Helsinki University Central Hospital, Helsinki, Finland

Immobilization of a rabbit knee in extension leads within a few days to muscle atrophy, necrosis and morphological changes, especially in vastus intermedius profundus (VIP), and, later in the more superficial muscles vastus intermedius superficialis (VIS) and vastus lateralis (VL).

Material and method: The ongoing patholocial processes were monitored by determining element concentrations (Na, K, Mg, Ca, P, Fe, Zn and Cu) in the VIP, VIS and VL of control animals and animals immobilized for three and seven days. The extra- and intracellular water distribution was estimated by determing the Cl concentrations.

Results: The three muscles revealed characteristic element concentrations and significant correlations between K, Mg, Zn and P in the control and immobilized animals. Immobilization caused a marked increase in most element concentrations in lyophilized muscle samples, especially VIP already after 3 days. Major part of this increase was seen in muscle Na and Ca concentrations and thus in extracellular water volume. The Fe and K did not change. Intracellular Zn concentrations were markedly increased in VIP and to lesser degree in the other muscles. Phosphorus concentrations decreased in the VL.

Conclusion: The muscle element concentrations provide a useful means to investigate the pathological processes resulting in muscle atrophy and necrosis.

32. Early morphological changes in rabbit leg muscles following immobilization

Jarl-Erik Michelsson, Heikki Aho, Matti Haltia, Tuomo Holm, Hannu Kalimo and Liisa Strengell

Divison of Orthopaedic Surgery and Traumatology, Surgical Hospital, Helsinki University Central Hospital, Helsinki, Finland

Immobilization of a rabbit knee in extension leads to degenerative changes, thickening and stiffening of the joint. Repeated manipulations of the knees during the immobilization period leads to heterotopic cartilage and bone formation especially in the vastus intermedius muscle. The aim of this study was to investigate the early morphological chages in the thigh muscles following a continuous immobilization.

Material and methods: The right knee of adult rabbits was immobilized in extension with the hip free. After different periods of time biopsies of the muscles of both legs were taken for microscopical and histochemial studies.

Results: Slight morphological changes were registered already within three days of immobilization, especially in the deep portion of the vastus intermedius. The changes then progressed towards atrophy and fibrosis during 14 days. In the other muscles of the leg there were no or only slight degenerative changes. The vastus intermedius was mainly of type I fibers and it was in a shortened position during the immobilization.

Conclusion: Immobilization of the rabbit knee in extension led within a short time to marked degenerative muscle changes especially in the vastus intermedius. The type of this muscle and its shortened position due to the immobilization are obviously important in the patogenesis of our previously described immobilization-manipulation model of heterotopic bone formation.

33. Hemodynamics of spinal lumbosacral nerve roots. Blood flow, plasma space, vascular permeability, and A-V shunting

Kristian Høy, He Shuzheng, Ebbe S. Hansen, Kjeld Søballe, Tine B. Henriksen, Dorthe Kjølseth, Vibeke Hjorthdal and Cody Bünger

Orthopedic Hospital in Aarhus, Institute of Experimental Clinlcal Research, University of Aarhus, Denmark

To study the patophysiology of motor and sensory dysfunction associated with spinal stenosis and other nerve root entrapment syndromes, the baseline regional blood flow (RBF), and arteriovenous shunting (A-V) was studied in all neural structures of the spine in pigs (group 1), whereas RBF, plasma space (VV) and vascular permeability (VP) were analyzied in dogs (group 2).

Material and methods: Nine pigs weighing 40 kg (group 1), and eight mongrel dogs 6–7 months weighing 15–20 kg (group 2). Both groups were anesthetized in supine position by Immobolin Vet., relaxed by Pavulon and ventilated mechanically after orotrachael intubation. Central hemodynamics were monitored by blood pressure, central venous pressure, and arterial blood gasses. RBF was measured with microspheres technique using 15-μ spheres labelled with 141-Ce in both groups and additionally by 50-μ spheres labelled with 46-Sc in group 1. VV (group 2) was accessed by the equilibrium distribution of 125-I fibrinogen. VP (group 2) was measured by the ratio between 125-I fibrinogen and 131-I Albumin, 10 min after injection of these tracers. The fibrinogen stays in the vascular system whereas albumin slowly permeates through the capillary wall. After killing the animals, the entire spinal cord including lumbar and sacral nerve roots was exposed by laminectomy from C1 to the last sacral vertebrae and cut into segments. Segments in group 1 were seperated in grey and white matter. Gamma activity in the biopsies was counted and correctect for background, crosstalk and decay during counting.

Table. Hemodynamic measurement. Mean values/SE

	Dogs (n 8)			Pigs (n 9)	
Localisation	RBF	VV	VP	RBF 50/15	Ratio
Cord C5–6	11.80	0.74	0.99	13.3/36.0	1.31
Cord L4–5	13.12	1.22	0.87	10.4/23.7	1.42
Root L4–6 R	2.94	1.44	1.33	4.5	1.40
Root L4–6 L	2.49	1.48	1.36	4.4	1.35
Lumbar dura	2.63	2.19	1.45	1.54	1.29

Results and discussion: Both in pigs and dogs reproducible blood flow patterns were found, when evaluating total segments. High RBF values were found in intradural neural segments associated with high motor function. Significantly lower RBF rates were present in nerve roots and dural tissue. Separating cord segments into grey and white matter revealed a two-fold higher blood flow in grey matter reflecting the higher metabolic need of this structure. The VV and VP was highest in structures with low RBF such as in dural sac and nerve roots. These areas were also characterized by significant nonentrapment of 15μ spheres suggesting presence of A-V shunts. The hemodynamic milieu of the dural sac and nerve roots was rather different, probably reflecting perfusion and nutrient supply by diffusion. The presence of A-V shunts migth indicate a capacity for regulatory phenomena of blood supply to neural roots.

34. Nerves in inflammatory synovium: Immunohistochemical observations on the adjuvant arthritic rat model

Mats Grönblad, Yrjö T. Konttinen, Richard G. Rees, Mika Hukkanen, Seppo Santavirta, Sally J. Gibson, Julia M. Polak and Darrick A. Brewerton

University Central Hospital, Helsinki, the Orthopaedic Hospital of the Invalid Foundation, Helsinki, Westminster Hospital, London, and Hammersmith Hospital, London

Our work presents evidence of alterations in synovial nerves in adjuvant-induced arthritis (AA) in rats. Nerves were studied in well-perfused and fixed rats, using immunohistochemistry with the sensitive avidin-biotinperoxidase complex (ABC) method and heterologous antisera to cytoskeletal protein gene product 9.5 (PGP) and the neuropeptide substance P and calcitonin gene-related peptide (CGRP). The innervation of synovium was compared in normal rats and rats with AA. Observations concordant with what has previously been reported for neuropeptide nerves in the synovium of patients with rheumatoid arthritis (RA) are presented. Previously it has been suggested that neural peptide substances are reduced in nerves of synovium from RA patients. In the AA rat a specific reduction of lining zone and sublining nerves in the synovium was noted. The AA rat model is very suitable for studying the involvement of synovial nerves in arthritis, permitting optimal preservation of immunoreactive neural epitopes.

35. Does posterior spinal fusion induce spinal stenosis? An experimental study in adult rabbits

Dietrich Schlenzka[1], Juhani Soini[1], Veijo Ritsilä[1] and Wolfgang Rauschning[2]

The Orthopaedic Hospital of the Invalid Foundation[1], Helsinki, Finland, and Department of Orthopaedic Surgery[2], University Hospital, Uppsala, Sweden

Posterior (laminar) spinal fusion has been criticized in the literature because of the possible danger of laminar hypertrophy causing iatrogenic spinal stenosis. Purpose of the present study was to investigate changes of the diameter of the spinal canal after posterior lumbar fusion in rabbits.

Material and methods: 39 adult rabbits were used for this series. Four groups were formed: group A (n 2) unoperated controls, group B (n 6) subperiostal preparation of 2 lumbar segments from a posterior approach, group C (n 6) like group B plus decortication of the laminae, group D (n 25) like group C plus posterior fusion using autogenous iliac bone grafts. The animals were killed after 6 months follow-up. Cryoplaning technique was used to obtain sagittal cuts of the lumbosacral spine. To facilitate morphometric assessment, metric scales were photographed together with the specimen. Measurements of the sagittal diameter of the spinal canal were carried out at seven different levels and three different cuts per specimen.

Results: There was no difference between the diameters of the bony spinal canal in the four groups. Narrowing of the spinal canal was seen only due to bulging of the intervertebral discs but not due to bony ingrowth or hypertrophy of the laminae.

36. Injury surveillance in hospital emergency departments

Karl Akke Alberts, Ian Goldie, David Edler, Mats Nilsson and Tom Häggmark

Departments of Orthopedics and Surgery, Karolinska Hospital and Södersjukhuset, Stockholm, Sweden

A comprehensive program for injury surveillance and injury prevention has been adopted by the Stockholm County Council. An injury epidemiological unit has been established to coordinate collection and analysis of data from all the hospital emergency departments and primary care units receiving injuries.

Material and methods: A pilot study has ben initiated at two large hospitals serving a combined population of 343,000 adult inhabitants. All injuries are registered and the cause of injury is classified according to the NOMESKO-code, E-code and N-code.

Results: During the period March to September 1989 11,327 injuries were recorded, corresponding to an inci-

dence rate of 66 injuries per thousand and year. Twentysix per cent occurred at home and 19 percent on the roads and in other areas of transportation. The activity was leisure in 50 per cent, all kinds of work in 15 percent and sports in 13 percent. The mechanism of injury was a fall in 42 percent, collision with an object in 24 per cent and crush or cut in 15 percent. The main diagnosis was a fracture in 21 percent, dislocation, sprain or contusion in 45 percent, wound in 28 percent, internal chest, abdominal or skull injury in 2 percent and the diagnosis was missing in 4 percent. The injury panorama was dominated by wounds to the face, skull and hand and by distortions of the ankle and knee.

Conclusions: The comparatively low incidence rate can be attributed to a long tradition of injury prevention work. Information of all injuries in a defined population may serve in achieving rational use of medical resources and selecting clusters of injuries amenable to prevention.

37. Hip fractures in the county of Aarhus, Denmark—a prospective study

Bent Erling Lindblad, T. Lind, K. Nielsen, K. Døssing, F. Weile, J. Skafte, B. W. Jakobsen and J. Jensen

Departments of Orthopedic Surgery, The County Hospital and The Municipal Hospital of Aarhus, The Central Hospitals of Randers and Silkeborg, and The City Hospitals of Odder and Grenaa, Denmark

The number and the incidence rates of hip fractures are rising in the western countries. The first Danish prospective study on the epidemiology of hip fractures started 1st of January 1987.

Patients and methods: Prospectively all hip fractures, fracture subtypes, treatment and personal data were registered.

Results: During 1987, a total of 935 hip fractures in patients older than 15 years occurred in the County of Aarhus, Denmark. A total of 907 hip fractures occured in patients aged 50 years and above. The male:female ratio in the latter group was 1:3.3 and rose to 1:4.5 in persons older than 80 years. The cervical hip fracture was four times as common, and the trochanteric fracture three times as common in women as in men. The overall incidence of hip fractures was 5.5/1000/year above the age of 50 years and rose to 26/1000/year in persons above 80 years. In both sexes the incidence rates increased exponentially with age. 51 percent of the fractures occured in patients older than 80 years. Based on the age specific incidence rates in 1987 and not taking the yearly increase in the age-specific incidence rates in consideration a projection was made on the official population forecast for the years 2005/2010 giving a 21/24 % increase in the number of hip fractures.

38. Predicting fractures in women by using forearm bone densitometry

Per Gärdsell, Bo E. Nilsson and Olof Johnell

Department of Orthopaedics, Mamö General Hospital, Sweden

This study was performed to demine to what extent bone mineral measurement could predict a future fracture.

Material and methods: 1,076 women had had their forearm bone mineral content (BMC) measured with single photon gamma absorptiometry. All fractures that occurred in these women after the bone mineral measurement, from 1975–87 (13 years), were recorded. During the collection period 469 fragility fractures occurred in women.

Results: At BMC 1 cm level, mainly trabecular bone, there was a good predictive value up to the age of 70. At the 6 cm level, mainly cortical bone, the predictive value was also significant at the age of 70. In a logistic regression model for the different fractures we calculated the relative risk of having a fracture to 1SD less bone for the various fractures. The relative risk was highest for those who were to have a trochanteric hip fracture or a vertebral fracture—between 2 and 3.7—and slightly less in the other fragility fractures. When age was included in the model, BMC was a stronger predictor than age for both trochanteric and vertebral fractures. A logistic regression model was used for weight and at age group 50–70 the weight was significant only for those with a trochanteric hip fracture, while over 70 age was significant for virtually all different fracture types and was in this age group still significant when also age and BMC were included in the model.

Conclusion: In comparison with other screening methods such as cholesterol for coronary heart disease and blood pressure for stroke, BMC appears to be as valuable in predicting a future fracture and can be used for screening procedures.

39. Fractures of the proximal femur in Finland in 1988

P. Lüthje

Department of Surgery, Regional Hospital, Kuusankoski, Finland

The number of fractures of the proximal femur or femoral neck and trochanteric fractures is increasing in all civilized countries. The aim of the present study was to analyse the femoral neck and trochanteric fractures treated in Finnish hospitals in 1988.

Patients and methods: All patients admitted to Finnish acute hospitals for primary treatment of fractures of the proximal femur were selected from the National Board of Health statistics: those who had been treated more than once during the same year because of the same injury were identified. The material was analysed according to age, sex, type

of fracture, type of hospital and duration of treatment in hospital. The increase of the fractures since 1970 was counted from an earlier study (1). The age-specific incidence was counted as the number of fracture cases of proximal femur per 100,000 population year (2).

Results: During the year 1988 3,727 patients with femoral neck and 2,412 with trochanteric fractures were treated in Finland. The total number of hospitalization days was 331,316. In university hospitals the average length of stay for patients with femoral neck fractures was 23 days and with trochanteric fractures 37 days. In central hospitals the number of days was 16 and 20, in regional hospitals 30 and 33, and in city hospitals 140 and 122 days, respectively. The mean hospitalization time of the total material was 55 days for femoral neck and 53 days for trochanteric fractures. The femoral neck fracture was 2.8 times and the trochanteric fracture 2.5 times as common in women as in men.

85 % of women and 63 % of men with femoral neck fractures were over 69 years of age. In trochanteric fractures 88 % of women and 56% of men were over 69 years of age. The age-specific incidence for both fracture types and both sexes rose over 39.

From 1970 to 1988 the total number of fractures of the proximal femur in Finland increased from 2,372 to 6,139 (2.6 times).

Conclusion: In Finland the total number of fractures of the proximal femur increased 2.6 times from 1970 to 1988.

References

1. Lüthje (1985) Acta Orthop Scand 56: 223.
2. Central Statistical Office of Finland (1989) Population projections 1988–2010.

40. The impact of menopausal age on future fracture risk

Pär Gärdsell, Olof Johnell and Bo E. Nilsson

Department of Orhtopaedics, Malmö General Hospital, Malmö, Sweden

Early menopause may be considered a risk factor and therefore be useful in predicting fragility fractures. However, the impact of menopause on bone loss may decline with advancing age. Therefore, it is reasonable to question its correlation with fracture risk in old women.

Material and methods: 733 women over 50 were in 1970–76 questioned with regard to their menarcheal and menopausal ages. Only those with natural menopause were included. All fractures sustained in 1975–85 were then recorded.

Results: In the age group 50–59 (n 202), those who were to sustain a fragility fracture had an earlier menopause but the difference was not significant. In the age group 60–69 the difference was significant. Those with future fracture had earlier menopause and also a shorter fertile period. In subjects over 70 there was no difference with regard to menopausal age or fertile period betwen those with and without fracture. The risk ratio for fracture in women 50–69 was 1.5 when comparing the lowest quartile of menopausal age with the highest.

Conclusion: Women with a precocious menopause sustain more fragility fractures during their postmenopausal decades. For women over 70, the menopausal age was not correlated with future fracture risk.

41. A history of a fragility fracture: Increased future fracture risk?

Per Gärdsell, Olof Johnell and Bo E. Nilsson

Department of Orthopaedics, Mamö General Hospital, Sweden

The objective of this study was to estimate the risk of future fracture in individuals who have already had a fracture indicating bone fragility.

Material and methods: In 1970–76 all previous fractures were registered in a sample of 1,076 women who also had their forearm bone mineral content measured with the single photon technique. During a follow-up period, 1975–85, all fractures and all fall episodes requiring radiographic examinations were recorded.

Results: Significantly increased odds ratios for fragility fracture during the observation time (1975–85) was found in those with a previouus fracture of the distal end of the forearm and the hip in the age group 40–49, fracture of the distal end of the forearm and the vertebrae in the age group 50–59 and fracture of the vertebrae in the age group 60–69. However, in women over 70, a history of a previous fragility fracture was not predictive. The falling tendency was clearly predictive in the age group 40–49 and after 70. A stepwise logistic regression was performed including also initial values for BMC—for women after 70, only falling tendency ($p = 0.0001$) remained independently significant.

Conclusion: The predicting power of the various fragility fractures appears to change with age—after 70 it is lost.

42. Analysis of downhill injuries and their costs

P. Lüthje, P. Asikainen, M. Järvinen, and V. Avikainen

Regional Hospital Kuusankoski and Jämsä, Department of Orthopedics, University Central Hospital, Tampere, and Central Hospital, Jyväskylä, Finland

We present an analysis of injuries and costs of treatment for patients with downhill skiing injuries in Jämsä during the 1987-1989 ski seasons.

Patients and methods: The study included all persons injured while skiing and treated at the emergency medical care

in Jämsä at the Central Hospital in Tampere and Jyväskylä. The total treatment costs were calculated on the basis of the costs of treatment days, out-patient fees, and the costs of sick leave (mean industrial wage).

Results: The total number of skiing injuries was 211. There were 132 men (63 %) and 79 women (37 %). 102 patients (49 %) were younger than twenty. The injury rate was 0.9 per 1,000 skier-days. The frequency of lower extremity lesions was 41 % and of upper extremity 38 %. The most common injuries were distorsions (34 %), fractures (20 %), contusions (19 %), and wounds (12 %). The majority of all injuries were located to the knee (23 %), the thumb (16 %), the shoulder (12 %), and the head (12 %). 9 % of all injured patients needed operative treatment. The total costs were FIM 1,230,372.

Conclusion: Two thirds of the total costs were due to injuries of the knee, shoulder and thumb.

43. Registration of postoperative wound infections and other complications in orthopedics

Jacob Stouby Mortensen, Steen Bo Kalms, Jørgen Gottlieb, Leif Panduro Jensen, Per Jørgensen, Hans Henrik Noer and Carsten Törholm

County Hospitals of Viborg, Roskilde, Gentofte, and Køge, Denmark

"Micro-kir" a microcomputer system designed and elaborated by the infection group in Danish Orthopaedic Society for continuous surveillance of postoperative wound infections and other complications, is now used in several hospitals all over Denmark. The purpose of elaborating the program was to create a comprehensible and inexpensive tool, to obtain a uniform and comparable registration working all over the country.

The program was designed to fulfil all present demands concerning EDP-security in registration of patient data. The provisional results from the registration of 5,000 operative interventions performed in four Danish hospitals are presented.

In 8 percent of the cases complications were registered, among these were superficial wound infections 2.3 percent and deep infections 1.1 percent making a total of postoperative wound infections of 3.4 percent.

In clean operations superficial wound infections occurred in 1.7 percent and deep infections in 0.4 per cent of cases, principally caused by staphylococcus.

The remaining complications registrated by "Micro-kir" were predominantly infection of the urinary tract, pneumonia and thromboembolic complications. "Micro-kir" automatically provides information on the length of hospitalisation, in cases of postoperative complication a significant increase in hospitalisation time can be documented.

"Micro-kir" is easy to use without any EDP knowledge and very suitable in local surveillance of postoperative complications as well as a tool for interscandinavian projects concerning prophylaxis against postoperative wound infections.

44. The Norwegian hip replacement register: A survey of 11,726 operations

Leif Ivar Havelin, Lars Birger Engesæter and Norvald Langeland.

Department of Orthopedic Surgery, Haukeland University Hospital, Bergen, Norway

From September 1987 the total hip replacements in Norway, primary and revisions, were registered in the Norwegian National Register for Total Hip Replacements. Until January 1990, 11,726 total hip replacements were reported. 10,151 (87 percent) were primary replacements and 1,575 (13 percent) were revisions.

Of the patients with primary THR, the diagnoses were idiopatic coxarthrosis in 68 percent, sequelae after femoral neck fractures in 13 percent, rheumatoid arthritis in 4 percent, and others 15 percent. The reasons for revisions were loosening of the femoral component in 64 percent, loosening of the acetabular component in 57 percent, infection in 4 percent and luxation in 4 percent. The lateral approach was used in 60 percent of the cases and the posterolateral in 30. A trochanteric osteotomy was used in 25 percent of the operations.

Cementless acetabular components were chosen in 17 percent of the primary operations and in 26 percent of the revisions. In the femur, cementless components were used in 12 percent of the primary operations and in 19 percent of the revisions. The Charnley prosthesis constituted 48 percent of all implants. In the acetabulum 35 different types of prostheses were implanted (18 cementless), and in the femur 34 different types (14 cementless). 26 different types of head components were used.

The Christiansen prosthesis was still the most common among the revised prostheses. 138 cementless prostheses were revised.

45. Cost-effectiveness of the Dutch consensus on prevention of thromboembolic complications after total hip replacement

Bart A. Swierstra, Niek S. Klazinga[1], Jan H. P. van der Meulen[2]

Department of Orthopedics, University Hospital Dijkzigt, Rotterdam, National Organisation for Quality Assurance in Hospitals[1], Utrecht, Center for Clinical Decision Analysis[2], Erasmus University Rotterdam, The Netherlands

During the Dutch Consensus Conference on Total Hip

Replacement (THP) agreement was reached on the following guideline: "Apart from thromboprophylactic measures around the operation, treatment with oral anticoagulants is necessary for three months, aiming at an international normalized ratio of 2.1". This consensus implies a considerable prolongation of postoperative thromboembolic prophylaxis compared to previous strategies according to which prophylaxis was discontinued at discharge from hospital. The aim of this study was to evaluate these two strategies in terms of lives saved and money spent.

Methods: A decision tree was designed that models the possible outcomes of management of venous thromboembolism. The probabilities for all events in the model were estimated on the basis of recent literature and own data. Finally, a sensitivity analysis of key parameters was performed.

Results: The expected mortality rate of the "Dutch strategy" was 1 per 1000 THP's versus 7 per 1000 under previous regimens. Furthermore it appeared that the continuation of low-dose oral anticoagulation for three months even led to lower costs if a 5 percent delayed thrombogenesis after the second postoperative week was assumed.

Discussion: Low-dose oral anticoagulation for three months following THP is highly cost efficient. A major obstacle in our study however was the lack of data about the natural history of postoperative venous thromboembolism after discharge from the hospital; this indicates the necessity of further epidemiological research on this subject. It is also to be expected that future developments in the field of thrombosis prophylaxis might influence the results of our study.

46. Dutch concencus on prevention of thromboembolic comlications in orthopedics and traumatology

Bart A. Swierstra (on behalf of the expert committee of the CBO)

Department of Orthopedics, University Hospital Dijkzigt, Rotterdam, The Netherlands

In 1989 in The Netherlands a Concensus Conference was held on Prevention of Deep Venous Thrombosis, organised by the CBO—National Organisation for Quality Assurance in Hospitals. During this conference agreement was reached on the following guidelines:

1. After major orthopedic surgery the risk for thromboembolic complications often remains after discharge from the hospital, in spite of preventive measures around the operation. In those situations oral anticoagulation is indicated as an out-patient procedure.
2. In immobilised posttraumatic patients oral anticoagulation is indicated. During the initial phase of adjustment other preventive measures should be used.

These guidelines are based on the following considerations.

- No prophylactic method gives full protetion against thromboembolic disease after major orthopedic procedures; even if successful it leaves one out of five patients with deep venous thrombosis.
- Some preventive measures seem to delay thrombogenesis until after the second postoperative week (when most patients have already returned home).
- In trauma patients the thrombogenetic events are initiated before admission to the hospital.
- Regarding oral anticoagulation there is now evidence that a sensitive control technique in combination with an international normalized ratio of 2.0–2.5 is safe and efficient in venous thrombosis.
- In The Netherlands a well-functioning Thrombosis Service exists that can treat patients at home.

47. The local tumour control in extravisceral soft tissue sarcomas: An evaluation of 272 cases

Otto Sneppen, Jørgen Høgh, Svend Østgaard, Olaf Myhre Jensen and Aksel Nordentoft

Orthopaedic Department, University Hospital, Aarhus, Denmark

During a period of 10 years from 1979 through 1988, 272 patients out of a population of approximately 2 million in Jutland were treated for extravisceral soft tissue sarcomas. The treatment was based on radical surgery. At referral to the Tumour Centre 27 (10%) had metastases, 204 (75%) had some preoperative operative procedure including biopsy, and 56 (21%) were referred after local recurrence. According to histological grading 65 (20%) were grade I, 40 (15%) grade II, 84 (31%) grade IIIA, 77 (28%) grade IIIB, and 16 (6%) NOS. In the Tumour Centre, compartmental excision or radical amputation were performed in 72 (26%), wide excision in 115 (42%), marginal excision in 31 (11%), and no surgical treatment in 55 (20%) of the patients. 48 (18%) had radiotherapy and 13 (5%) chemotherapy. The recurrence rate in the high grade tumours (grade IIIA and B) was after marginal resection 18%, after wide excision 24% and after radical operation 11%. The 10-year metastasis-free survival was in grade I and II 97%. In grade IIIA the 5-year survival was 59% and the 10-year survival 40%, and in grade IIIB the 5-year survival was 35% and the 10-year survival 29%.

The variable which significantly increased the probability of local recurrence was previous local recurrence at referral to the Centre. The analysis indicated that patients with tumour grade IIIB or with malignant fibrous histiocytoma had a tendency to higher recurrence.

48. Long-term results after ventral decompression surgery in cervical myelopathy

Klaus Maier-Hauff and Rainer Baerwald

Department of Neurosurgery, UKRV, FU Berlin, Germany

Progresses in radiological techniques with introduction of CT und MRI have improved the detection of spinal cord lesions. Cervical ventral disc herniations or osteophytosis with spinal stenosis can produce a cervical myelopathy (CM) by acute or chronical pressure of the medulla. The removal of this process may influence the outcome of the disease.

Methods: 90 patients with CM were operated by the ventral procedure. Before the intervention all patients were examined with CT and some also with MRI and SSEP. The outcome was evaluated 18–38 months after ventral decompression and the neurological status compared with the postop. MRI and SSEP.

Results: In 42 cases we removed a sequestrated disc herniation and in 48 patients a bony stenosis using Cloward or Smith-Robinson method. 76 % of the cases with disc herniations have good or excellent results. As for the chronical myelopathy with bony stenosis we observed an improvement of the symptoms in 50 %, in 40 % the progress of the CM could be stopped. Considering the low risk of the operation and the good results the indication for surgery should be given very early.

Conclusion: Our results show, that cervical myelopathy can be treated successfully by ventral decompression surgery. The best results were obtained with early surgery in chronical myelopathy.

49. Functional dynamometric assessment of the clinical significance of the posterior disc bulging

M. Szpalski, S. Poty and J. P. Hayez

Centre Hospitalier Moliere Longchamp, Brussels, Belgium

Posterior disc bulging is a common finding of CT scan and/or MRI, however, the relation with clinical complaints is difficult to establish. Cadaveric and myelographic studies have shown that fatigue load in extension increases disc bulging and may represent a risk of root compression, especially if associated with facet hypertrophy. We studied the signs of functionnal impairement associated with bulging disc.

Material and methods: We included 46 consecutive patients having undergone CT scan for chronic low-back pain, associated or not with neurological complaints, and in which clear disc herniation was not demonstrated. Functional assessment was performed with a computerized isoinertial triaxial dynamometer (Isostation B200, Isotechnologies, USA) which measures torques, velocities and positions along the three axes of motion simultaneously.

Results: Posterior disc bulging was described in 15 of the 46 patients. In 10 of them we found a short (0.2–0.6 s) loss of velocity appearing during sagittal extension between 20° and 0°, and corresponding to the "posterior closure" of the affected disc. This was found in only 6 of the 31 remaining patients ($p < 0.001$). There seemed to be a relation between this image and the presence of neurological complaints, however, not statistically significant. In some patients there was a sudden tendency to unilateral transverse plane movement, during sagittal extension, contralateral to the side of neurological complaints. Important secondary axis torque in sagittal flexion during lateral movements was also found more frequently in patients with posterior disc bulging ($p < 0.01$).

Conclusion: Functional multiaxis dynamometric studies can be of value in the assessment of patients presenting posterior disc bulging, by showing the patterns of movement associated with the relief of stress in the posterior disc.

50. Need for orthosis during the consolidation of posterolateral lumbosacral fusion determined by roentgen stereophotogrammetric analysis

R. Johnsson, G. Selvik[1], B. Strömqvist, G. Sundén

Departments of Orthopedics and Diagnostic Radiology[1], Lund University Hospital, Lund, Sweden

Roentgen stereophotogrammetric analysis (RSA) evaluates the stabilizing effect of lumbar fusions with high accuracy (1). In the present study RSA was used in an attempt to determine whether the duration of postoperative orthotic wearing affects the speed and rate of the consolidation of posterolateral fusions in the lower lumbar spine.

Patients: Fifteen men and 7 women with a median age of 37 (17–59) years and no prior spinal surgery, had a posterolateral fusion, including application of tantalum indicators for the RSA, between L5 and S1 or L4 andS1. In a first series (n 11) a rigid lumbar orthosis was used during 5 months after surgery, and in a second series (n 11) during 3 months. Nineteen patients had spondylolysis-olisthesis and 3 intervertebral disc disorder with lumbar and/or radiating pain.

Methods: All the patients were followed with RSA monthly for 6 months. At each RSA the patients were examined without orthosis in supine and erect positions and the translatory movements of the fused vertebrae between these positions were calculated. Conventional radiographs were taken 6 months postoperatively.

Results: In the first series there was osseous fusion radiographically in 8 patients 6 months postoperatively. In these patients the intervertebral translations between the fused vertebrae began to decrease after 3 months, and the fusions became rigid as defined by RSA or intervertebral translations of mostly less than 1 mm persisted. In 3 patients with poor fusion radiographically no rigid fusion was obtained and intervertebral translations of up to 10 mm persisted.

In the second series, a similar RSA pattern was noted in 4 patients with osseous fusion and 7 with doubtful fusion radiographically 6 months after surgery.

Discussion: The mobility of the lower lumbar spine decreases 3–6 months after a successful posterolateral fusion in patients with no prior spinal surgery, and the fusion may either be rigid as defined by RSA or permit small intervertebral translations probably due to an osseous springing effect (1). The findings of the present study indicate that the consolidation of posterolateral fusions in the lower lumbar spine is fmproved by wearing a rigid lumbar orthosis for more than 3 months postoperatively. Whether further fusion consolidation in the group with doubtful fusion will occur during the second postoperative half-year is being evaluated.

Reference

1. Johnsson R, Selvik G, Strömqvist B, Sundén G. Mobility of the lower lumbar spine after posterolateral fusion determined by roentgen stereophotogrammetric analysis. Acta Orthop Scand 1989; 60: Suppl. 231: 39-40.

51. Relief from pain in sacroiliac syndrome by arthrodesis

Einar Sudmann and Sjur Braaten

Hagavik Orthopaedic Hospital, University of Bergen, Bergen, Norway

Patients and methods: A selected group of patients, 6 men and 41 women, aged 23 to 64, were treated by arthrodesis of one (23 patients) or both 24 patients) sacroiliac joints. A trauma initiated the syndrome in 9 patients and 21 out of 41 women had suffered disabling sacroiliac pain during pregnancy and after child birth. All patients were unfit for work, and two were on continuous opiate medication. The median duration of disability was 6.5 (1–20) years. A rearthrodesis was performed up to 3 times in 9 sacroiliac joints (6 patients). At primary operation a dorsal, extraarticular arthrodesis and a transiliac, intraarticular arthrodesis were performed in 28 and 52 joints, respectively. Only one symphysis was plated. At operation obvious joint instability was not seen. Postoperatively the patients were confined to bed for 6 weeks. A Hoffmann external pelvis fixation apparatus was used in 4 patients.

Results: Postoperatively one patient developed icterus of unknown etiology. One case of pulmonary embolism and one pin tract osteomyelitis were seen. In addition, unrelated to the arthrodesis, one patient was operated on due to acute appendicitis and one due to small bowel obstruction.

At follow up, 0.5–11 years postoperatively, by CT scans 61 out of 71 joints were ankylotic, 45, 4 and 12 joints were relieved, partly relieved or not relieved from pain, respectively. All 9 joints reoperated on improved but one.

Conclusion: Our results indicate that the sacroiliac syndrome in our selected group of patients is an extra-articular affection characterized by pain and tenderness mainly at the sacroiliac joint capsule and ligaments.

52. The natural course of lumbar spinal stenosis

Karl-Erik Johnsson, Ingmar Rosén[1] and Alf Udén

Departments of Orthopaedics and Clinical Neurophysiology[1], Malmö General Hospital, Malmö, Sweden

It is a common opinion that the natural course of spinal stenosis is so poor that the patient should be operated on without too much delay. In this study we have analysed the further course of nonoperated patients with spinal stenosis.

Material and methods: During 1981–89, 32 patients (24 men and 8 women) with spinal stenosis, not operated on, were observed. The mean age was 60 (42–80) and 61 (51–73) years, respectively. All patients had a lumbar myelogram. Patients who had sustained spinal surgery and patients with impaired circulation in the legs were excluded. The mean duration of symptoms prior to myelography was 22 (4–96) months. The mean duration of observation after myelography was 49 (10–103) months. On the myelogram the AP measure was 11 mm or less in all cases (mean 7 mm). All patients had a neurophysiologic investigation. All were clinically examined once a year. At the time of the last follow-up all patients were sent a questionnaire and asked to compare their situation prior to the myelogram with their present situation on a visual analogue scale (VAS) graded 0–100. At this time 3 patients (2 men) were deceased and 2 (1 man) declined to participate.

Results:

	Clinical follow-up (n 32)			Visual analogue scale (n 27)			
	–	=	+	– (–45)	= (46–55)	+ (56–)	Missing
Men	1	10	13	1	16	4	3
Women	4	2	2	3	3	0	2

19/27 patients remained unchanged (=), 4 improved (+) and 4 deteriorated (–). A progression of the neurophysiologic changes was found in 12/21 patients, 6 missing.

Conclusion: The majority of nonoperated patients with spinal stenosis remained unchanged after 4 years and no proof of severe deterioration was found. Observation seems to be an alternative to surgery and immediate operation should be advised only if pain is intolerable.

53. Treatment with calcium 1,25-dihydroxy-cholecalciferol and calcitonin in women with spinal osteoporosis

Staffan A. V. Eriksson, Lars Sundkvist and Urban Lindgren

Departments of Orthopedic Surgery and Hospital Physics, Huddinge University Hospital, Stockholm, Sweden

Administration of calcitonin has been advocated as a treatment for osteoporosis. It does however include a risk of secondary hyperparathyroidism which may interfere. 1,25-dihydroxycholecalciferol could prevent the increase in parathyroid activity and in this study a combination of calcitonin and 1,25-dihydroxycholecalciferol was used. A reasonably satisfactory intake of calcium was guaranteed by giving 0.5g Ca/day to all patients.

Patients and methods: 17 women (aged 41–74 years) with spinal osteoporosis were given daily oral doses of 0.5g calcium, 0.5μg dihydrocholecalciferol and 0.5mg calcitonin s.c. 3 times a week for 2 years. A control group of 11 women (aged 39–71 years) with spinal osteoporosis was treated with only 0.5g calcium supplementation. The patients were seen every 6 weeks for blood chemistry evaluation. Calcium absorption tests using 45-Ca were performed before treatment and and after 6 months. Bone densitometry was done before treatment and after 1, 2 and more than 4 years after the initiation of treatment by dual photon absorptiometry in the lumbar spine and by single photon absorptiometry in 2 locations of the radius.

Results: Some of the patients developed hypercalcemia during treatment which lead to adjustment of the dose of 1,25-dihydroxycholecalciferol. The absorption of calcium was significantly raised in patients with combined treatment. In the two groups no significant increase in bone density was found on any location during 2 years of treatment even though in some patients an increase was found.

Conclusion: Preliminary data indicate that treatment of spinal osteoporosis using calcium, calcitonin and 1,25-dihydroxycholecalciferol in the doses used is not better than calcium supplementation only.

54. Locked intramedullary nailing versus functional bracing in the management of tibial shaft fractures

Antti Alho, Jan Benterud, Hans Erik Høgevold, Arne Ekeland and Knut Strømsøe

Orthopaedic Service, Ullevaal Hospital, University of Oslo, Oslo, Norway

The study was scheduled to compare the Grosse-Kempf locked intramedullary nailing with functional bracing in tibial fractures.

Patients and methods: We excluded multitrauma, Grade-III-open fractures and non-displaced fractures, and based on age and fracture type (Table) matched 35 conservatively treated fractures with 43 similar nailed fractures. There were no significant differences in the important variables between the groups. The conservative treatment in 30 closed and in 6 Grade-I-open fractures consisted of reduction and plaster cast for median 25 (14–42) days followed by functional bracing. Five GradeII-open fractures were treated by external fixator for median 57 (29–80) days followed by the brace. 26 nailings were done immediately and 17 later during 3 weeks.

Table I. Matched series of displaced tibial shaft fractures treated by functional bracing or locked nailing

	Brace n 35	Nail n 43
Matching criteria		
Age (median and range)	38 (16–68)	41 (16–89)
Closed/Open Grade I/Grade II	24 / 6 / 5	26 / 11 / 6
Transverse/oblique/comminute	12 / 17 / 6	15 / 21 / 7
Other variables		
Male/female	26 / 9	24 / 19
Low / high energy	22 / 13	21 / 22
Location, high/middle/low	1 / 15 /19	2 / 18 / 23

Results: The complications in the brace group were: 1 infection, 1 compartment syndrome, 5 delayed unions, 1 refracture, and 2 nonunions (treated with locked nail). The complications in the nail group were: 3 infections, 2 reoperations, and 1 delayed union.

The end results in the brace group were (Ekeland et al. Clin Orthop 1988; 221: 205): 16 excellent , 6 good, 11 fair, and 2 poor. The results in the nail group were: 26 excellent, 12 good, and 5 fair (chi-square test, $P < 0.01$).

Conclusions: Locked intramedullary nailing of displaced closed and Grade-I-II-open tibial shaft fractures is a safe procedure provided that operative resources and training are adequate. It allows free mobilization of the limb thus restoring function better that conservatice treatment.

55. A comparison of cast treatment versus Ex-Fi-Re external fixation treatment in oblique tibial shaft fractures

Asbjørn Bøe and Markus Hordvik

Department of Orthopaedics and Traumatology and Department of Radiology, Haukeland University Hospital, Bergen, Norway

With the Ex-Fi-Re external fixation system fractures can be manipulated under complete control of stability, providing the possibility of exact reduction and compression. Oblique fractures can be stabilized through lateral compression.

To evaluate the usefulness of the system a comparison between plaster cast and Ex-Fi-Re treatment on displaced oblique tibial shaft fractures was carried out in a randomized prospective study. This is a preliminary report of the results.

Material and methods: In 14 patients treated with external fixation pin tract infection was noted in 7, leading to the removal of pins in 2 cases. 15 patients has been treated with plaster cast. In six of these cases, the treatment failed, leading to intramedullary nailing in four and external fixation in two.

Results: Ex-Fi-Re-group: In the two patients where the external fixator had to be removed because of infection, the end result was varus deformity and shortening, and in one there was delayed union. Healing time in the total group was mean 15.1 weeks and median 14.5 weeks. Mean deformities were varus 1.2° and valgus 0.1°. Mean shortening was 1.8 mm.

Cast group: Delayed union ocurred in 6 patients; in three of these operation for nonunion was nesessary. Healing time in the whole group was mean 25.7 weeks and median 17 weeks. Mean deformities were varus 1.3° and valgus 0.4°. Mean shortening was 5.1 mm.

Conclusion: Healing time and shortening were reduced in the Ex-Fi-Re-group compared with the cast group. Only minor differences were found in the angulation parameters.

The incidence of treatment failure leading to a change of treatment was two in the Ex-Fi-Re-group versus six in the cast group.

56. Two-diciplinary approach in the primary and secondary management of Grade III tibial fractures

Richard Hammer and Disa Lidman

Department of Plastic and Reconstructive Surgery and Orthopedic Surgery, Linköping, Sweden.

Primary management of the severely injuried limb with extensive loss of soft tissue and bone tissue is still a challenge to the surgeon. However, during the last two decades new methods for soft tissue cover have evolved e.g., microvascular free tissue transfer (MFTT), pedicle muscle (PMF), and fasciocutaneous (FCF) flaps. These procedures have a wide indication in tumor and reconstructive surgery. An increasing use of these techniques in trauma have replaced the older, time and resource consuming, multistage methods. In addition, stable soft tissue conditions are required prior to secondary skeletal reconstructive procedure.

Material and methods: From 1980 through 1989, a total of 26 flaps were done in 24 patients with Grade III tibial fractures. The majority of the patients were late referrals (1 week to 9 years). The combined initial procedure included thorough debridement, stabilization with external fixation and coverage with either a local or a free flap. Fourteen pedicle flaps, either PMF or FCF and 12 MFTT were used. Among the MFTT, the majority were latissimus dorsi (7), and 5 flaps contained vascularized bone.

The goal has been to achieve stable and infection free local conditions enabling us to reconstruct bone defects (4–18 cm) 6–10 weeks later.

Results: In all patients except one, stable soft tissue conditions were achieved and all fractures healed. Two pedicle flaps and 2 FMTT necrotized. In 2 patients, local flap failures were replaced with FMTT and the subsequent course was successful. One patient with a long-standing chronic osteomyelitis, compromized soft tissue, and a compound segmental fracture was amputated 4 days after a FMTT.

Conclusion: The two-diciplinary approach, used since 1980, has been a major contributing factor for the successful outcome in this series of patients with soft tissue and skeletal problems of considerable magnitude. Twenty-three out of 24 injuries healed and the results were especially favourable when the combined treatment was commenced within the first week after trauma. However, the use of microvascular techniques can only be maintained in a department with a considerable "background flow" of flap procedures. Therefore, patients with Grade III limb injuries should preferrably be transferred within a week to a hospital where major reconstructive procedures are performed regularly.

57. Open tibial fractures/nonunions treated by microvascular free tissue transfer

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

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

The management of fractures/nonunions of the tibia with bone and/or skin loss is demanding and may in some cases result in below knee amputation. This paper is a review of our experience with 17 patients treated by microvascular free tissue transfer.

Material and methods: Between 1984 and 1989 16 males and 1 female were treated. Their age at the time of the operation was 31 (16–51) years. Traffic accidents caused 11 injuries, gun shot 2, and crush accidents during work or sport 4. An acute open leg fracture accounted for 14 patients, including 3 replanted legs. The remaining 3 patients had an infected pseudarthrosis of the tibia. The average skin defect measured 14 x 7 cm (range 4 x 3 to 30 x 10 cm), the length of the uncovered tibia averaged 6 (0–20) cm and the average tibial defect measured 3 (0–10) cm. The defects were covered by 8 scapular flaps (3 combined), 6 lateral upper arm flaps, 4 iliac crest flaps (3 combined), 1 fibula and 1 forearm flap. 3 patients had 2 different flaps.

Results: 13 of the 17 fractures/nonunions healed. One patient has developed a pseudarthrosis that has been bone grafted elsewhere without healing. One patient with a forearm flap and a vascularized iliac crest graft had a below knee amputation because the upper end of the bone graft did not heal. Another patient developed sepsis 2 days after the transfer and the leg was amputated. One patient who had an additional ipsilateral grade IV femoral fracture which had been treated elsewhere by intramedullary nailing, developed an empyema of the femoral canal and sepsis, and a high fe-

moral amputation was performed 12 days after an uncomplicated transfer of a lateral upper arm flap. Eleven patients had 37 secondary operations including 7 revisions of the vascular anastomosis, 16 conventional bone grafting and 14 split skin grafting procedures. The donor site morbidity was minimal.

Conclusion: Autologous free tissue transfer is a salvage procedure in difficult leg fractures.

58. Free microvascular flap reconstruction in complicated fractures of the tibia

Erkki Tukiainen, Sirpa Asko-Seljavaara and Börje Sundell

Plastic Surgical Division, Töölö Hospital, Helsinki, Finland

35 patients with complicated tibial fractures were treated with microvascular muscle flaps or vascularized bone grafts. The aim was to save the leg by covering the soft tissue defect and revascularize the infected, devitalized fracture site. In all cases a radical wound revision was made. Cancellous bone grafting was performed in 19 cases. Bony instability demanded external fixation in 25 cases. Reconstruction was made with latissimus dorsi muscle (24 cases), rectus abdominis (6 cases) and gracilis muscle (2 cases). Osteomusculocutaneous free flap was used in 3 patients who had a tibial bone defect exceeding 5 cm.

In distal tibial fractures (15 cases) the reconstruction was succesful in all cases. However, the late sequelae were due to secondary ankle arthrosis in 7 cases.

In middle tibial fractures the microvascular reconstruction was used in extensive loss of bone and soft tissue (7 cases), because in less severe injuries local muscular flaps were used. Therefore, two patients ended up with leg amputation. Extensive injury, large avascular fragment of bone and severe nerve injury are bad prognostic signs.

In proximal tibial fractures (4 cases) all reconstructions were succesful. However, due to the intra- or periarticular nature of these injuries, instability, stiffness or secondary arthrosis of the knee joint were common.

Nine patients with chronic osteitis after complicated fracture of the leg (5 to 60 years after the initial injury) were treated with radical revision and with a microvascular muscle flap. In 7 cases, the osteitis healed (follow-up > 4 years), but in two cases, recurrent osteitis demanded amputation.

59. External fixation of severe tibial fractures

Antti Kyrö and Erkki O. Karaharju

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

External fixation is an established method for treating complicated fractures of the lower leg. Infection with severe soft tissue damage often still presents a great problem in the treatment.

Material and methods: During a three year period 9 patients with 40 severe tibial and combinated ankle fractures were treated with external fixation. There were 28 tibial shaft fractures, 6 pilon fractures, 2 combinated ankle and one malleolar fractures. Three tibial shaft fractures were closed and 25 open; two were of grade I, six of grade II, 15 of grade III and two of grade IV. Four of the pilon fractures were closed, and two were open; one grade I and one grade III.

Results: The mean clinical union time for 22 tibial shaft fractures was 8 (4–17) months, and for five pilon fractures 5 (3–8) months. One malleolar fracture did not unite.

There were 13 superficial infections: 10 cases in tibial shaft fractures, 2 in pilon fractures and one in malleolar fractures. Pin hole infections occured in ten cases: 8 in tibial shaft and 2 in pilon fractures.

Femoral or lower leg amputations were performed in six cases: 5 tibial fractures and one pilon fracture. One patient, with a grade IV tibial fracture, died 17 days after the injury.

Discussion: Primary union by osteotaxis only can be achieved in most cases, even in most severe fractures. Osteotaxis should be applied without delay at an early stage. A combined bone and soft tissue reconstruction should be undertaken during the early period of osteotaxis to avoid complications in healing , or amputation.

60. Acute sports injuries: A prospective study of patients attending a large casualty department

J. Södergård, E. Partio, A. Harilainen, J. Sandelin and P. Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital Helsinki, Finland

During the last decades a trend of more and more people engaging themselves in sports activities has been seen. This trend involves women and men at all ages and also at different levels and types of sports activities. A development in this direction is considered beneficial from many aspects but a major drawback is a consequent rise in the number of sports assoicated injuries.

Patients and methods: This study was performed in order to outline all patients injured in sports attending the casualty department of the Department of Orthopaedics and Traumatology, Helsinki University Hospital during one year. The study was prospective in that all patients injured in sports were given a questionnaire to answer in connection with their first wisit at the casualty department. In this questionnaire the patients sports activity and earlier injuries were outlined and furthermore the circumstances leading to the actual sports injury.

Results: During the one year period 1,779 patients injured in sports were seen. Men outnumbered women with

77% and the mean age was 27 years. Most injuries was seen in soccer (25%) followed by indoor ball games (24%) and ice-hockey (10%). Most injuries occurred dur;ng recreational sports (48%) while injuries during competition was seen in 36%. The majority of injuries were located to the lower extremity (56%) followed by injuries to the upper extremity (27%). Sprain types of injuries dominated with 42% followed by fractures and luxations in 22%. Of the patients injured in sports 16% needed further treatment as in-patients. The average time for patients from their sports injury to their arrival to the casualty department was 12 hours.

61. Incidence of traumatic and overload injuries in professional cycling: A 7-year epidemiological study

Carlos Barrios, Juán Ramón Valentí, José Calabuig

Orthopaedics and Sports Medicine Unit, Navarra University Clinic, Pamplona, Spain

In the Sports Medicine literature, a variety of injuries has generally been attributed to the practice of cycling. However, to date, there is no report reviewing over a long period the true incidence of these injuries at high competitive level. To analyze this issue, a 7-year retrospective study of all acute and overloading injuries related to the sports activity was carried out in a professional cycling team.

Material and methods: A total of 32 cyclists with a mean age at review of 25 years were investigated. Including training and competition, the mean cycling distance per racer was 28,000 Km/year. The severity of injuries was classified according to the Abbreviated Injury Scale, AIS, and a three-point scale defining the time-interval of absence from sports activity due to injury. Minor AIS-1 lesions were considered irrelevant.

Results: There were 46 injuries recorded of which 14 caused by falls. Traumatic injuries included fractures in 12 cases, 6 of them involving the clavicle. Surgical treatment was applied to 3 fractures. A severe injury, AIS-4, was only seen in one case with an important thoracic trauma and concomitant grave diaphragmatic laceration requiring surgery. Nontraumatic musculoskeletal injuries due to overloading were registered in 31 cases (24 cyclists). The most frequent lesion was tendinitis at the knee level (8 cases) and of the Achilles tendon (5 cases). Patellar complaints were referred by 12 cyclists. In 9 of them, arthroscopy examination disclosed a chondromalacia of the patella at different evolutive stages. Except for one of these cases with a lateral patellar deviation, none of the nontraumatic injuries required surgical treatment. As for the absence from competition, there were 5 major injuries (more than a month absence), 33 moderate and 7 minor injuries (less than a week). Only 4 cyclists were free of injuries during the period of study.

Conclusions: Although only a few major injuries occurred, cyclists at a competitive level were found to be a high risk population for sports injury. The majority of lesions are related to overloading mechanisms. The most frequent injuries were clavicular fractures among traumatic lesions and tendinopathies at the knee level like chondromalacia of the patella among overloading injuries.

62. Injuries in handball players

B. E. Lindblad, C. J. Terkelsen, H. E. Helleland, K. Høy, C. J. Terkelsen and L. N. Lindblad.

University Department of Orthopedic Surgery, Central Hospital of Randers, Denmark

Material and methods: In a one year period a total of 1839 sports injuries were prospectively registered in the casualty ward. 570 (31%) were handball injuries. Primarily all were registered and later 84 % participated in a questionnaire.

Results: 381 (67%) were women. The mean age was 21 years; women 19 (6–43) years and men 23 (9–48) years. The incidence of handball injuries was 46/10,000, and double as high in females (61/10,000) as in males (31/10,000). The incidence of injuries was similar during different time intervals during the game. Type of injury: Fractures constituted 12% and lesions localized to the joints 62%. 3.7% were hospitalized primarily and a further 3.4% later from the outpatient clinic. In 32% of the injuries the AIS was 2 or more. A major part of the lesions classified as minor or moderate resulted in a greater sick leave than expected. 68% of the injured handball players were absent from handball more than 1 week and 8% of the minor injured resulted in a sick leave of more than 6 days.

Conclusion: Compared with the major sports, handball injuries are more common in women; the lesions are less serious and fewer are hospitalized. A major part of the small injuries result in a great sick leave.

63. Effect of prophylactic measures in long distance runners

Bent Wulff Jakobsen, Karsten Krøner, Steen Asmus Schmidt and Anette Kjeldsen

Accident Analysis Center, Department of Orthopedic Surgery, Aarhus Amtssygehus, Denmark

The aim of this study was to evaluate the effects some prophylactic features on injury incidence and running ability in long distance runners.

Material and methods: Forty-two long distance runners were divided into 2 groups matched according to age, weight, height, experience, basal training, maximal training and injury incidence in 1987. All runners had planned to

participate in at least two races of marathon-distance. The runners of the first group were examined clinically and individual training features were proposed. These runners were recommended to follow one of two designed training programs. The runners of the second group served as controls. Actual training time, distance and technique was monitored daily, all participation in competition was registered and injuries diagnosed by the authors. Injuries of the investigation group were treated too.

Results: During one year the investigated runners sustained 54 injuries, 28 during practise and 26 in competition. The controls had 22 injuries, 8 during practise and 14 in competition. The injury incidences were 104.5 per 1,000 h competition and 8.7 per 1,000 h training in the test group; 86.7 per 1,000 h competition and 3.3 per 1,000 h training in controls. The runners of both groups sustained mainly overuse injuries. Test runners participated in significantly more competitions for longer distances than controls, but with identical pace (km/min).

Conclusion: Prophylactic features in long distance runners seem to increase running ability, at the expence of a higher injury risk.

64. Laxity and performance after repair of the anterior cruciate ligament: A two-year follow-up with roentgen stereophotogrammetry

Håkan Jonsson, Lars-Gunnar Elmqvist and Johan Kärrholm

Department of Ortopedic Surgery, University Hospital of Umeå, Sweden

Material and methods: 25 patients with old anterior cruciate ligament ruptures were reconstructed over the top. Thirteen patients were augmented with a Kennedy-LAD braid. The laxity of the injured and intact knees was examined preoperatively and the injured knees 6, 12, and 24 months postoperatively with roentgen sterephotogrammetry. Knee function was assessed using functional score, activity grading, performance tests, and muscle strength measurements.

Results: The operation reduced the anterior posterior laxity 3.6 mm (SD 3.7) 6 months after surgery; eight patients, all without augumentation, showed less than 2 mm side difference. Between 6 months and 2 years the knee laxity increased with 1.7 mm. At the two-year follow-up no correlation was observed between the scores, muscle strength, performance and AP-laxity.

Conclusion: Reconstruction of the anterior cruciate ligament reduced AP-laxity in most of the patients but not to normal levels. Absence of correlation between functional/activity scores, performance and knee laxity suggests that the operations also had other effects on knee stability than reduction of AP-laxity.

65. A prospective, randomized study comparing three surgical procedures in the treatment of anterior cruciate ligament tears

Lars Engebretsen, Ove Fasting, Anders Mølster, Torbjørn Strand and Pål Benum

Department of Orthopeadic Surgery, Trondheim University Hospital, Trondheim, Norway

The purpose of this study was a two year follow up of a prospective, randomized study on acute ACL repair comparing direct repair with a synthetic and biological augmentation procedure.

Patients and methods: 150 consecutive patients aged 29(16–50) years with acute ACL tears were selected at random for treatment by one of three surgical methods. Patients with concomitant posterior cruciate ligament tears or fractures were excluded from the study. After the injury was established through testing in anesthesia and arthroscopy, the treatment for each patient was selected at random according to the envelope technique. Fifty patients were treated with primary repair (Palmer 1938), fifty patients with patellar tendon augmentation (Clancy et al. 1988) and fifty patients were augmented with the LAD (Schabus 1988). All the patients were operated on within 10 days of injury. There was no age difference between the groups, nor were there any statistical differences between the groups concerning additional ligament or meniscal injuries. The rehabilitation protocol was identical, with a long leg cast for two weeks followed by a brace for six weeks with limited motion and no weightbearing. The patients were followed prospectively with the Lysholm functional and Tegner activity level score. Stability was evaluated clinically and with the KT1000 arthrometer.

Results: Three patients were lost to follow up. The mean activity level was significantly reduced for all three groups at the one-year control and there was no difference between the groups. The repair group reduced its level from 6 to 4 at one year and stayed on this level at the two-year control. The LAD group had a similar development the first year, but had a small, although significant increase from one to two years without reaching the preinjury level. A significant increase in the activity level for the patellar tendon group, brought this group close to the preinjury level. 34/50 in the repair group, 18/47 in the LAD group and 18/50 in the patellar tendon group had reduced their activity level at the two-year control. The functional score showed no difference between the groups at one year (mean 90). However, at the two-year control, the repair group had decreased the mean score significantly and had 25 percent of the patients in the fair/poor group. The LAD patients stayed on the same functional level at two years as at one year, while the patellar tendon group improved the score significantly from the first to the second year with only one patient in the fair/poor group at two years.

Ten percent of the patients in the repair group had a positive pivot shift after one year, significantly increasing to 35 percent after two years. 6/47 patients in the LAD group had a positive pivot shift at one year with no increase after two

years. In the patellar tendon group there were no patients with a positive pivot shift at either one or two years. Thirtyfive percent of the patients in the repair group, 30 percent in the LAD group and 13 percent in the patellar tendon group had a side difference > 3 mm on the KT1000 at one year. For the repair group there was a significant increase in the anterior translation from one to two years, whlle the LAD group and patellar tendon group were unchanged.

66. Repair of acute ACL rupture with augmentation using the iliotibial band

Markku Järvinen, Matti Lehto, Pekka Kannus, Antero Natri and Petri Liuha

Division of Orthopaedics, Department of Surgery, University Central Hospital, Tampere, Finland

We have used the iliotibial band as an augmentation material in the operative repair of acute anterlor cruciate ligament (ACL) rupture as described by Marshall.

Material and methods: 20 patients were operated using this method from September 1987 to March 1988 and the follow-up study performed December 1989 consisted of a questionnaire, clinical examination, laxity tests with KSS maschine (Acufex, Norwood, Ma, USA), radiolographic evaluation, and isokinetic muscle strength testing. There were 14 isolated ACL ruptures, in 3 cases also a meniscal injury, in 5 cases a medial and in 1 case a lateral collateral ligament injury..

Results: 17% of the patients were satisfied with the end-results and according to our objective functional criteria 18% had good outcome. According to Lysholm and Marshall scores 15% were excellent or good. There were no failures in repaired ACL. Two patients had flexion deficit more than 10 degrees. The clinically measured A-P laxity correlated well with the KSS measurements. The manual Lachman test was mildly positive in 9/17 (8 had l+ laxity and 1 had 2+ laxity) and the anterior drawer test in 8/17 (7 had l+ and 1 had 2+ laxity). Total amount of anterior-posterior laxity measured with KSS was in the Lachman test 8.8 ±3 mm in the operated knee and 5.6 ± 2 mm on the uninured knee. Corresponding values at the knee angle of 90° of flexion were 6.4 ± 2 mm and 4.9 ± 1 mm, respectively. Compared with the uninjured knee, the operated knees showed in the isokinetic tests 33% strength deficit in extension and 14% in the flexion at the speed of 60 deg/sec. At the speed of 180 deg/sec, the corresponding deficits were 27% and 20%, respectively. 12 patients, who had been active in sport before the inury, could continue their sport activity also after repair, but at a lower level.

Conclusion: In the acute repair of ACL, iliotibial band augmentation seems to be a good method of restoring the functional stability of the knee.

67. Knee joint motion and ligament force in nonaugmented and augmented primary repair of anterior cruciate ligament ruptures

Lars Engebretsen, William Lew, Jack Lewis and Roben Hunter

Department of Orthopaedic Surgery, Trondheim University Hospital, Trondheim Norway and Bioengineering Lab, University of Minnesota, USA

Supported by the hypothesis that immediate repair of acute ACL ruptures leave better results than later reconstructions, primary repair is a commonly used procedure. A review of the literature, however, shows decreasing knee stability and function with time. Several augmentation-procedures have therefore been developed to reinforce and protect the repair while growth and remodeling takes place. However, no data are available on the load carried by the repaired ACL and its effect on knee joint motion. The purpose of this study is to increase the understanding of the immediate postoperative mechanical state of the repaired knee with and without an augmentation procedure using a test-system for measuring knee joint motion and ligament force.

Material and methods: Five freshly thawed knees were prepared by removing excess tissue and carefully preserving the knee capsule and ligaments. Buckle transducers were installed on the ACL and both collateral ligaments. Complete joint motion was measured using an instrumented spatial linkage, and external loads were applied to the specimens using a pneumatic load apparatus. A 90 N anterior directed load was applied to each unconstrained tibia at extension and 30°, 60° and 90° of flexion. Ligament forces and joint motion were measured for the normal knee and the cut ACL state with the buckles in place. The ACL was cut proximally and a repair was carried out with 4–6 sutures in varying depth sutured anteromedial to posterolateral in the ligament substance and placed through two tunnels in the lateral femoral condyle at the anatomical site of the attachement of the ACL on the femur. The repair was tensioned to prevent a-p translation > 5 mm and each suture tied over a cancellous screw. The ligament force and joint motion measurements were carried out under the same load states as for the normal ACL. The specimens were then removed from the load apparatus and two separate augmentation procedures were carried out. In one procedure a Kennedy 3M Ligament Augmentation Device (LAD) was taken through a tibial drill hole emerging at the anteromedial insertion site of the ACL and then passed with the anteromedial suture bundle from the ACL-remnants through the widened posterior drill hole in the femoral condyle. In the second procedure the LAD with the anteromedial suture-bundle was passed through the over the top position. In both procedures the sutures from the ACL were tied down as previously and the LAD stapled down at 30° of flexion with a pretensioning of 15 lbs. Buckle transducers were installed on both the repaired ACL and the LAD for both repair procedures. For each specimen the test series consisting of a 90 N anteriorly directed load at each of the four flexion angles were carried out.

Results: Under the anteriorly directed load, the forces in

the nonaugmented, reinserted ACL exceeded the normal ACL forces in 30°, 60° and 90° of flexion and was lower than normal in extension (mean repair forces/normal ACL = 2.0). In the unloaded state the normal ACL carried very little load as opposed to the repair which carried a significant amount of load in 60 and 90° of flexion. None of the repairs reproduced the normal knee joint kinematic although all the repaired knees had less anterior displacement than the cut ACL state. When the augmentation was done with the LAD through the condyle, the composite graft carried more load than the normal ACL in all flexion angles in all the knees and considerable loads were carried also in the unloaded state. The ACL repair-portion of the composite graft still carried higher loads than the ACL in 60° and 90° of flexion. When the augmentation was done as an over the top procedure, the composite graft carried more load than the normal ACL, but the ACL repair part of the composite carried equal to or less load than the normal ACL under the anteriorly directed load. The augmented knees did not reproduce normal joint motions and tended to become overcorrected with the tibia in a posterior and externally rotated position as compared to the normal knee state.

The loadsharing between the LAD and ACL repair varied with augmentation pocedure and flexion angle, but varied little between the specimens. When the LAD was taken over the top it carried 77% of the load in extension, decreasing through the flexion range to approximately 25% in 90° of flexion. The loadsharing profile for the augmentation through the condyle showed a more even distribution through the flexion range of approximately 50%.

Conclusion: The high forces in the repaired ACL in the unloaded and loaded knee stae in all flexion angles may lead to a gradual stretching of the repair and thus to a decrease in knee joint stability with time. With augmentation the forces in the ACL repair decreased and this could protect the ligament while growth and remodeling takes place.

68. Arthroscopic meniscus repair—a 3-year follow-up

C. J. M. Oosterbos and A. D. Verburg

Department of Orthopaedics, Maasland Ziekenhuis Sittard, Netherlands.

Material and methods: Thirteen patients underwent arthroscopic medial meniscus repair, using an inside-to-out technique, in 1986 and 1987. The tears were located in the periphery of the medial meniscus, were of traumatic origin and were accompanied by a rupture of the anterior cruciate ligament, with a mild instability. The rupture was generally not reconstructed. The meniscus tears were documented preoperatively by arthrography, which was repeated six months postoperatively.

Results: Seven menisci showed 95–100% healing, four menisci showed only a small remaining fissure in the posterior horn. All patients had a good or excellent Lysholm score at follow-up. Two patients required removal of the posterior horn of the medial meniscus, one due to a reactive arthritis, one due to persisting pain. One patient required ACL-reconstruction and re-suturing of he medial meniscus after reinjury. Eight patients resumed sports activities, most of them on a lower level.

Conclusion: We conclude that in a combined inury of the knee, consisting of an ACL-rupture and a tear in the periphery of the medial meniscus, with a clinically mild instability, it is best to repair and thus preserve the meniscus arthroscopically, in order to save the patient from a large reconstruction operation with a long rehabilitation period.

69. Fat pad disease of the knee—results of arthroscopic resection

Heikki Aho and Jouni Havulinna

Hatanpää Hospital and Tampere Research Station of Sports Medicine, Tampere, Finland

Anterior knee pain is one of the major problems in orthopedic sports medicine. An irritated and enlarged fat pad is often the only or the main pathology of such a patient. The aim of our study was to analyze the results of arthroscopic fat pad resection after failed conservative treatment.

Patients and methods: 47 patients (mean age 33 (15–64)) years have so far been followed-up for at least one year. Twelve of them had a medial synovial plica in addition to the fat pad disease. Mean duration of the symptoms was 28 months. Main symptoms were anterior knee pain (59%), giving way (17%), joint effusion (13%), and locking (11%). Over half of the patients were active in sports, nine were competitive athletes. The right knee was symptomatic in two third of the patients. One third of the patients had previously been treated for or had symptoms from the other knee, too. At the operation the extra volume of the fat pad was resected with a rongeur to or slightly beyond normal. All local reddish synovium was removed. The one-year follow-up was performed by the one of us, who was not responsible for the operation.

Results: At one-year follow-up 39 of the patients reported considerable improvement. 15 were completely free from symptoms. 26 of the patients had increased their physical activity. No major complications occurred. None of the patients got worse.

Conclusion: Arthroscopic fat pad resection is a safe and simple treatment. It gave good result in 4/5 of the patients with chronic fat pad irritation after failure of a conservative treatment. Our study does not support the theory of fat pad disease occurring only with medial plica.

70. Operative treatment of impingement syndrome

Denis A. Dartee and Aart D. Verburg

Department of Orthopaedics, Maasland Ziekenhuis, Sittard, The Netherlands

Between January 1984 and December 1988, 268 patients with impingement syndrome of the shoulder were treated operatively. The operation was performed according to Neer: acromioplasty, if nessesary, in combination with a cuffrepair. The post operative treatment depended on the extent of the cufflesion and the percentage of deltoid muscle that had to be released.

In our retrospective study the results were analysed in relation to the period of time between operation and work resumption and the ability to resume the same kind of work as before injury.

Preoperative complaints of the neck had a negative affect on the final result. However, the severity of the degenerative lesions of the cuff and the kind of after-treatment given, did not influence the final outcome of the operation.

71. Arthroscopic subacromial decompression

Ove J. Fasting, Anders Hareide, Arne Nilsen and Tom Ludvlksen

Department of Orthopedics, Aker Hospital, Oslo, Norway

In selected cases with the impingement syndrome the efficacy of open anterior acromioplasty has been well documented. The purpose of the present paper was to document the results of decompressing the subacromial space utilizing arthroscopic techniques.

Method: After arthroscopic evaluation of the humeroscapular joint the scope was introduced in the subacromial bursa. Continuous distention of the subacromial space with Xylocain/adrenalin in saline at a level of 30 mm Hg was performed with a motorized pump (3M). With a motorized shaver a partial bursectomy was performed and the bony landmarks of acromion outlined with needles. With a motorized burr > 6 mm of the undersurface of the anterolateral acromion was resected and smoothed towards posterior and medial. The coracoacromial ligament was released from the acromion and about 5 mm removed with a punch forceps. Full range of motion was encouraged immediately after the operation in a suspension sling.

Material: 58 consecutive cases, stage II and stage III, with minor rotator cuff tear were operated. 11 had failed to respond to conservative treatment with symptoms for more than two years. The average age was 48 years, and the female:male ratio was 3:2. 56 shoulders (2 lost) were followed for 3 to 29 months. The results were graded on the UCL Shoulder Rating Scale before operation and at follow up.

Results: The overall results were 48% satisfactory cases and 8% unsatisfactory (5 fair and 3 poor). The average UCL pain score improved from 1.7 preoperatively to 8.1 at follow-up.The functional score increased from 4.3 to 9.2. Strength and forward flexion increased from 3.7 to 4.8 and 4 to 4.8 respecetively. There was only one minor complication with transient neuropraxia among the first patients where we used traction without 20 degree of anteversion.

Conclusion: The results of arthroscopic subacromial decompression are as good as the results obtained by the open method. The complications are few. The method can be practiced without electrosurgical techniques or hypotension to control bleeding. It is essential to have a continous distention at a level between 30 and 50 mm Hg, which is only possible with a pressure-controlled infusion pump. The resection of the acromio-coracoid ligament should be performed at the end of the operation as this is the only point were bleeding can be a problem.

72. Serratus paralysis

Martti Vastamäki

Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

One hundred patients with serratus paralysis with a follow-up of more than 2 years have been evaluated. There were 56 males and 41 females; the mean age was 32 (11–57) years. The presumed etiology was a trauma in 22, heavy exertion in 30, operation in 17, infection in 17, and unknown in 14 cases. The most applied treatment was derotation of the scapula by means of a protecting brace in 82 cases. The brace was applied on an average 6 (1–20) months after the onset of winging and it was used on an average 10 (2–40) months. The patients used the brace on average 12 hours a day.

In the bracing group, 38 patients recovered and 27 improved. 30 patients had been unable to work before using the brace. 18 of them started working after having the brace.

In most cases the long thoracic nerve will recover spontaneously over a period of about one or two years. However, the palsy normally makes the patient unable to do other than light work. Therapy should be directed toward protecting the serratus anterior muscle and the nerve from overstretching. Using the brace can yield working ability. Quite obviously it also confirms recovery in borderline cases that otherwise would not recover.

73. Comparison of different operative techniques in the treatment of tears in the rotator cuff of the shoulder

Matti Lehto, Timo Kyyrönen, Timo Paakkala, Timo Telaranta, Pentti Lepistö, Eino Rintamäki and Markku Järvinen

Department of Surgery and Radiology, Tampere University Central Hospital, Finland

Patient and methods: From 1980 to 1987, 159 patients (169 shoulders) with tears of the rotator cuff were treated operatively at the Tampere University Central Hospital. There were 40 women and 127 men with an average age of 54 and 53 years, respectively. Four patients had had one previous operation in the same shoulder. 12 shoulders (7%) had to be excluded of the study because of insufficient available information. Follow-up evaluations ranged from 1.5 to 9.5 years.

Results: According to Wolfgang's rating system the results were excellent in 67 (43%), good in 50 (32%), fair in 26 (17%) and poor in 12 (8%) shoulders. Patients treated with Neer's acromioplasty had 16 (73%) excellent, 3 (14%) good, 1 (5%) fair and 2 (9%) poor results. The same ratings for patients treated with acromion osteotomy were 27 (46%), 19 (32%), 10 (17%) and 3 (5%) and for patients treated with lateral resection of acromion 22 (31%), 27 (38%), 15 (21%), 7 (10%), respectively.

There was no difference in the results between the use of free tendon graft, reinsertion or suturen of supraspinatus tendon. The results were better if the coracoacromial ligament was resected. The results were worse if the rupture was larger than 3 cm regardless of the operative technique.

74. Transfer of the tuberculum majus for massive ruptures of the rotator cuff

Pekka Paavolainen, Pär Slätis and Jan-Magnus Björkenheim

The Orthopaedic Hospital of the Invalid Foundation and The Department of Orthopaedic Surgery, Surgical Hospital, Helsinki, Finland

To surgically repair a rotator cuff (RC) tear, the tendon defect must be defined and the tendon edges mobilized.The surgeon is often confronted with large tears in which there is loss of tendon substance and difficulties to proceed with primary tendon-to-tendon or tendon-to-tuberosity repair. The main goals of reconstruction of the RC is restoration of the soft tissue spacer function, centering of the head in the glenoid and adequate correction of concomitant lesions of the joint. The reconstruction is combined in every case with a decompressive acromioplasty.

Methods: In our department reconstruction of the chronic, massive and retracted cuff tears have been tackled by transfering the intact tendons of the infraspinatus teres minor and/or subscapularis in order to interpose the space between the humeral head and acromion. The posterior muscle insertions have been released with a cancellous bone block and transferred anteriorly towards the lateral margin of the intertubercular groove. The block with the tendon insertions have been inlayed to this new position and fixed with an screw. A similar bone block released from the inlaybed was used to refill the original defect area on the posterior aspect of the humeral head.This procedure enables the lateral and anterior margins of the defect to be drawn closer to each other on the surface of the humeral head where they can be sutured together without excess tension.

Patients: Thirty-one patients have undergone operation with this technique. There were 24 males and the ages of the patients ranged from 41 to 68 years. All of them were followed for a minimum of one year.

Results: The average Neer's function assessment key value was 47.4 preoperatively and 72.5 postoperatively. In eleven cases it exceeded 80 points. The average maximum postoperative abduction was 135° (range 40°–180°). Fifteen patients achieved more than 170° of abduction. Relief of pain was encountered in 29/31 cases. The loss of function caused by the defect on the original posterior insertions of the transferred muscles seemed to be negligible.

75. Reconstruction of the rotator cuff: A postoperative sonographic and MR-imaging study

Juhani Ahovuo, Antti Lamminen, Pekka Paavolainen, Jan-Magnus Björkenheim and Ilkka Suramo

Surgical Hospital and Department of Diagnostic Radiology, Helsinki University Central Hospital, Finland

Surgical treatment of rotator cuff (RC) tears has been used as the last resort to abolish shoulder pain and dysfunction. One of the main goals is to restore the soft tissue spacer function between the acromion and the humeral head. The results of the tendon repair are, however, poorly documented and the quality of the soft tissue cover over the humeral head is still obscure.

Patients and methods: Twenty consecutive patients were selected for ultrasound (US) and/or MR-imaging examination after reconstruction of the RC either with straight tendon-to-tendon or tendon-to-tuberosity (McLaughlin) repair. This was done at least two years after the reconstruction and all those who were selected had a good pain-relief effect after the operation. US studies were made with a real time linear-array scanner, provided with 7.5 MHz transducer and NMR studies with a 1-T scanner. The results obtained from US studies were compared with well-known commonly used criteria of the rotator cuff.

Results: Thinning of the tendinous cuff or hyperechogenic changes of the tendons were commonly observed in patients after RC repair. Total absence of tendons could not be verified in any case. Fluid collections around the bi-

ceps tendon was a surprisingly common US-finding also in patients with normal thickness of the RC tendon. The above mentioned findings could also be verified with MR imaging.

Conclusion: Abnormal tendons, after repair of the RC, were commonly seen in US and MR examinations. However, they appeared in patients with clinically good results. A cuff layer, even though a thin one, may be a sufficient buffer between the coracoacromial roof and the humeral head to prevent pain and to center the head in the glenoid at abduction of the glenohumeral joint.

76. Clinical results of total hip replacement: A comparison of 3 different concepts

Kjell Bye, Astor Reigstad, Merete Brandt, Svein Waage, Karl R. Hetland and Magne Røkkum

Kronprinsesse Märthas Institutt, Oslo, Norway

In January 1985, a randomized, prospective study comparing an uncemented Endler/Zweymüller total hip replacement with a cemented Landos prosthesis was started. The 120 hips included in this study were operated by April 1986. At this time the Endler cup became our standard socket. Women younger than 65 years and men younger than 70, had a cementless stem, while older patients had a cemented Landos stem. Our aim with using the combination cementless socket/cemented stem was to avoid the large acetabular cavities seen at revision of cement sockets, and the thigh pain frequently reported from patients with cementless stem replacement.

Patients and methods: The 120 hips above were compared with the 100 first hips having a cementless Endler socket and a cemented Landos stem. All 220 hips have been operated by the same surgeons, using the same approach and the same postoperative regimen. A clinical evaluation using the Merle d'Aubigné/Postel hip score, as well as a radiographic evaluation has been made at 4 months, 1 year and yearly thereafter. The mean age was somewhat higher and the health condition inferior in the Endler/Landos group.

Results: The operation time was 20 minutes shorter in the Endler/landos group than in the all cemented Landos group. Both the Endler/Landos group and the Landos group had one postoperative dislocation of the hip, treated consevatively with a good result. One Endler socket in the Zweymüller series was recently revised because of loosening after 4 years. One socket in the Endler/Landos series is also loose, but the patient's bad health makes revision hazardous.

Table. Functional results at 3 years

	Landos	Endler/ Zweymüller	Endler/ Landos
Pain	6.0	5.7	5.9
Gait	5.8	5.5	5.8
Motion	4.9	4.8	5.0
Total hip function	16.7	16.0	16.7

Conclusion: In this comparative study, the clinical results of the combination cementless socket/cemented stem equal those of the all cemented, "gold standard" hip replacement at 3 years. The results of the all cementless group are inferior in all qualities of the index. Long time follow-up of the Endler socket indicates wear of bone in contact with polyethylene and that the particles of polyethylene accelerate the loosening of the socket. In spite of a low revision frequency in long time studies, the all polyethylene socket has been withdrawn from the market. It has been replaced by a titanium-backed version of the Endler socket.

77. Five-year follow-up of 100 cementless Mathys total hip replacements

Timo Niinimäki, Timo Kemilä, Jaakko Puranen and Pekka Jalovaara

Department of Surgery, University of Oulu, Finland

Mathys hip endoprosthesis was developed about 15 years ago. In this series, the third generation model has been used. Its isoelasticity allows the implant and bone to deform as one unit. It also loads the proximal femur as physiologically as possible. The prosthesis is apt to fill completely the medullary cavity of the femur. These properties cause an effective osteogenic stimulus to bone and it is anticipated that this gives a good possibility for sound press-fit fixation of the prosthesis and prevents boneloss.

Material: From 1983 we have performed about 700 THR using Mathys isoelastic cementless prosthesis at Oulu University Central Hospital. Six hundred of them have been primary arthroplasties. This survey consists of the 100 first THR operations of 89 patients with a median age of 65 (35–80) years. Median follow-up was 5.3 (4.7–6.5) years.

Methods: All operations were performed under spinal anesthesia using a posterior approach . The length of the femoral component at this time was 150 mm.A cementless cup was always used;mostly Mathys own polyethylene but sometimes an acetabular ring or a threaded cup.The patients were followed during the first two years according to a fixed schedule and thereafter a centralized follow-up examination was arranged during 1989. A radiological examination was also performed. The outcome was assessed using a modified d'Aubigne scale.

Results: Four patients were dead and a revision arthroplasty was performmed on 5 hips. The results concerning pain, mobility and walking were mostly good or excellent. Four patients had marked pain and their results were evaluated unsatisfactory. Most revision operations were performed during the fourth and fifth year. Luxations and perioperative fractures were the main early complications. Two late deep infections were observed.

Discussion: Our revision rate of 1 per year is reasonable although the operative technique was not, in this series, at the level it is today. The stem of the prosthesis has been

lengthened to 180 mm which enforces the bone-prosthesis interface. It is interesting to see if there will be more changes in the future and the exchange rate after 10 or 15 years.

The reasons why we selected this prosthesis were low price and difficulties in revision arthroplasties after cemented prosthesis. That problem does not exist anymore. The stem, if it is loose, is easy to extract and still we have a good bone quality for a revision operation.

Peroperative fractures and fissures are due to the exact press fit. Actually, they have not caused any serious consequences.

Luxations have been our main problem. There are several causes for this. One is the posterior approach, which makes the hip more unstable than the lateral or anterior approach. Positioning of the cup in relation to the stem is critical because of the thick neck that limits the movement of the head and probably causes luxation if there is not suitable anteversion in both components. This problem has been solved in the next generation model by a thin titanium neck and a ceramic head.

No final conclusions on the basis of this 5 year follow-up series can be done. However, the exhange rate has been tolerable but the next 5 years will show the usefulness of this method. Some problems exist. The excercise pain continues often several months postoperatively. Luxations are quite frequent and loosening is difficult to diagnose. The advantages are the gentleness of the stem to the bone, easy revisions and moderate expenses.

78. Femoral bone remodeling following implantation of a cementless total hip replacement

A. Reigstad, K. Bye, M. Røkkum and M. Brandt

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

The attraction of biological fixation of a hip prosthesis lies in its potential of direct attachment to bone without an interposed fibrous tissue layer. It has been shown that the interface between implant and ingrowing bone can remodel with time and can maintain stability.

Material and methods: We have studied the radiographic bone changes caused by the femoral component of the Zweymüller prosthesis 4 months, 1, 2, and 3 years after implantation using the 3-week radiograph as a reference. Sixty of these press-fit, sandblasted prostheses were inserted in arthrotic patients in the age group 60–72 years. No revision operations were performed. Stress shielding was graded according to Engh (J Bone Joint Surg 1987; 69(B): 45-55).

Results: After 4 months, 25 and 7 percent of the hips showed stress shielding of grades 1 and 2, respectively. After 1 year, 30, 23, and 3 percent had stress shielding of grades 1, 2, and 3, respectively. The corresponding figures for the 2-year and 3-year follow-up were 30, 27, and 5, and 28, 23, and 9, respectively. No distal cortical thickening was seen in any hip 4 months after surgery. After 1 year, 27 percent had developed cortical thickening and after 3 years, this was evident in 60 percent. In 29 percent of the hips the cortical thickening extended up to the lesser trochanter. This means that a decrease in bone mass has taken place proximally and an increase distally. However, the overall bone balance was graded as positive in 32, negative in 15, and unchanged in 52 percent of the hips. No correlation between postoperative hip pain and negative bone balance was seen. After 3 years, 42 percent of the hips had a radiolucent zone around the implant in the trochanteric region, and in 4 percent this zone was seen distal to the isthmus. No migration of the implants occurred. According to the radiographic criteria for implant fixation proposed by Engh, 96 percent of the prostheses in this series seemed to have achieved stable fixation by bone ingrowth.

Conclusion: No alarming bone remodeling was seen 3 years after implantation of this femoral component, and this seems to be the situation for the hips that so far have been evaluated after 4 years.

79. Total hip replacement after intertrochanteric osteotomy

Seppo Suominen[1], Ilkka Antti-Poika[1], Seppo Santavirta[1], Yrjö T. Kanttinen[2], Visa Honkanen[2] and T. Sam Lindholm[3]

The Orthopaedic Hospital of the Invalid Foundation[1], The Fourth Department of Medicine, Helsinki University Central Hospital[2], Department of Surgery, Tampere University Central Hospital[3], Finland

Patients and methods: We analyzed 45 hips in 42 patients treated with total hip replacement (THR) after a previos intertrochanteric osteotomy. The indication for osteotomy was primary arthrosis in 34 and secondary arthrosis in 11 hips. At the time of osteotomy, the patients' mean age was 50 (14–65) years. THR was performed a mean (SD) interval of 11.9 (7.7) years later. Narrowing or closure of the medullary canal made insertion of the prosthesis stem difficult in 10 cases. After THR, the patients were followed-up for a mean of 6 (3–11) years.

Results: At the follow-up, the hips had a mean (SD) Mayo score of 81 (13) points (17 excellent, 12 good, 7 fair, and 9 poor). Statistically, a cemented prosthesis (n 35) and a cementless prosthesis (n 10) gave similar results. The failure rate was 7%. Overweight had an adverse effect on the outcome.

Conclusion: Intertrochanteric osteotomy may impair the result after subsequent THR and, therefore, we recommend that its use be limited to patients not overweight who suffer from pain at rest and have moderately restricted hip motion.

80. Functional leg length in revision hip arthroplasty

Veijo Hoikka, Seppo Santavirta, Antti Eskola, Timo Paavilainen, Jussi Wirta and T. Sam Lindholm

Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

Functional leg length was measured in 30 patients before and after revision of total hip replacement. In order to correct the length inequality the leg was lengthened at revision in 25 cases, left unchanged in 2 cases, and shortened in 3 cases. The mean functional leg length inequality was 13 mm preoperatively and 4 mm postoperatively. The mean radiographic inequality between the upper surfaces of the iliac crests was 13 mm postoperatively and 9 mm postoperatively. Preoperatively, the side operated on was more often functionally shorter, and postoperatively more often longer than the other side. Sacral tilt correlated well with height differences between the iliac crests both preoperatively and postoperatively, as well as with lumbar scoliosis both preoperatively and postoperatively.

We emphasize the importance of functional leg length in revision hip arthroplasty. The functional length discrepancy can be corrected in revision but there appears to be a risk of overlengthening.

81. Results of rearticulation of ankylotic hips with total hip replacement

M. Røkkum, A. Reigstad, J. Berg, M. Brandt and K. Bye

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

Fusion of a hip may cause pain in the contralateral hip and in the ipsilateral knee. It may also lead to severe low back pain. This may, together with the disability caused by the stiff hip joint itself, indicate conversion to a total hip arthroplasty. Another indication for rearticulation is painful nonunion of a fused hip.

Patients and methods: Between 1974 and 1989, 19 hips with unilateral hip fusion underwent conversion to total hip arthroplasty. The hip fusion had been performed because of arthrosis (9), congenital hip dislocation (2), meningomyelocele (1), polio sequela (1), Legg-Calve-Perthes disease (1), fracture/dislocation (2), physiolysis capitis femoris (1) and septic arthritis (2). One of the latter fused spontaneously. The duration of the ankylosis was 14(1–53) years. The indications for conversion to total hip arthroplasty were painful pseudarthrosis (6), low pack pain (10), ipsilateral knee pain (5), malposition/ disability of the stiff hip (5), and proximal femoral shaft pseudarthrosis after fracture (1). 9 females and 10 males were operated on. Their age at conversion was > 55(18–72) years (average 55 years). 8 patients had a cemented prosthesis, 8 had a cementless prosthesis and 3 had a combination of cementless socket and cemented femoral component. Follow-up was 3(0.5–15) years.

Results: 3 of the 10 patients with severe low back pain had residual pain. 2 of these had occasionally mild pain while 1 had unchanged severe pain. Moderate knee symptoms disappeared in 3 patients and were reduced in 1. One patient with severe knee problems was operated with knee prosthesis during the same hospitalization. The hip function was ranged according to d'Aubigne/Postel. Pain score was 6.0, range of motion 4.4, and walking ability 4.1. Eight patients used one cane or crutch, 2 patients used 2 crutches postoperatively. 2 patients had femoral stem loosening 9 years postoperatively, and both underwent successful revision surgery.

Conclusion: Conversion of a fused hip to a mobile hip by total hip arthroplasty had very good effect on the low back pain and on moderate knee problems. The total hip function was good. Some muscular weakness about the hip was accepted by the patients.

82. Revision arthroplasties using Mathys cementless total hip endoprothesis

Timo Niinimäki, Jaakko Puranen and Pekka Jalovaara

Departement of Surgery, University of Oulu, Finland

In the last decade there has been a rapid evolution in the technique and design of total hip arthroplasties (THR) and a proportionate rise in the number of these operations performed. Inevitably, this increase in total hip arthroplasties has been followed by an increase in the number of that need revisions. In 1988, 14.2% of the THR operations in Finland were revisions. During the last five years we have used in revisions only Mathys isoelastic cementless total hip endoprosthesis, especially its revision model. The idea of the prosthesis is to fill the proximal femur as completely as possible and to form a medullary nail like a stock for the femoral shaft. The physiological loading and the isoelasticy of the femoral stem give an ossifying stimulus to the bone. Finally, the soft stem material makes it possible to solve problems of fractures with different fixation devices.

Material and methods: This material consists of 100 revisions using Mathys THP performed until the end of 1989. The longest follow-up time was 6 years, median being 3.4 years. Included are also some really problematic cases, some having had 5 THR operations. The operations were performed by 5 senior orthopaedic surgeons, all of whom used a posterior approach. Cement was removed via a window ar the tip of prosthesis or using an image intensifier and a stiff cement drill. The largest possible femoral shaft was inserted and bone transplantation using autologous bone was performed as a routine. a bone bank was established last year and homologous transplantation was used in five cases bedsides patients' own bone. In cases with fractures osteosynthesis was mostly carried out with double cerclage wires.

In some case also plate and screw fixation was applied. The revisions of the acetabular part have been performed with press-fit dome cups, acetabular rings and threaded cups. In infected or desperate cases, where a thorough reconstruction of the acetabulum is required, a two stage operation has been used. This review bases on our THR register, which controls the patients two years after operations and thereafter on every new admission because of hip problems.

Results: The frequency of revisions after these operations is 10%. Causes for these operations have been luxations, failed osteosythesis, loosening and deep infection. The clinical outcome has been satisfactory in 80% of all cases.

Conclusion: Mathys isoelastic cementless total endoprosthesis has proved useful in revision surgery after failed THR. Its special advantages are its osteogenicity, gentleness to bone and its favourable properties for osteosynthesis in cases with fractures.

83. Bilateral knee arthroplasty in one seance

Björn Tjörnstrand, Gudmund Gudmundsson, Ulf Svärd and Lars Nistor

Department of Orthopaedics, Kärnsjukhuset, Skövde, Sweden

Patients and methods: Between 1986–1989, 51 patients underwent arthroplasty of both knees in one seance. There were 33 females and 18 males. The mean age was 71(39–84) years. 43 patients had arthrosis and 8 polyarthritis. Sixteen patients had unicomparmental and 33 total knee arthroplasties bilaterally. Two patients had one unicompartmental and one total knee arthroplasty. Two surgeons operated simultaneously in 16 patients, whereas 35 patients were operated sequentially by one surgeon. The operations were performed in epidural anesthesia and a tourniquet was used.

Results: The median operation time was 160(90–205) min, and the blood loss 990(325–3920) ml. The mean hospital stay was 21(10–39) days. Seventeen patients were referred to rehabilitaion units and 34 went directly home.

Seven complications were registered during the first three months; one fatal pulmonary embolus, two cerebral infarcts, one peroneal palsy, one deep infection and two minor wound complications.

Discussion: The goal for operating both knees in one seance is to make the patients ambulant with an optimal knee function in a short time. This was achieved in our series with shorter hospital stay and less bleeding per knee than in our unilaterally operated patients. Despite three severe complications our opinion is that if arthroplasty is deemed feasible in a patient with bilateral knee derangement a one seance bilateral procedure should be considered.

84. PCA total knee replacement in rheumatoid arthritis

Anders Herrlin, Cecilia Enderlein, Gudmund Blomgren and Urban Lindgren

Deparments of Orthopaedic Surgery and Radiology, Karolinska Institute, Huddinge University Hospital, Huddinge Sweden

Joint replacement patients suffering from rheumatoid arthritis (RA) are generally younger and more disabled than those with arthrosis. Cementless fixation has been thought to offer better long term results due to decreased risk of infection as well as decreased risk of late mechanical loosening. We have used the PCA prosthesis with or without bone cement. The tibial component used in cementless resurfacing has two fixation pegs and in some cases an anterior cancellous screw while the cemented tibial plateau has a central stem.

Patients and methods: During the years 1982–1988, 84 PCA tricompartmental knee replacements were performed on 66 patients suffering from RA at Huddinge Hospital. Cementless fixation was used when the bone quality was considered good. 49 of the tibial, 65 of the femoral and 59 of the patellar components were uncemented. All patients were instructed to partial weightbearing two months postoperatively. Clinical and radiolographic data were collected prospectively. To date, (Jan 1990), 42 knees have passed the 3-year and 16 the 5-year follow-up.

Results: 35 of the 3-year and 13 of the 5-year group reported complete or almost complete relief of pain. A range of motion of 90 degrees or more was reported in 56% preoperatively and in more than 75% one year postoperatively. 4 noncemented knees have been revised after tibial loosening/subsidence. 1 cemented knee has been revised due to infection. 6 patients died during follow-up.

Conclusion: The aseptic complications were seen in the noncemented knees and appeared relatively early. With a careful analysis of the causes of complications in this material it may be possible to define the cases suitable for noncemented fixation. In this early phase, cemented fixation has given a safety margin against early complications.

85. A 2-6-year study of the PCA unicompartmental knee with special reference to fixation with or without cement

Anders Stenström and Anders Lindstrand

Department of Orthopedics, University Hospital, Lund, Sweden

In general, unicompartmental knee arthroplasty has a complication rate of about 5 % after five years according to the Swedish national survey. We report a partly randomized study with respect to the use of cement on the PCA unicompartmental knee.

Patients and methods: In a consecutive series, 120 knees were operated with the PCA unicompartmental knee for gonarthrosis stage I–III according to Ahlbäck during 1983 through 1987. The use of cement was randomized at surgery from case 30. Fourteen knees were excluded from follow-up (neurologic disease 2, severe sciatic pain 2, later diagnosed RA 2, and death 8). Thus 106 knees remained for clinical follow-up.

Results: The HSS-score in the entire material increased from 47 to 89 points. By subjective assessment 80 knees were much improved, 23 improved and 3 failures. The mean postoperative flexion was 124°. There were three failures due to pain on walking. Two failures were among 59 uncemented knees while the remaining failure was among 47 cemented arthroplasties. The cemented knee was revised to a total knee arthroplasty due to a loose tibial component. The two uncemented knees have not been reoperated but the pain might be due to loosening of one or both components. Nine uncemented arthroplasties experienced pain or discomfort during the first steps of walking. After the first steps the patients' knee was completely painfree again. The patients had otherwise good or excellent results. First-steps problems were not seen in the 47 cemented knees.

Conclusion: A difference was found between the cemented and uncemented arthroplasties ($p < 0.01$) where the cemented artrhoplasties had a higher frequency of full pain relief as there were no first-steps pain observed in this group. The patients had otherwise good or excellent results. The results of the cemented arthroplasties were highly successful and well comparable with other unicompartmental reports. Provided that correct indication and surgical technique is used we conclude that, compared with uncemented prosthesis, this prosthesis used with cement gives a somewhat higher frequency of complete pain relief with satisfactory results after 2–6 years.

86. Knee kinematics during active knee motion in total knee arthroplasty: A roentgen stereophotogrammetric analysis of the Tricon-M knee prosthesis

Kjell G. Nilsson[1], Johan Kärrholm[1] and Leif Ekelund[2]

Departments of Orthopedics[1] and Diagnostic Radiology[2], University Hospital, Umeå, Sweden

Knee prostheses with high inherent conformity may transmit high stresses to the bone/prosthesis interface increasing the risk of aseptic loosening. Some implants are therefore designed to imitate the kinematics of the normal knee.

Patients and methods: 11 patients (mean age 69 years), operated on with the Tricon-M knee prosthesis because of arthrosis or rheumatoid arthritis, were examined one year after operation when performing active flexion and extension. The patients were radiographed using two film exchangers and roentgen stereophotogrammetric technique (RSA). The results were compared with 23 normal knees (mean age 25 years) examined in the same way.

Results: The prosthetic knees displayed a combination of internal rotation, abduction and and lateral translation of tibia during flexion and the reversed movements during extension. During the first 25° of flexion these movements were small, reflecting the high congruency between the articular surfaces. The normal knees displayed a combination of internal rotation, adduction and medial translation during flexion and the reversed movements during extension. The prosthetic knees also exhibited an increased posterior displacement during flexion when compared to normal knees. There was a positive correlation between the positioning of the femoral component in the sagittal plane and the recorded AP translations.

Conclusion: The prosthetic knees displayed the same degrees of freedom regarding rotational and translational movements as the normal knees, although the kinematics were not equal. The design of the prosthesis and the presence or absence of the cruciate ligaments may explain these differences.

87. Immunopathological response in loosening of the cementless THR acetabular component

Seppo Santavirta, Yrjö T. Konttinen, Veijo Hoikka and Antti Eskola

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland and Institute of Molecular Immunology, Hospital for Joint Diseases Orthopaedic Institute, New York, USA

The immunohistopathology connected with loosening of the cementless THR acetabular component was analyzed. Polyethylene particles birefringent in polarized light were seen embedded in tissue samples studied. The loosening of the titanium based Biomet prosthesis was macroscopically associated with a dark-stained biomembrane, which in microscopic analysis correlated with small titanium particles in the extracellular matrix and inside tissue macrophages. Metallosis was not associated with the chromium-cobalt-steel alloy based Lord prosthesis. Titanium and polyethylene particles led to migration, adhererence and phagocytosis by CD11b-positive, endogenous peroxidase negative mature tissue macrophages. In spite of macrophage involvement and appearance of CD2-positive T-lymphocytes predominantly of the CD4-subset in the reactive tissue, there were no signs of activation of the specific immune response as there were neither interleukin-2 receptor positive activated T-cells nor PCA-1 plasmablasts/plasma cells present in situ. In contrast, resident mesenchymal fibroblast-like cells showed signs of activation, in particular in common-type of loosening, in form of expression of the carboxyterminal propeptide of type I collagen, which suggests activation of the fibroblast-mediated collagen synthesis or repair process. In aggressive granulomatosis-type of loosening there was mas-

sive involvement of macrophages and multinucleated giant cells but at the same time deficient fibroblast activation.

The clinical relevance of these findings is that the use of cementless THR prosthesis is not a guarantee against adverse tissue reactions.

88. Primary management of the multiply injured patient

Richard Hammer, Ingvar Jansson and Sten Lennquist

Department of Orthopedic and General Surgery, University Hospital, Linköping, Sweden

Early stabilization of long bone fractures in multiply injuried victims (MIV) may reduce the incidence of Adult Respiratory Distress syndrome (ARDS). In a series of 291 MIV, 25% were dead on arrival. Mortality rate in hospital was 2% and 389 fractures were diagnosed in 185 patients. The mean ISS was 33
(9–75). Traffic accident was the cause of injury in 81%. 13 patients (6%) developed ARDS of which 7 died, 5 of whom had a complex femoral shaft fracture.

Patients and methods: 57 patients (26%) had 55 diaphyseal, 4 subtrochanteric and 2 distal femoral fractures. The mean ISS was 27 (18–66). There were 40 men and 17 women, mean age 34(5–76) years. 13 patients (14 fractures) had a definitive stabilization with an IM-nail (10), a compression plate (3) or external fixation (1) within 24 hours. 45 fractures in 42 patients were primarily stabilized in skeletal traction 45 hours after admission and traction was continued for an a average of 7(1–28) days followed by an IM-nail (40 fracturcs). Five were managed in prolonged traction and 1 had a late plating (9th day).

Results: Seven patients (12%, mean ISS 44), all with a comminuted femoral shaft fracture died after 10 (1–44) days. All except 1 were stabilized in prolonged skeletal traction and 5 developed ARDS. The other 2 died within 48 hours due to intracranial injuries (ISS 5O) or multiple organ failure (ISS 66), respectively. These 7 patients had a significantly higher ISS and age ($p < 0.001$) when compared with the 50 survivors.

Conclusion: It is not possible to say whether the higher ISS or age explains the outcome among the nonsurvivors. However, it is reasonable to assume that regardless of age, a higher ISS is a strong indication for early (< 24 hours) and definite stabilization of femoral shaft fractures in MIV. This statement is corroborated by the fact that since this series was ended 1980, all femoral fractures are stabilized after 24–48 hours, and in 8 MIV (1987–1989), no mortality due to ARDS was registered. The in-hospital mortality rate in this later series was l0%, the major cause being severe intracranial injuries. It is concluded that improved managment of MIV requires a well organized multi-diciplinary trauma organization and an adequate interdiciplinary communication upon which the early treatment protocoll for MIV is based.

89. Intensive care of trauma patients

Pentti Rokkanen, Aarne Kivioja, Pertti Myllynen and Eero Wilppula

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

The treatment of the most severely injured patients has been centralized to the intensive care unit in our Department since 1966.

Patient and methods: 2,002 consecutive trauma patients admitted to the Intensive Care Unit were analysed with special regard to patient groups which would benefit from intensive care, and to prognostic factors.

Results: 65 percent of the patients were injured in road traffic accidents. Injuries to the lower extremity were the most frequent (60 percent). The ICU mortality was 9 percent and the total hospital mortality was 12 percent. For 1,169 patients with multiple injuries the average time of treatment in the ICU was 11 days and in hospital 51 days. Assisted ventilation was necessary in 46 percent. Important parameters for good prognosis were no cardiopulmonary resuscitation, no need for assisted ventilation, young age, low amount of initial blood transfusions, less severe brain and thoracolumbar spine injuries, no renal complications, no previous mental disturbance or alcoholism, few complications during treatment and a swift start of necessary operations. A fall in the mortality of patients with multiple injuries from a level of 15 to 5 percent by 1981 was observed.

Conclusion: Treatment in the intensive care unit is recommended for all trauma patients with multiple injuries, who need assisted ventilation and patients with tetraplegia. Fractures should be stabilized immediately, and patients should readily get prophylactic mechanical ventilation. Serious hidden thoracic, abdominal and brain injuries and complications leading to respiratory distress must be actively searched for. The prevention of complications and a thorough understanding of each single injury and its treatment are prerequisites for the successful treatment of multiply injured patients. In addition, a well-organized and coordinated trauma care system is mandatory.

90. Magnetic resonance tomography, surgical treatment and outcome in discoligamentous cervical spinal injuries

Wolfgang Rauschning, Halldór Jónsson Jr. and Rickard Nyman

Departments of Orthopaedic Surgery and Radiology, Academic University Hospital, Uppsala, Sweden

Accurate diagnosis of cervical spinal lesions is crucial for both treatment and outcome. Especially injuries of the discs and spinal ligaments are exceedingly difficult to detect with conventional plain radiographs. Magnetic Resonance

Tomography (MRT) has the potential of unveiling such "hidden or occult" soft tissue injuries.

Methods: This prospective study encompasses 5 patients who had sustained whiplash-type of injuries in traffic accidents and who had negative plain radiograms of the cervical spine at the emergency examination. After six weeks, complete neurological examination as well as flexion-extension radiograms were done. Patients with symptoms, signs and/or radiograms indicative of segmental spinal injury were referred to MR tomography. Clinical and MR data were correlated.

Results: All acute plain radiographs were normal although 14 patients had significant neck pain and/or radiating pain at first examination. After six weeks, 24 patients had significant signs of either decreased or painful neck mobility, deep local neck tenderness and radiculopathy. Sixteen of the MR examinations showed abnormal disc signals, 10 were indicative of disc herniations. Eight of these ten herniias were confirmed during anterior decompression and interbody fusion. All patients became asymptomatic. Two patients with proven segmental instability but with normal MR disc signals became pain-free after posterior fusions in which rupture of the posterior ligaments was found.

Conclusion: The high incidence of discoligamentous injuries in indirect, distorsion-type of cervical spinal injuries—which also has been corroborated in a recent pathoanatomical study—calls for a high level of suspicion of radiographically occult or hidden soft tissue lesions and for improvements of diagnostic techniques, in particular magnetic resonance tomography.

91. Whiplash injuries: A prospective clinical study

Christer Hildingsson[1], Göran Toolanen1 and Bo Edlund[2]

Departments of Orthopaedics[1] and Diagnostic Radiology[2], University of Umeå, Sweden.

The aim of the present prospective investigation was to statistically analyse factors as type and force of impact, initial symptoms and radiographic findings in relation to the final recovery.

Patients and methods: The present prospective study includes 93 patients, 40 males and 53 females with a mean age of 31 (17–67) years, treated at the Orthopaedic Clinic, University Hospital, Umeå, because of a whiplash injury to the cervical spine resulting from car accidents.

At the initial consultation and at follow-up, a physical examination was made and a detailed form was completed, which recorded personal data, details of the accident, symptoms and behavioral variabels. The follow-up was done on avèrage 2 years after the accident. Seventeen factors were studied and the data were analysed by computer.

Results: The most frequent acute symptoms after injury were aching and stiffness in the neck and headache, followed by dizziness and shoulder pain.

Symptomatic recovery, with no subjective residual problems related to the injury, occured in 42% while 15% reported some minor discomfort. Forty-three percent had major complaints and of these 18% had changed jobs, worked part-time or were applying for other jobs and 10% were retraining. One patient was pensioned and 14% were reported sick.

Neck pain and stiffness were the most frequent complaints at follow-up and nearly one fifth of the cases complained of continual shoulder and interscapular pain. Twentyseven percent of the patients complained of low back pain related to the injury.

Conclusion: We could not show any significant relationship between the 17 analysed parameters and the prognosis.

92. Posterior wiring without bony fusion in traumatic distractive flexion injuries of the lower cervical spine: A long term follow-up of 30 patients

Carsten Feldborg Nielsen[1], Mårten Annertz[2], Liselott Persson[3], Hans Wingstrand[1], Hans Säveland[3], Lennart Brandt[3]

Departments of Orthopedics[1], Neuroradiology[2] and Neurosurgery[3], University Hospital, Lund, Sweden

Patients: 34 consecutive patients, 24 of whom males, with a mean age of 40 (10–86) years. 15 had cord involvement and 9 had root involvement only. 30 patients had a follow-up at mean 38 (12–78) months.

Methods: Skeletal lesions were classified according to Allen and neurological deficits according to a modified Frankel classification. Posterior interspinous wire stabilization was performed after mean 7 (1–22) days. Postoperative mobilization with a semirigid collar for 6–8 weeks. Follow-up included independent observer review of hospital records, radiographs including follow-up radiographs in neutral position, in flexion and extension, a questionnaire answered by the patients and a clinical examination by a physiotherapist.

Results: Postoperative cervical alignment had deteriorated at the time of follow-up ($p = 0.0001$). Mean loss of lordosis was 7.5°. Six patients had residual mobility in the affected segment. Patients with incomplete cord injuries or root symptoms only improved. 16 patients had radiographical signs of spontaneous fusion anteriorly, posteriorly, or both. 24 patients complained of pain on motion. 8 patients had wire breaks, all occurred later than 3 months postoperatively. No major complications related to surgery were seen.

Conclusion: The results indicate that posterior interspinous wire fixation provides adequate immobilisation for disc and ligament healing, in some cases with residual segmental mobility. Results regarding alignment and pain may be improved by adding bony fusion to the stabilization procedure.

93. Anterior stabilization of the cervical spine by a locked screw-plate system

H. Jonsson Jr, G. Karlström, S Olerud and L. Sjöström

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

Loosening of screws with loss of stability has been observed especially in cervical trauma cases when conventional plates have been used. With a new screw-plate system (HSPS) in titanium, the screws are locked in the plate by an expanding bolt giving an enhanced stability. The hollow screws, all of same length, should never perforate the posterior vertebral wall. There is no need for cervical collar after an osseointegration time of 6–8 weeks.

Patients and methods: Sixty-two patients (41 males and 21 females, mean age 42 years) have been operated with this new screw-plate system in the lower cervical spine. The mean time of follow-up is 1 1/2 year. Patients with burst fractures, disc prolapses, discitis or spinal stenosis were usually operated with the anterior screw-plate only, while in fracture-dislocations posterior plates were added. A Philadelphia collar was used for six weeks and immediate mobilization was allowed and encouraged.

Results: All fractures and fusions healed without any loosening or deformity. One local complication, an oesophageal fistula occurred in the only case where self-retaining hooks were used. Two elderly patients, 85 and 90 years of age and one Bechterew patient, all with tetraplegia, died of myocardial infarction in the postoperative period. One patient operated with anterior fusion after a burst fracture, died 2 months after surgery in a traffic accident from craniocerebral- and multitrauma injuries. At forensic autopsy the fusion was found solidly healed and the screws were firmly anchored to the vertebral body with bone in all screw cylinders.

94. Cervical spinal cord injury—the correlations of initial clinical features and blood gas analyses with early prognosis

P. Myllynen, A. Kivioja, P. Rokkanen and E. Wilppula

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Finland

The predictive value of some early posttraumtic clinical symptoms and signs, and laboratory values on problems, complications and prognosis of the initial treatment of tetraplegic patients were studied.

Patients and methods: The study was carried out by scrutinizing the files of 54 patients with a spinal cord injury, 40 of them complete and 14 incomplete. Most of the patients (n 43) needed ventilatory support, the duration of which depended on the level and completeness of the spinal cord injury. Bradycardia, hypotonia and tachypnea at admission occurred most frequently in patients who would later develop complications or die. In addition, the frecquency of complications correlated to a patient's age, previous diseases and to the height and degree of the spinal cord injury. Tachypnea at admittance forecast the later development of respiratory compliction. All the eight patient who died, five of them from pneumonia and three from pulmonary embolism, had their spinal cord injury at the level C4–C5 and they were significantly older than those who survived.

Conclusion: In a tetraplegic patient, the age and previous disease of the patient, the level and degree of spinal cord injury, and the blood pressure, heart rate and respiratory frequency at admission can have a prognostic value concerning the early posttraumatic course.

95. LSF—a new lumbosacral fixation device

S. Olerud, G. Karlström and L. Sjöström

Department of Orthopaedics, University Hospital, Uppsala, Sweden

Internal fixation devices for the lumbosacral junction are still a problem. They are difficult to mount, they break easily or they loosen, especially in the sacrum fixation.

A new device was developed with partly new principles: The new fixator has a possibility for a self regulating adaptation in all planes. There is an adjustable lumbosacral angulation. The anchorage in sacrum is secured with a three-dimensional sacral block construction.

Pedicle screws are placed in L4 or/and L5 vertebra. Via an adjustable junction these screws are connected to the sacral blocks. The block screws diverge from each other, one towards the promontorium and the other into the wing of sacrum. By an expansion mechanism the sacral screws are completely locked to the sacral block making one single unit which then will have an unbreakable hold in the sacrum. The device has been used for lumbar fusion procedures in cases of degenerative instabilities and spondylolistheses. It has also been used to stabilize L5 fractures both in trauma and tumor destruction. The preliminary results are very promising.

96. Surgical treatment of thoracolumbar burst fractures

Thomas Kiær, Søren Merser and Erik Tøndevold

Department of Orthopaedic Surgery U, Rigshospitalet, Copenhagen, Denmark

Controversy still exists concerning the treatment of unstable spinal fractures. Recent development in spinal implants has improved the options in treatment of these fractures. The outcome with respect to healing, restoration of spinal anatomy, and neurological function was analyzed.

Patients and methods: 70 patients were surgically treated for unstable thoracolumbar fractures. 65 per cent of the fractures were located to T12 and L1. Preoperatively 1/3 of the patients were neurologically intact, 1/3 Frankel grade D, and 1/4 were total paraplegics. The rest had variable degree of neurological deficits. In 80 percent of the cases, fixation was obtained using Harrington distraction rods with sublaminar wires two levels above and below the lesion. In another 10 per cent the AO internal fixator was used, the rest was stabilized using the Luque technique or Roy-Camille plates. Wide decompressive laminectomy was performed if the canal cross-sectional diameter was reduced.

Results: With an observation period from 6 month to 4 years all fractures healed without secondary deformity. The correction obtained was in average 25% improvement in vertebral body height, and in all cases with kyphosis, restoration was obtained. The only implant failure was one case of sublaminar wire breakage. No surgical complications or deterioration in neurological status were seen. 40 percent of patients with neurological impairment improved in average 1.5 levels on the Frankel grading scale.

Conclusion: Surgical treatment of unstable thoracolumbar fractures corrected deformity without deterioration in neurological functions or other complications. The neurological outcome was favorable compared to nonoperative treatment.

97. Spinal canal remodeling after thoracolumbar fractures with intraspinal bone fragments

Björn Strömqvist, Ragnar Johnsson, Kristian Herrlin and Gunnar Hägglund

Departments of Orthopedics and Radiology, University Hospital, Lund, Sweden

Instability and neurologic deficit combined with an intraspinal bone fragment have been regarded as indications for operative reduction and stabilization of thoracolumbar spinal fractures. A large bone fragment in the spinal canal of a stable fracture without neurologic deficit has also been proposed to be an indication for surgery in order to prevent symptomatic neural compression to occur. Recently, however, some cases with pronounced resorption of nonreduced intraspinal bone fragments have been demonstrated.

We wanted to study remodeling of the spinal canal after thoracolumbar fractures with an intraspinal bone fragment.

Patients and methods: In retrospect, we studied the radiographs and CT investigations for some 50 patients below 60 years of age treated during the years of 1986 and 1987 for major spinal fractures. We found three patients with stable fractures without neurological symptoms but with intraspinal bone fragment, treated nonoperatively and 14 patients who after operative reduction and stabilization had remaining reduction of the cross-section area of the spinal canal. All these 17 patients had a follow-up examination performed 2.5 (1–3.5) years after the trauma comprising clinical investigation, radiography and CT scanning.

Results: Radiography: The kyphosis measured at the primary investigation was 3 (-25–16) degrees and had increased to 15 (-12–34) at follow-up. Three patients had a Cobb-angle exceeding 5 degrees at the first investigation and 6 patients at follow-up.

CT investigation: The reduction of the spinal canal area was 29 (10–70) percent at the first examination and decreased to 14 (0–30) percent at follow-up. In five cases with a canal reduction of 20% or less, the area was unchanged at follow-up; for all the other patients the narrowing had decreased. The ratio between the sagittal diameters of the spinal canal and the vertebral body was 0.21 (0.15–0.4) at the first examination and 0.34 (0.17–0.54) at follow-up.

Clinical symptoms: All but 4 patients had some local ache or stiffness at the fracture level. No relation to the spinal canal reduction was seen. Improvement of neurologic deficits correlated with the level of the fracture but not with the degree of spinal canal reduction or the degree of remodelling.

Conclusion: Due to resorption or remodeling, the majority of intraspinal bone fragments after thoracolumbar fractures diminish in size during the first years after fracture. A major intraspinal bone fragment in a stable fracture in a patient without neurologic deficit should probably not be regarded as an indiction for operative therapy.

98. Transpedicular interbody grafting in the acute treatment of thoracolumbar fractures

Lennart Sjöström, Göran Karlström, Halldor Jonsson and Sven Olerud

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

Late flexion deformity is common in thoracolumbar fractures despite surgical treatment. The main reason is loss of height in injured discs. To avoid recurrence of kyphosis an anterior bony support has to be created in the injured discs.

Patients and method: Ten patients with fractures at the thoracolumbar junction with damage to the disc above the fractured vertebra were treated. The fractures were reduced and internally stabilized with a PSF internal transpedicular device. The injured disc was evacuated, the lower end plate of the upper vertebrae perforated and the disc bone grafted with bone paste through one pedicle in the fractured vertebrae. On postoperative CT scans the amount of bone and distribution of bone in the disc was studied. Minimum follow-up was one year.

Results: 15 (8–20) percent of the disc cross-section area was filled with bone graft. No complications were seen. The average gain in lordosis was 14° at operation and the average loss of correction during the first 12 months 4°. Repeat radiographs showed signs of revascularization and integration of the grafted bone. No resorption was seen.

Conclusion: Transpedicular bone grafting into an injured disc seems to be a possible way to create an anterior support and fusion and thus prevent late kyphotic redeformation.

99. Femoral fractures in multiply injured patients

Aarne Kivioja, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

The treatment of femoral fractures in multiply injured patients is operative. Conservative management makes ordinary nursing more difficult. Unfixed femoral fractures predispose to complications, mainly fat embolism. The timing of operations has been subject to a lot of debate.

Patients and methods: 30 percent of all trauma patients treated at our intensive care unit for multiple injury had a femoral fracture.

Results: There were 372 patients with femoral fracture and multiple injury. The average age of the patients was 36 years with 27 percent females. Road traffic accidents caused 80 percent of the injuries. The patients were given 10 (0–52) units of blood during the first 12 hours and 54 percent were acidotic at arrival. 41 percent had assisted ventilation. The femoral fracture was bilateral in 50 patients. 29 percent of the fractures were complicated. 77 percent of the fractures were operated. 16 reoperations were necessary. Most initial operations were initiated within eight hours from the injury. The occurrence of fat embolism was 16 percent, significantly higher than in the total series 8 percent). The series included 7 arterial lesions, none requiring but suturation and 8 nerve injuries. Total hospital mortality was 10 percent, with only one death occurring after discharge from the ICU.

Conclusion: Accurate diagnosis and competence will lead to the right method of treatment with minimization of the need of later interventions and complications. Since all but one death occurred during ICU treatment it is in the initial hours and days we have to concentrate our efforts.

100. Self-reinforced polyglycolide rods in 768 fractures and osteotomies

Eero Hirvensalo, Ole Böstman, Esa Partio, Pertti Törmälä and Pentti Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Helsinki, Finland

During the years 1984–1989 a total of 768 operations were done on 744 patients using absorbable self-reinforced polyglycolide rods. The main indications and results are presented.

Patients and methods: The main indication was displaced ankle fracture, 428 patients, osteotomy operation, 147 in 123 patients, and intraarticular fractures of the elbow joint, 79 patients. For fixation of the fragments one or several rods were inserted into predrilled channels of equal sizes nearly perpendicular through the fracture surfaces. In case of fractures, a postoperative plaster cast immobilization was accomplished.

Results: The postoperative course was uneventful in 697 cases. Reoperation because of failure of fixation was needed in 6 patients. A bacterial wound infection was observed in 13 (1.7%) cases. In 52 cases (6.8%) there was a transient inflammatory non-specific abacterial tissue reaction manifested clinically as a late discharge from the incision scar. This complication did not influence the final radiographic or functional outcome. The functional end-result in those ankle fractures followed for at least one year became good in 87% of 102 patients with unimalleolar ankle fractures, in 63% of 62 patients with bimalleolar fractures and in 73% of 41 patients with severe ankle fractures. Twenty of 24 patients with radial head fracture followed for at least 2 years showed excellent or good radiographic and functional outcome. The end-result in 60 patients with chevron osteotomy was excellent or good in 45 patients (75%), when assessed 1 year after the operation.

Conclusion: Absorbable self-reinforced polyglycolide rods can be used for fixation of selected fractures and osteotomies in cancellous bone.

101. The indication for the fixation of fractures with totally absorbable SR-PGA screws

Esa K. Partio, Ole Böstman, Eero Hirvensalo, Hannu Pätiälä, Seppo Vainionpää, Kimmo Vihtonen, Pertti Törmälä[1] and Pentti Rokkanen

Department of Orthopaedics and traumatology, Helsinki University Central Hospital and Helsinki Biomaterials Laboratory[1], University of Technology, Tampere, Finland

Totally absorbable SR-PGA screws for bone surgery were used since May 1987 in the clinical study.

Material and methods: 217 patients (102 male, 115 female) with a cancellous bone fracture or acromioclavicular luxation were included in this study. The mean age was 37 (14–71) years. The follow-up varied from 6 weeks to 2 years and 8 months. The screws were manufactured of polyglycolide with a special self-reinforcing technique. The length of the screws used in this study was 25–70 mm and the inner diameter 3.4 mm.

Results: Clinical results were subjectively good in 208 cases (96 %). In this series an insignificant displacement immeadately or later occurred in 24 cases (11 %) and failure, i.e., refractures, failures of fixation (displacement over 2 mm) or insufficient fixations were observed in 9 cases (4 %). Reoperations performed for ankle fractures were: 1 for an insufficient fixation performed immeadately postoperatively, 1 patient with a new fracture and 1 patient for a peroneal tendinitis. Two acromioclavicular luxations failed. The failure of fixation without a new accident was the reason for reoperation in two cases (1 %). The results is presented in table below.

Table

Indication	n	A	B	C	D	E
Ankle fractures (A&B)	118	37	113	4	1	3
Ankle fractures (C)	39	38	33	6	0	0
Olecranon fractures	19	44	14	3	2	1
Ac.-luxations	7	38	2	3	2	2
Fract. of dist. clavicle	7	41	3	2	2	1
Fract. of med. cond. of humerus	7	23	7	0	0	0
Fract. of distal radius	7	41	1	6	0	0
Humeroscapular fract.	6	34	6	0	0	0
Patella fractures	4	36	3	0	1	1
Failed Evans procedure	1	37	1	0	0	0

A Mean age, B Exact, C Insign. displ., D Failure, E Reop.

The complications comprised in this series were sinus formation 10 (5 %), sperficial infection 3 (1 %), deep venous thrombosis 2 (1 %), deep infection 1 (0.5 %), compression of plaster and wound irritation 2 (1%), wound leakage 1 (0.5 %), olecranon bursitis 2 (1 %) and 1 peroneal tendinitis 0.5 %).

Discussion and conclusion: The development of totally absorbable screws in bone surgery is rapid. One advantage is the elasticity of this screw which in some cases may be a disadvantage. Fractures suitable for these screws are; ankle fractures, humeral condylar fractures, some olecranon fractures, fractures of glenoid cavity and humeral neck, and some patellar fractures. Acromioclavicular luxation should not be treated using a pure SR-PGA screw fixation.

102. Biodegradable fixation of physeal fractures in children

Antero Mäkelä, Ole Böstman, Martti Kekomäki, Jyrki Vainio, Eero Hlrvensalo, Jerker Södergård, Pertti Törmälä and Pentti Rokkanen

Department of Orthopaedics and Traumatology, Kopio University and Helsinki University Central Hospital, Aurora Hospital, Helsinki and Biomaterials Laboratory, Tampere University of Technology, Tampere, Finland

Polyglycolic acid (PGA) has been in a worldwide use as a biodegradable suture material since 1970. Biodegradable implants made of PGA were introduced in osteofixation of cancellous bone fractures in 1985. The purpose of the present study was to introduce the biodegradable fixation in pediatric fracture care in order to lessen the psychic stresses and economic costs.

Patients and methods: From September 1987 to January 1990, 36 consecutive displaced physeal fractures necessitating open reduction and internal fixation were treated by transphyseal biodegradable fixation with SR-polyglycolide (SR-PGA) pins. Included were i.a. 10 displaced fractures of the lateral humeral condyle, 5 avulsions of the medial epicondyle of the humerus, and 4 displaced radial neck fractures. The surgical technique was to use two 1.5 mm by 60 mm SR-PGA-pins for fixation across the fracture surfaces after an accurate reduction. Postoperatively, a padded plaster cast was worn for four weeks except ankle fractures who had six weeks of immobilization. The age of the patients on admission ranged from 2 to 15 years, with an average of 10 years. 22 patients were boys, and 14 were girls.

Results and conclusion: An uneventful postoperative course without any signs of adverse tissue reaction ensued in all cases. No signs of impairment of the physeal function were seen during the follow-up time up to 2 years.

The advantages of the transphyseal biodegradable fixation obviating the need of a second implant removal operation cannot be emphasized only from economic points of view. The psychological aspects as well are to be remembered as far as children are considered.

103. Preliminary results of reinsertion of ruptured ulnar collateral ligament of the first metacarpophalangeal joint with totally biodegradable polylactide (PPLA) pin

K. Vihtonen, H. Pätiälä, P. Rokkanen, M. Pellinen1 and P. Törmälä[1]

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital[1], Institute of Plastics Technology, Tampere University of Technology, Finland

Patients and method: Twenty patients, five women and 15 men with total distal or proximal avulsion of the ulnar collateral ligament of the first metacarpophalangeal joint were operated. Mean age was 33 years. In 18 patients the avulsion of the ligament was distal. In these cases a channel of 1.1 mm diameter was drilled in the basis of the proximal phalanx perpendicularly to the axis of the bone through both cortices. Two patients had proximal avulsion and the channel was drilled into the head of the first metacarpus. A Kirschner-wire, 1.1 mm in diameter, was used in the channeling of the ligament. A PLLA pin of 1.15 mm by 15 mm was placed through the ligament and the bone channel. The head of the nail (4 mm) was pressed tightly against the cortex. The device stabilized the joint immediately. A dorsal plaster cast from distal phalanx to proximal third of the antebrachium immobilized the thumb for five weeks. The clinical course was or will be checked two, five and seven weeks and three, six and twelve months after the operation. Radiographs were or will be taken preoperatively and immediately, five weeks and three, six and twelve months after the operation.

Results: In all of the cases the healing of the wound was uneventful and the ulnar collateral ligament remained stable. Full range of movement of the MCP I joint was observed 3 months after operation. The drill channel was seen radiographically three months postoperatively. On the basis of these preliminary results we conclude that reinsertion and fixation of the ulnar collateral ligament of the MCP I joint with a totally biodegradable PLLA pin can be a reasonable alternative for metal wire fixation.

104. Biodegradable fixation of displaced ankle fractures

Johnny Frøkjær and Bjarne Nue Møller

Department of Orthopaedic Surgery, Haderslev Hospital, Denmark

Patients and method: Since february 1988 we have used biodegradable rods in the treatment of displaced ankle fractures at Haderslev Hospital. So far 27 patients, mean age 46 years, with displaced uni-, bi- or trimalleolar fractures were fixed with biodegradable rods. 23 patients were included in this study. Postoperatively the ankle was immobilized in a below-knee plaster cast for 8 weeks, the last 2 weeks weight-bearing was allowed. The patients were discharged from hospital after mean 7 days. Clinical and radiographic examination was performed after 8 weeks, 6 and 12 months.

Results: We found no complications during surgery. In two cases the plaster cast caused a superficial necrosis, which healed without infection. One patient had a wound infection which healed after conservative treatment. She later developed a sinus formation, that perforated spontaneously and thereafter healed. No allergic reaction was observed. 12 patients were controlled after 12 months, 5 after 6 months. In the first group, one patient had a painful ankle with a visible fracture, in the second group, the fracture was still visible in two cases, one having pain. In one case the fracture dislocated after surgery and was operated on using metallic implants.

Conclusion: We found the biodegradable fixation device useful in the treatment of displaced ankle fractures. However, fixation with rods is not always sufficient; there is a risk of fracture redislocation.

105. Chevron osteotomy with biodegradable fixation for hallux valgus

Søren Andersen, Poul Martin Gehrchen and Eva Brems

Department of Orthopaedic Surgery, Frederiksberg Hospital, Frederiksberg, Denmark

The general intention is an immediate mobilization after a Chevron ostotomy by use of a biodegradable implant when operating for hallux valgus.

Method: The Chevron osteotomy is fixated with a biodegradable implant (Biofix rod, diameter 2.0 mm, length 25.0 mm). The implant is mainly composed of self-reinforced polyglycolic acids (PGA). PGA is metabolized via tricarboxylic acid cycle and gradually expelled through the lungs as water and carbondioxyde during approximately 3–4 months.

The foot is dressed in sterile foam pads and an elastic bandage. The patients are mobilized immediately after the operation.

Preliminary findings: After treatment of 80 feet, the preliminary results showed that 79 patients were radiographically healed 6 weeks postoperatively without secondary dislocation. The patient who did not heal showedsigns of osteitis and was treated with antibiotics. The diagnosis was not verified by a bone scan. One patient developed a fluid accumulation.

106. Foreign body reactions to absorbable fracture fixation devices

O. Böstman, E. Hirvensalo, J. Mäkinen and P. Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

The overall results so far reported of patient series managed using absorbable internal fixation devices made of polyglycolide or lactideglycolide copolymer have been favorable. However, approximately 6 % of the patients have developed a local inflammatory reaction at the implantation site 2 to 4 months after the operation. The purpose of this study was to elucidate the nature of these reactions.

Patients and methods: Absorbable rods made of polyglycolide or of lactideglycolide copolymer were used in the internal fixation of a variety of fractures and osteotomies in 516 patients.

Results: A clinically manifest non-bacterial inflammatory reaction occurred in 41 patients (8 %). The reaction made its appearance as a local fluctuant swelling at the implantation site 12 weeks after the operation on an average. Spontaneous sinus formation discharged remnants of the degrading implants. With drainage the discharge subsided within three weeks. At histological examination, a typical non-specific foreign body reaction with abundant giant cells was seen. The reactions observed did not influence the functional or radiographic end results of the conditions managed.

Conclusions: It seems impossible to predict a clinically manifest foreign body reaction in an individual patient. But recognizing the incidence and the features of the phenomenon is necessary as implants made of absorbable synthetic polymers are increasingly being used in orthopaedic surgery.

107. Shear strength of cancellous bone after osteotomy fixed by biodegradable implants made from PGA and PLLA: Experimental study on rabbits

M. J. Manninen, U. Päivärinta, J. Mikkola, H.-M. Lähde, P. Törmälä, H. Pätiälä and P Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Helsinki, Finland Tampere University of Technology and Biomaterial Laboratory in Institute of Plastics Technology, Tampere, Finland

It has been revealed in many histological, histomorphometrical, OTC-fluorescent, and microradiographical studies that new bone modelling and calcification are normal after fixing cancellous bone osteotomies with biodegradable polyglycolic acid (PGA) or polyL-lactic acid (PLLA) rods. The purpose of this study was to find out if there is any difference in cancellous bone healing after osteotomy fixed with biodegradable rods compared with classical metallic rod fixation.

Material and methods: The right distal femurs of 42 adult rabbits were osteotomized and fixed with two Ø 1.5 mm metallic rods (Kirshner-rods), PGA rods (Biofix CG), or PLLA rods. There were 14 animals in each group, 10 for shear strength studies and 4 for OTC-fluorescent and microradiographical studies. Follow-up times were 6 and 12 weeks.

Results: The shear strength of the osteotomized femurs was compared with the nonosteotomized control-femurs (30 rabbits). There was no remarkable difference in shear strength values between these groups (table below).

In radiographic examination (42 rabbits), it was found that all fixations had succeeded. In radiographic and microradiographic (12 animals) studies, extemal callus formation was strongest in PGA-group.

Conclusion: The shear strength of the healing cancellous bone after experimental osteotomy is as good with the SR-PGA and SR-PLLA rod fixation as with the classical metallic rod fixation. It seemed radiographically that the PGA rods did not keep the fixation as exact as the metallic and PLLA rods.

Table: Shear strength (mean MPa) of osteotomized and control femurs

Fixation	A	B	C	A	B	C
Follow-up (weeks)	6	6	6	12	12	12
Number of animals	5	5	5	5	5	5
Osteotomized femur	4.3	3.7	4.0	4.9	5.9	4.2
Control femur	6.0	5.4	5.6	6.7	7.4	5.8
Ratio (percentage)	72	69	71	76	80	73

A Metallic rod, B Polyglycolic acid rod, C Poly-L-lactic acid rod.

108. Fixation of mandibular osteotomies with self-reinforced polylactide srews and plates: An experimental study in sheep

Riitta Suuronen, Seppo Vainionpää, Laura Wessman, Jarkko Vasenius, Matti Mero, Esa Partio, Kimmo Vihtonen, Pertti Törmälä, Pentti Rokkanen and Valle Oikarinen

Department of Surgery, College of Veterinary Medicine, Helsinki, Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Helsinki, Institute of Plastics Technology, Tampere University of Technology, and Department of Oral Surgery, Institute of Dentistry, University of Helsinki, Finland

Mandibular fractures requiring surgical treatment are nowadays fixed with metallic devices with or without intermaxillary fixation. Fixation of fractures of cancellous bone with biodegradable rods has given good clinical results which encouraged us to study the possibility of biodegradable fixation of mandibular fractures.

Methods: A total of 36 osteotomies of sheep's mandibular condyle and corpus were fixed (respectively) with biodegradable selfreinforced poly-L-lactide (SR-PLLA) screws or SR-PLLA-plates with metallic screws. In the control group (36) similar metallic screws and plates were used. Two osteotomies in the condylar area were left unfixed.

Results: Early results of all experiments carried out clearly indicate that SR-PLLA-screws and -plates provide sufficient fixation for healing.

Conclusion: Based on these findings we found it worthwhile to continue developing a combination of SR-PLLA-screws and plates to be used together as a totally biodegradable fixation device.

109. Experimental lumbar interbody fusion with reinforced coralline hydroxyapatite: A radiologic analysis

P. Ylinen, S. Vainionpää, M. Raekallio, K. Vihtonen, R. Taurio, M. Mero, P. Törmälä and P. Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Institute of Plastic Technology, Tampere University of Technology, and Department of Surgery, College of Veterinary Medicine, Helsinki, Finland

Succesful use of porous coralline hydroxyapatite (HA) as a bone graft substitute has documented experimentally (1). It has recently become clinically available as filling device, e.g., in metaphyseal fractures of proximal tibia (2).

Because of brittleness of HA, it's use is limited to the regions where high mechanical strength is not required. To overcome this disadvantage the outer surface of HA blocks was reinforced with polylactide composite fibres seated in grooves in 2 mm distance (3). An experimental ventral lumbar interbody implantation was performed with growing pigs. The purpose of this study was to examine the strength

of implants and their performance as a scaffold for creeping bone formation.

Materials and methods: Twenty three growing pigs averaging 17 kg were operated on. The pigs were laparotomized and the lumbar spine was exposed. The anterior longitudinal ligament was preserved and one of the lumbar intervertebral disc spaces was evacuated. The end plate cartilages were excised to the subchondral cancellous bone of the vertebrae. Reinforced HA block 3 x 8 x 12 mm (Interpore 200 TM) in size was then inserted into the disc space. The anterior longitudinal ligament was restored to keep the block in place. The pigs were killed at 3, 6, 12 and 16 weeks. Radiographs in A-P and lateral projections were taken postoperatively and after sacrifice. Four pigs were operated on as a control in which the disc space was evacuated in a similar manner without implantation.

Results: Twenty one pigs were analyzed, two died from postoperative complications. All the implants were kept in place. A zone of resorption (0.5–1.0mm) was radiographically seen around the implant at 3 weeks and remained up to 16 weeks. Radiographically, the implant was clearly visible throughout the study, but it's resorption was increased from 12 weeks up to 16 weeks. The implant showed some fragmentation from 12 weeks onward. Solid radiographic fusion was not revealed in any case. Gross examination confirmed minor mobility in every case.

References

1. Holmes R. Bone regeneration within a coralline hydroxyapatite implant. Plast Reconstr Surg 1979: 63; 626.
2. Bucholz R W, Charlton A, Holmes R. Interporous hydroxyapatite as bone graft substitute in tibial plateau fractures. Clin Orthop 1989; 240: 53.
3. Törmälä P, Taurio R, Pellinen M, Ylinen P, Vainionpää S. Reinforcing of porous hydroxylapatite blocks with polylactide composite. Trans. VII Internat. Conference of Polymers in Medicine and Surgery, Holland 1989.

110. Validity of pre-clinical design analysis relative to endurance of cemented THA

R. Huiskes

Biomechanics Section, Institute of Orthopaedics, University of Nijmegen, Nijmegen, Netherlands

Long-term clinical results of cemented THA are now frequently reported in the literature. Apart from indication and surgical parameters, the survival rates are evidently influenced by prosthetic design (1, 2). It is hypothesized that the effects of the design parameters are related to biomechanical factors. The purpose of this project was to investigate the relationships between THA stem shapes and stress patterns, in order to estimate the validity of preclinical numerical design testing.

Methods: A standardized FEM model was developed and applied to determine the load-transfer mechanisms of nine cemented stems. Included were the Müller Curved and Straight stem prostheses, the Charnley, Osteonics, Exeter, Precision and Scandinavian Hips, the DF80 and the SHP. Cement and interface stress patterns, and stress-shielding characteristics were determined for standardized loads. Effects of calcar resorption on the (secondary) stability were also studied.

Results: Cement and interface stresses, stress-shielding and "secondary" stability characteristics of the nine stems were found to be vastly different for the nine prostheses, emphasizing the significance of stem design. Cement and interface stresses were much higher for the Müller and DF80 prostheses, as compared to the Charnley, which also showed superior secondary stability. Clinical studies showed much higher survival rates of the Charnley, as compared to the Müller and DF80 designs (1,2).

Conclusions: The hypothetical relationship between survival rates and biomechanical factors of cemented hip-stem shapes is confirmed in this study. Numerical design testing, using FEM, is found to be a valid option for preclinical evaluation of prosthetic designs.

References

1. Herberts P, et al. Multicenter clinical trials and their value in assessing total joint arthroplasty. Clin. Orthop. 1989; 249: 48–55.
2. Robinson R P, et al. Early femoral component loosening in DF80 THA. J Arthroplasty 1989; 4: 55–64.

111. Revision hip arthroplasty for loosening using cementing techniques: Results from a Swedish multicenter study with a minimum of 5 years follow-up

Christer Strömberg, Peter Herberts and Bo Palmertz

Departments of Orthopaedics, East and Sahlgren Hospital, Gothenburg, Sweden

In a prospective study of total hip replacement in Sweden, the epidemiology of reoperations has been documented since 1979. From this nationwide register, the result of revision arthroplasty for aseptic loosening was evaluated in a defined patient population.

Material and methods: During the period January 1981 to January 1982, 252 nonrheumatoid patients aged 55–70 years (average 65) required first time revision arthroplasty for aseptic loosening. 202 patients (204 hips) were available for clinical and radiographic analysis with a minimum of 5 years follow-up (average 6.6 years). Prerevision bony defects were classified according to Gustilo.

Results: 56 hips had an unsatisfactory clinical result with Charnley-d'Aubigne score for pain < 3 or poor function. Radiographic mechanical loosening was noted in 69 hips (34%). 32 hips were rerevised, 24 hips because of aseptic loosening and 8 hips for other reasons. Calculated survival rate for the prostheses was 75% after 8 years. For the acetab-

ular component there was a significant correlation between pre-revision bony defects and mechanical loosening ($p < 0.01$).

Conclusion: 77 (38%) prostheses were mechanically loose or rerevised. Altogether 103 hips (51%) were radiographically loose, rerevised or had an unsatisfactory clinical result.

112. Multiple revisions of hip arthroplasty

Jens B. Retpen, Jens-Erik Varmarken, Niels D. Röck and J. Steen Jensen

Department of Orthopaedics, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

Clinical outcome of first time cemented revision THA is potentially as good as that after primary THA, but final results are deteriorated by high rates of complications and further failure. In this study we analyze results of second revisions with special emphasis on complications, risk of further failure and clinical outcome, in relation to results after first revisions. By January 1987, 49 of 306 first revisions, performed within the preceeding decade, had been revised a second time with exchange of one or both components. Outcome of these 49 cemented revisions have been measured by January 1990. Rate of complications, i.e., peroperative fracture, postoperative dislocation, and deep infection, was noted.

Risk of further failure was analyzed using survivorship analysis.

Clinical outcome, i.e., pain and function, was evaluated using a 0–5 points pain grading scale and the Functional Outcome Scale (FOS). Results were compared with the corresponding findings after first revisions. Rates of complications were equal after first and second revision, 24% and 22%.

16/49 were revised again (exchange of components) and 5/49 were reoperated, (osteosynthesis of femoral fracture, open reduction, house-cleaning). Total risk of failure (revision or re-operation) within 48 months was 40%. Risk of further revision within 48 months was 28% compared to 12% after first revision.

Aseptic loosening of component revised twice before occurred earlier as compared with components revised once before. After second revision, 10/19 were without pain compared with 95/141 after first revision ($p = 0.3110$); 4/19 achieved maximum FOS score compared to 89/141 ($p = 0.0019$)

Conclusion: Results after a second cemented revision THA are further deteriorated as compared with results after first cemented revision THA.

113. Allografts in the repair of bony defects in hip revision surgery

Gunnar Follerås, Arnulf Hagen, Paul Lereim, Ingjald Bjerkreim and Jahn Pahle

Sophies Minde Orthopaedic Hospital and Oslo Sanitetsforenings Reumatismehospital, Oslo, Norway

After repeated hip prosthesis surgery, the fixation of the new prosthetic components can be very difficult, often resulting in a Girdlestone hip. This increasing problem is encountered both in rheumatoid and arthrotic patients. In SMOH we have employed material from our bank for osteoarticular allografts, to reconstruct the bone-deficient pelvis and proximal femur.

Patients: 6 patients with mean age 64.5 yrs, observed mean 6 months (1–15) were operated on. Two patients had defects chiefly in the pelvis, three in the proximal femur, and one on both sides.

Methods: The pelvic defect was replaced with an alloacetabulum configured to match the defect, screwed to the pelvis, and a standard polyethylene cup was cemented into the alloacetabulum. The deficient femoral bone was replaced with an allofemur, in two cases plated to the distal femur, and in two cases placed inside a big, egg-shell like cavity. A long stem femoral component was cemented into the construction.

Results: One patient had secretion from the wound for 4 weeks, no bacteria could be cultured. All hips are radiographically stable. The function of the hips are all good.

Conclusion: The methods described are good alternatives to a Girdlestone end-stage procedure. The short term results are encouraging.

114. Elderly patients' response to preoperative autologous blood donation

Hans Fredin[1], Awad A. R. Alawad[1], Svante Jonsson[2] and Martin Laurell[3]

Department of Orthopaedics[1], Transfusion Medicine[2] and Clinical Chemistry[3], Malmö General Hospital, Malmö, Sweden

60 patients with an average age of 71 (60–82) years underwent preoperative phlebotomy prior to total hip replacement. One group had iron substitution, another group was given iron and folic acid substitution and the third group was without substitution during the phlebotomy period. Blood was donated on three oocasions, starting at an average time of 34 days before the operation, with an average interval of 11 days. One patient was unable to donate, due to inadequate venous access. 44 patients donated 3 units each, except for 2 patients who donated 2 units each. Thus the total number of units donated was 130 units.

No complication was encountered with phlebotomy. The patients were enthusiastic and tolerated the procedure very

well, also the substitution remedies. Hemoglobin, hematocrit, S-Fe and S-Ferritin dropped in the autologus predeposit group as compared to the control grop, but the values remained within the normal range for these parameters as well as all other parameters studied.

Conclusion: Preoperative blood donation in the elderly is safe and well tolerated. The procedure should be encouraged in elective surgery requiring blood transfusion, since it elimimates the risk encountered with homologous blood transfusion and contributes to the community blood supply.

115. Predeposit autologous blood in elderly patients undergoing hip arthroplasty

Awad A. R. Alawad[1], Hans Fredin[1], Svante Jonsson[2] and Martin Laurell[3]

Departments of Orthopaedics[1], Transfusion Medicine[2] and Clinical Chemistry[3], Malmö General Hospital, Malmö, Sweden

In a prospective randomized study, a total of 130 units of blood were deposited by 45 patients prior to total hip replacement. Fifteen patients served as controls (no phlebotomy). The average age of the patients was 71 years (range 60–82). No major complication was encountered with phlebotomy. All the patients were able to maintain their hematologic and biochemical parameters within the normal range throughout the period of donation. The autologous blood covered all the peroperative transfusion needs for the patients in the autologous group. It also accounted for 97% of the total transfusion requirements. There was a significant difference in the postoperative blood loss ($p < 0.001$) as well as the total blood loss ($p < 0.01$) between the autologous groups and the homologous group. There was no difference in the rate of postoperative complications between the groups.

Conclusion: We recommend the use of predeposited autologous blood in elective orthopedic operations, regardless of age, since it proves to be feasible cost effective and avoids the risks associated with homologous blood transfusion.

116. Tibia vara due to focal fibrocartilaginous dysplasia

Mohammed Zayer

Department of Ortopaedics, Ängelholm Hospital, Sweden

The condition is characterized by severe unilateral tibia vara in early childhood with a typical radiographic appearance which reveals a cortical defect in the area between the metaphysis and diaphysis of the medial proximal tibia and a surrounding area of sclerosis. Bell et al (1985) called the lesion "focal cartilaginous dysplasia" because in two cases the biopsy showed dense hypocellular tissue resembling fibrocartilage in some areas and tendon in others. The etiology is obscure. Only eight cases are reported in the literature; three by Bell et al (1985) and five by Bradish et al (1988).

Bell et al. (1985) suggest that the mesenchymal anlage of the tibial metaphysis has, for unknown reasons, developed abnormally at the insertion of the pes anserinus. Langenskiöld (1985) found a similarity between the lesion and his previous experimental work on rabbits in (1949). He provoked a localised damage to the epiphyseal line by help of radiography. Langenskiöld suggests that a kind of necrosis to the medial epiphyseal line after delivery trauma could be the predisposing factor with later regeneration and a diaphyseal defect. An analysis of the eight previously reported cases plus the two studied by the author shows early that the clinical, radiographical and histological features are identical, and that the treatment should be conservative. Unilateral tibia vara may be seen in Mb. Blount, which is a growth disturbance involving the metaphysis, physis (epiphyseal line) and the epiphysis of the posteromedial part of proximal tibia (Zayer 1973), while FFD is a cortical defect outside the growth area with severe varus, which is always unilateral and never shows the features of other conditions such as Ollier's disease, neurofibromatosis or trauma.

117. Deformities of the lower extremities in diastrophic dysplasia

Soini Ryöppy, Mikko Poussa, Juhani Merikanto, Eino Marttinen and Ilkka Kaitila

Children's Hospital and Department of Medical Genetics, University of Helsinki and Orthopaedic Hospital of Invalid Foundation, Helsinki, Finland

Diastrophic dysplasia is a rare autosomal recessive skeletal dysplasia with severe short-limbed stature, generalized limitations of joint movements and various deformities of the skeleton. Because of its exceptionally high prevalence in the Finns (1:32,600) it has been possible to evaluate 105 of the known 151 patients in Finland.

Patients and methods: The data was obtained partly from hospital records and partly from personal examination. Of the 105 patients 60 were females ad 45 males. The age range was from newborns up to 79 years.

Results: Hip. The main clinical abnormalities are limitation of extension, abduction and rotation, the flexion deformity being the most significant from the clinical point of view. The range of extension could be registered in 90 patients. It was limited by less than 15° in 13, by 15°–30° in 29 and > 30° in 48 patients. Radiographically the deformation of the joint seems to increase with the age giving the impression of deformation of the "soft" femoral head as the cause of mechanical stress.

Knee. The data for analysis was sufficient in 92 patients. Twelve patients had no obvious deformity. Twelve had flexion contracture, 24 anteroposterior instability, 10 anterior dislocation of the tibia, 14 instability in varus-valgus direction and 70 had valgus deformity. There were more than one abnormality in the majority of knees and in 17 patients the deformity was asymmetrical. A severe valgus deformity was often combined with dislocation of the patella

Foot. The type of the primary deformity could be registered in 102 patients. In altogether 204 feet 14 feet had no clinical deformity, 17 had equinus deformity, 59 equinovarus combined with metarsus adductus, 88 tarsal valgus deformity combined with metatarsus adductus and 26 had only metatarsus adductus.

Conclusion: The material is large enough to reveal several new details of this rare syndrome. Considering the fact that altogether 284 orthopaedic operative procedures have already been performed on these 105 patients, all additional information is useful for planning the treatment.

118. Spine in diastrophic dysplasia

Juhani Merikanto[2], Mikko Poussal[1], Soini Ryöppy[2], Eino Marttinen[2] and Ilkka Kaitila[3]

The Orthopaedic Hospital of the Invalid Foundation[1], Childrens Hospital, University of Helsinki[2], Department of Medical genetics, University of Helsinki[3], Finland

Diastrophic dysplasia is an autosomal, recessive disorder of the skeleton, characterized by disproportionate short stature, generalized joint deformities, club feet, deformed ear pinnae and frequently spinal deformity and cleft palate. To find out the types and frequencies of spinal deformities, early signs in progressive cases and to follow the natural history of the disease, 58 female and 43 male patients were studied. At the follow-up study, 17 patients were below the age of ten, 21 below the age of 21 and 63 older than 21 years.

One third of the patients had cervical kyphosis, which in three patients resolved spontaneously before the age of five years. The overall frequency of scoliosis was 38 percent; 49 percent in females and 22 percent in males. Only 13 patients had curves exceeding 50° and these curves comprised distinct rotation at the apex from the early evolution of the curve. The early signs of these severe curves were detectable at the age of 2–4 years. Only two patients were operated on because of scoliosis; one with fusion in situ and the other with the pediatric CD-instrumentation. Three patients had a brace, which did not stop the progression of the curve. Symptoms referring to narrow spinal canal were registered in four patients, two of those were operated; a lumbar decompressive procedure was made at adult age.

119. Place of expanding intramedullary rods in osteogenesis imperfecta

M. J. Bell, I. Stockley and W. J. W. Sharrard

Department of Orthopaedics, Sheffield Children's Hospital, Sheffield, England

Multiple osteotomies and intramedullary rodding for the surgical treatment of osteogenesis imperfecta was first described 30 years ago. Initially only fixed length rods were used, but problems arose when the child outgrew the rod, as angulation or fracture occurred at the site of unsupported bone.

Over the last eight years, an expanding intramedullary device has been used in Sheffield. Initially this was the Bailey-Dubow rod, but problems with this have led to the development of the Sheffield rod system.

Twenty-four children, 11 girls and 13 boys have undergone intramedullary rodding with expanding rods at the Sheffield Children's Hospital. The indication for surgery in all patients was the correction of deformities and stabilization of fractures with the aim of promoting patient mobilization. Their mean age at insertion of the first rod was 8 (2–14) years and the operative follow-up averaged 5 (1–8) years. One hundred and seventeen operations on 83 bones have been performed. The mean number of operations per patient was 4.9 and the maximum 10. Forty-two femora, 39 tibiae and two humeri were rodded; 66 with Bailey-Dubow rods and 17 with Sheffield rods. Of the remaining 34 operations, 11 were corrective osteotomies for rotation and angulation deformities and 23 for complications of the rod or T piece, a revision rate of 28%.

Before surgery, the majority of patients were confined to a wheelchair and 12 had never walked. However, at review 23 children were walking.

Relative elongation of the rod had occurred in 62 rods. No growth disturbances or premature closure of epiphyses have bee seen radiographically.

Half of the children have sustained no further lower limb fractures since surgery. Five of the other 12, actually sustained their fractures whilst walking.

Problems with the rods tended to be in small or very young children. However, 62% of all the expanding rods inserted have elongated after one primary operation. The advent of the Sheffield rod system may expect to further reduce the number of complications, as the T piece is fixed and cannot become loose as occurs with the Bailey-Dubow rod.

We believe that expanding intramedullary rods should be available to all children with osteogenesis imperfecta as they reduce the incidence of fractures, prevent deformity from occurring, improve walking capability, and allow integration of the child into society.

120. Magnetic resonance imaging of the brain and spinal cord on idiopathic scoliosis

Lars Samuelsson[1], Dan Lindell[2] and Heinz Kogler[1]

Departments of Orthopedic Surgery[1] and Diagnostic Radiology[2], Örebro Medical Center Hospital, Örebro, Sweden

The brain and spinal cord were examined with magnetic resonance (MR) in patients with adolescent idiopathic scoliosis (AIS) to study the prevalence of brain-stem and spinal cord anomalies with special attention to cerebellar herniation and syringomyelia.

Patients: Twenty-one females and 4 males classified as having AIS, age range 10–36 years, mean 13±4 years and with a mean Cobb angle of 29° at first examination were studied. Their curves were thoracic in 15 cases, thoracolumbar in 3, lumbar in 3 and 4 were double curves. Twenty patients had been braced, 1 was operated on according to Harrington while 4 were not treated.

Method: MR was performed using a 1.0 Tesla superconducting magnet (Siemens Magnetom) using a spin-echo technique with T1-weighted images (TR = 600msec and TE = 15 msec). The brain-stem and cervical cord were examined with 15 sagittal scans of 4 mm thickness. The dorsal and lumbar spinal cord were examined with 34 continuous axial scans of 10 mm thickness. The examination time for each patient averaged 1 hour.

Results: Two patients had syringomyelia. One syrinx was situated at the C6–C8 level and the other between D6–D8. Both were centrally located and on sagittal scans somewhat irregular in shape. In another 2 patients, the lowest parts of the cerebellar tonsils were located 5 mm below the foramen magnum but not of the typical peg-like shape as in Chiari I malformations. No patient had any neurological symptom or sign which could be referred to the abnormalities.

Conclusion: Scoliosis associated with syringomyelia may not be as rare as previously thought and may wrongly be classiffed as AIS. Its natural history probably differs from AIS with regard to curve progression which may affect treatment. A small syrinx in a young person may enlarge and cause late neurological impairment. Sensory disturbances and pain as early symptoms of a syrinx should be looked for and MR of the spinal cord is diagnostic.

121. Comparison of two measurements of vertebral rotation in scoliosis

Ulric Willers[1], Rune Hedlund[1] and Lars Westman[2]

Departments of Orthopaedic Surgery[1] and Diagnostic Radiology[2], Huddinge University Hospital, Stockholm, Sweden

The rotational component of the scoliotic deformity has attracted more interest with the advent of new instrumentations with improved potential for rotational correction. Different measurements based on radiographs, CT, and sonography have been used. The purpose of the present study was to investigate the correlation between measurements made on CT and the Perdriolle pedicle angle of rotation (PA) based on radiographs. The purpose was also to estimate the precision of the measurement.

Method: In 22 patients operated with Harrington instrumentation for scoliosis the rotation of the apex vertebra was measured preoperatively, immediately postoperatively, and 10 years postoperatively. The rotation was measured on CT using the rotational angle of the vertebral body to the sagittal plane (RAsag) and to the sternal midpoint (RAML). The PA was measured independently by two observers.

Results: The correlation coefficient between the RAsag and RAML was 0.75 ($p < 0.01$), between the RAsag and the PA it was 0.61 ($p < 0.01$) and between RAML and PA it was 0.70 ($p < 0.01$). The interobserver precision of the PA measurement expressed as the coefficient of variations was 6.7% in preoperative radiographs, 15.2% postoperatively, and 12.0% 10 years postoperatively.

Conclusion: The PA was only moderately correlated to CT measurements and may not be a sufficiently strong predictor of the torsional deformity as measured on CT. The PA was measured with acceptable precision in preoperative radiographs. The less precise postoperative measurements are explained by interference by the rod and the fusion mass.

122. Leg lengthenings in Uppsala

Björn Tjernström, Sven Olerud and Göran Karlström

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

Totally, 21 patients, aged 6–36 years have been lengthened by the Ilizarov/DeBastiani technique in Uppsala since 1984.

Two patients have had both femurs and tibias lengthened due to short stature (< 140 cm). One patient has been lengthened twice and another 2 have had previous Wagner lengthenings. In all, 27 segments (12 femurs and 15 tibias) were lengthened between 3 and 18 cm. Achilles tendon lengthenings have been done due to equinus on most tibia lengthenings.

Pin tract infections are common but not dangerous. During treatment, all patients have impaired range of motion in hip, knee or ankle joints, but it is normalized after removal of the fixator. There is a risk of joint dislocation. During lengthening there is a great risk of angular deformity, which is easier controled with a circular frame. Two fractures were treated by bone grafting and internal fixation after lengthening.

Gradual leg lengthening after corticotomy is a rather safe method to correct leglength inequality of more than 3cm. Both patient and doctor must be devoted, and be well aware of that the treatment is time consuming and potentially dangerous.

123. Dynamic ultrasound evaluation in late-discovered congenital hip dislocation

Terje Terjesen

Department of Orthopaedic Surgery, Trondheim University Hospital, Trondheim, Norway

The purpose of the present study was to evaluate the potential for dynamic ultrasound in the primary evaluation and treatment of late-discovered congenital hip dislocation.

Patients and methods: During 1986–1988, 16 consecutive patients with subluxation (7 patients, mean age 6 months) and dislocation (9 patients, mean age 12 months) were examined by real-time ultrasonography. On the longitudinal scan from the lateral aspect, the distance from the lateral tangent of the femoral head to the lateral bony acetabular rim was measured (lateral head distance, LHD). The patients were examined without anesthesia before treatment was started and under general anesthesia after a period of traction. Dynamic ultrasound evaluation was applied in order to observe whether the hip could be reduced by gentle manipulation.

Results: The mean LHD in the neutral position was 7.6 mm in subluxation and 14.3 mm in dislocation. By flexion, abduction, and varying degrees of internal rotation, closed reduction guided by ultrasound was achieved at the primary examination in all the patients with subluxation and 6 of the 9 patients with dislocation. Primary reduction was not obtained in the 3 oldest patients; however, in 2 of them (25 and 26 months of age) closed reduction was achieved under general anesthesia after a period of traction.

Conclusion: Important information with regard to decision making was obtained, even at the initial examination, by dynamic ultrasound. The technique is suitable for guiding closed reduction and for assessing the stability of varying positions in children under 2 years of age. In older children, this evaluation is less reliable.

124. Treatment of congenital dislocation of the hip using the medial approach

Ali Baktir, Eyüp S. Karakas, Mahir Gülsen, Yildirim Türk

Department of Orthopaedic Surgery, Erciyes University, Kayseri, Turkey

Avascular necrosis of the ossification center of the femoral head and stiffness of the hip are well recognized complications of both closed and open reduction of congenital dislocation of the hip. Open reduction using the Ferguson medial approach is a simple, safe, effective and cosmetic method. The risk of avascular necrosis is also small.

Patients and methods: From January 1976 through December 1988, 71 hips with congenital dislocation in 43 children (32 girls and 11 boys) were subjected to open reduction via a posteromedial approach (Ferguson 1973). The average age was 13 months at operation and the average follow up was 6.4 years. The study was undertaken to determine if this method of treatment had any effect on the incidence of avascular necrosis of the femoral head and if there were preoperative factors predicting the outcome of treatment.

Results: The incidence of avascular necrosis was 4.2 % (3 hips). There were two early dislocations and at follow up eight subluxations. Over all, 90 % of the patients had successful results. Of the eight subluxations, six were operated on when the patient was more than twelve months old, with an acetabular index of 40 degrees or more.

Discussion: This study suggests that the most important factors affecting the postoperative results are the age at operation and the initial acetabular index. Patients, older than twelve months at operation with an acetabular index of 40° or more, have a high incidence of unsuccessful results after the Ferguson procedure.

125. The role of ultrasound on the irritable hip

Derek R. Bickerstaff, Lesley Neal, Anthony J. Booth and Michael J. Bell

The Sheffield Children's Hospital, Sheffield, England

We have investigated the incidence and natural history of the effusion seen in children vlith acute hip pain and brought into question the need for traditional radiography.

Methods: 111 children underwent ultrasound examination of their hips within 24 hours of presentation which was repeated at regular intervals until the effusion settled. AP pelvis and frog-leg lateral radiographs were also performed.

Results: An effusion was diagnosed by ultrasound in 79 (72%) patients but in only 17 (15%) by traditional radiography. The effusion persisted for 8.9 days (*SD 4.8*) on average with the symptoms lasting 5.1 days (*2.0*). All movements except abduction and external rotation were significantly restricted ($p < 0.001$). The capsular distension on admission was 6.3 mm (*2.0*) with the normal side being 2.6 mm (*0.8*). Two patients with Perthes' disease had a persistent effusion and symptoms. Probit analysis indicated that the duration of the effusion was uniformally distributed ($r = 0.97$). Hence, using the 95% confidence interval, the normal range was calculated as 2–24 days. Overall 6 patients (5%) had an effusion which persisted for longer the normal (including two with Perthes' disease). On average their effusion persisted for 32.7 ± 7.9 days with the symptoms settling by 7.2 ± 2.3 days. The mean size of the effusion at presentation was 7.8 ± 1.6mm which is significantly larger ($p < 0.05$) than the 6.2 ± 0.5mm occurring in the group whose effusion had settled by three weeks. This may be significant with regard to the development of avascular necrosis of the femoral epiphysis.

Conclusions: Radiography only affected patient management in the two new cases of Perthes' disease who had persistent effusions and symptoms and would therefore have been identified at follow-up. We conclude therefore that ultrasound should replace radiography as the initial investi-

gation of acute hip pain in children and have devised a management protocol.

126. Early signs of poor prognosis in Perthes' disease treated by intertrochanteric varus osteotomy

Timo Yrjönen, Mikko Poussa, Veijo Hoikka and Kalevi Österman

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

A total of 112 patients (126 hips) with Perthes' disease were studied. The treatment comprised intertrochanteric femoral varus osteotomy in every patient. In 20 patients (25 hips), the course of the disease was more severe than expected. The early radiographical criteria for this severe course were:

1. Lateral calcification extending far laterally towards the greater trochanter.
2. Deformation and widening of the femoral head before the fragmentation phase.
3. The Saturn phenomenon; a sclerotic epiphysis surrounded by a ring of looser bony tissue.
4. Deformation and widening of the femoral neck in the initial phase of the disease.
5. Early wide sclerotic changes in the metaphysis.

The overall results were poor. Two hips obtained a fair and 23 a poor results.

The radiographic changes described are readily recognized at an early phase of Perthes' disease and indicate poor prognosis. In these cases, varus osteotomy gave unsatisfactory results, which means that another type of treatment in these patients should be considered.

127. Free vascularized fibular graft in pediatric orthopedic problems

E. S. Heikkinen, P. Kinnunen, T. Raatikainen, W. Serlo and T. Waris

University Central Hospital of Oulu, Oulu, Finland

Since 1982 free vascularized fibular graft (VFG) was used in 14 children to substitute different kinds of defects in tibia, ulna, radius, humerus, and femur.

There were 8 girls and 6 boys. Only one patient was over 10 years of age at the operation, the youngest being 3 years old.

The cause of six tibial defects was congenital pseudarthrosis. The ulnar defects had been produced by major trauma in one patients and by hereditar osteochondromatosis in two patients. Replacement of the radius was performed in two cases. One had congenital aplasia of radius and the other a benign large cystic bone tumor. In one case, a 10-cm-long humeral defect after an elongation procedure was treated with VFG. Two girls with osteosarcoma in their distal femur were treated by a block resection and VFG substitute.

The lengths of the VFG's varied from 7 to 22 cm. The transplanted graft included the proximal fibular epiphysis in two patients. One had congenital aplasia of radius and the other had ulnar osteochondromas with distal defect. The vascular pedicle in one of these grafts consisted of peroneal vessels and in another of anterior tibial vessels. In both patients the growth plates had remained open after the operations, but exact evaluation of the growth potential of the grafts is not yet possible because of a rather short follow-up time.

Excluding the patients with femoral osteosarcoma, the results were good or fair. In most cases a solid bony union between the graft and recipient bone was achieved rapidly (2–5 months) and rehabilitation of the limb function was possible within a relatively short period of time, especially in the upper extremity problems. No complications or complaints at the donor limb were seen.

128. Swedish multicenter hip fracture study

K.-G. Thorngren[1], M. Berglund-Rödén[2], T. Dolk[3], 0. Johnell[4], J. Kärrholm[5] and H. Wingstrand[1]
Departments of Orthopedics in Lund[1], Sundsvall[2], Örebro[3], Malmö[4] and Umeå[5], Sweden

Since January 1988 a multicenter study of hip fractures in the elderly has been introduced in Sweden. This multicenter study is supported by the Swedish Orthopedic Society and the Swedish Medical Research Council. The aim of the project is to compare different methods of surgery, mobilization and rehabilitation in terms of efficiency, i.e., quality and cost. The study is successively expanding. For each region the study has started with the regional hospital, one central hospital and one more rural hospital, but for the majority of the regions several other departments are participating. The hip fractures are prospectively registered on standardized forms, which have been printed and distributed to all participants. The operating departments are registering the data concerning the hospital stay and also monitor the patient inquiry, which gives follow-up functional parameters at four months after the operation. At the registering department these data are put into a personal computer program and reportecd on date disks. Data programs with special application for this registration project have been compiled and distributed. The project now covers half of the Swedish hospitals. The goal is to successively increse the number of participating clinics to a complete registration of all hip fractures occurring in Sweden within the next few years. At present, the number of hip fractures in Sweden average 15,000 per year.

The study gives many interesting data for comparison. To examplify this, figures are here given from the hip fractures (both cervical and trochanteric) registered in 1988 in Lund, Sundsvall and Örnsköldsvik. Geographic as well as structu-

ral differences exist between these hospitals. Lund is situated in southern and the other two in northern Sweden (about 1 000 km apart). All the hospitals serve a geographically defined population.The figures given are thus, consecutive and population based without exclusions.

There were totally 232 fractures registered in Sundsvall, 116 in Örnsköldsvik (both nothern Sweden) and 325 in Lund (southern Sweden). The patients mean ages were 79, 77 and 79 years, respectively. Three out of four were women.

The majority of the cervical (femoral neck) fractures were operated on with two screws according to von Bahr in Sundsvall, whereas Örnsköldsvik and Lund used hook-pin osteosynthesis. For the trochanteric fractures Sundsvall used Ender nailing, whereas sliding screw with plate was predominating in Örnsköldsvik and Lund. Direct weightbearing was applied in all hospitals. The mean hospitalization time at the orthopedic department was 21 days in both Sundsvall and Örnsköldsvik and 16 days in Lund. The hospital stay was in all instances longer for the trochanteric than for the cervical fractures, e.g., 24 versus 17 days in Sundsvall, 31 versus 16 days in Örnsköldsvik, and 18 versus 14 days in Lund. Of patients coming from own home, 69% in Sundsvall could return directly home from the orthopedic department, 75% in Örnsköldsvik and 50% in Lund. Geriatric rehabilitation or nursing home was used by 9% in both Sundsvall and Örnsköldsvik and by 15% in Lund. Convalescence home was used by 15% of the patients in Lund but hardly in Sundsvall and Örnsköldsvik.

In the studied areas the structure for taking care of elderly differs, which has influence on the referral pattern. In recent years the availability of nursing home facilities, administered through the primary care system, has increased in Lund. In Sundsvall, the majority of the primary care resources have been concentrated on home care facilities.

Participants from other countries are welcome into the project. English versions of the forms have been printed and already sent out to several centers in differents countries. For example, in the Netherlands the Rotterdam area is already participting. This multicenter project will give gathered information more rapidly, of benefit for the future treatment of the hip fracture patients.

129. Femoral head blood flow in proximal femoral fractures: An analysis using intraosseous pressure measurement

W. M. Harper, M. R. Barnes[1] and P. J. Gregg

Departments of Orthopaedic Surgery and Medical Physics[1], Leicester, England

Fifty patients with proximal femoral fractures, 33 intracapsular and 17 extracapsular, were studied. Intraosseous pressure was used as a method of indicating bone blood flow and was measured with a catheter tip transducer introduced through a guide wire hole in the lateral femoral cortex.

Intracapsular pressure was measured with an extracorporeal blood pressure transducer via a needle introduced into the hip joint. Mean intracapsular pressure was 30.0 mmHg (±47.5) in intracapsular fractures and 23.1 mmHg (±39.1) in extracapsular fractures.

Mean femoral head intraosseous pressure before aspiration of the hip joint in extracapsular fractures was 49.1 mmHg (±18.3) with a mean pulse pressure of 7.9 mmHg (±4.4); following aspiration this increased to 49.9 mmHg (±19.9) with a pulse pressure of 7.8 mmHg (±4.6) (NS).

In intracapsular fractures, intraosseous pressure in the femoral head before aspiration was 45.0 mmHg (±26.8) and pulse pressure 5.2 mmHg (±5.9). After aspiration, mean intraosseous pressure fell to 40.4 mmHg (±20.0) and pulse pressure rose to 5.8 mmHg (± 5.8). For both mean and pulse intraosseous pressure these were significant differences at the $p < 0.05$ level.

These results suggest that the increase in pulse pressure and fall in intraosseous pressure represent an increase in femoral head blood flow secondary to relief of the tamponade effect of the intracapsular fractures of the femoral neck.

130. Hip fracture in the middle-age in men

Brynjolfur Jonsson, Olof Johnell and Ingemar Sernbo

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

In Malmö, Sweden, the age specific incidence of trochanteric hip fractures among men aged 50–60, has increased significantly from 0.22 per 1,000 residents in the 1950s to 0.58 per 1,000 in the 1980s. The incidence of cervical hip fracture among men and women and among trochanteric hip fracture among women in the same age group did not increase significantly during the same period of time.

From 1980 to 1985, we have analyzed the background factors among the 87 men, aged 50–64, at the time of the hip fracture. 48 men with trochanteric hip fracture significantly more often lived alone at the time of fracture, had a history of alcohol abuse, were early retirement pensioner, and had previously sustained a fracture elsewhere more often compared with middle-aged men with a cervical hip fracture. We also found that among middle-aged men with trochanteric hip fracture less severe trauma was involved, lower creatinine and hemoglobin values were measured at the admission to our hospital and the men were slender compared with the middle-aged men with cervical hip fracture.

Alcoholics and early retirement pensioners could be regarded as a risk group for sustaining a hip fracture. We should be more aware of the social effect after early retirement. To some extent, the increase of the incidence of trochanteric hip fracture in middle-aged men could be explained by alcohol abuse.

131. A prospective randomized trial in trochanteric hip fractures treated with compression hip screw with and without locking and compression of the lag screw

Ingmar Sernbo, Olof Johnell, and Anne Gärdsell

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

In a previous randomized study on 200 trochanteric hip fracture patients, we have shown that the compression hip screw (CHS) is superior to Ender nailing due to the high rate of secondary operation in the Ender nailing group. The objective of this study was to evaluate technical improvement of the CHS implant.

Material and methods: 200 patients with trochanteric hip fracture, 63 men (mean age 75) and 137 women (mean age 82) were randomized by drawing a sealed envelope when the patient was on the operating table. The patients were randomized to have a key and compression screw of the lag screw or not. Background factors were noted, as well as position of the implant, and radiographs were taken immediately postoperatively after 1 month and after 4 months.

Results: No differences were found between the two randomized groups regarding background factors and position of the implant. There was, however, after 4 months significant differences regarding the length of the lag screw—the compression—in women and mainly over the age of 80 and mainly in the more osteoporotic women. There were also differences regarding nonunion and varisation of the fracture after 4 months. In a stepwise logistic regression model it was shown that the distance between the tip of the lag screw and the joint space was a significant factor regarding nonunion and varisation of the fracture.

132. Femoral neck fractures: A prospective randomized comparison of von Bahr and Uppsala screws

Lars Rehnberg and Claes Olerud

Department of Orthopedics, University Hospital, Uppsala, Sweden

In a prospective randomized study the so-called Uppsala technique for internal fixation of femoral neck fractures was compared with the traditional technique of our department, the von Bahr technique. The series consisted of 222 consecutive patients, 167 women and 55 men, with a mean age of 80 (±8) years. Half of the patients were randomized to each treatment group. After two years, 21 failures occurred in the Uppsala group compared with 4 in the von Bahr group ($p < 0.01$). Of 130 patients without pain at the 4-month control, 22 (17%) developed failures, compared with 34 (88%) of the 39 that had pain at this time ($p < 0.001$). Late failures seems to occur mainly among patients with pain at the 4-month control. Follow-up radiography is only indicated in patients with pain at 4 months.

133. Unstable intertrochanteric and subtrochanteric femoral fractures treated with gamma nail

Arne Ekeland, Jan Benterud, Knut Strømsøe and Antti Alho

Orthopedic Service, Surgical Department, Ullevål Hospital, University of Oslo, Norway

Unstable intertrochanteric and subtrochanteric femoral fractures treated with hip compression screw are prone to a telescoping dislocation with medial displacement of the distal fragment and shortening of the leg. The newly introduced gamma nail may prevent this telescoping dislocation and still allow weight bearing of the operated leg.

Material and methods: During the period Jan. 1989–Jan. 1990, 20 patients with unstable intertrochanteric and subtrochanteric femoral fractures have been operated with the gamma nail. Twelve of the patients were women and 8 were men. The median age was 79 (33–96) years. Four of the operations were reoperations. In 2 cases, a primarily introduced hip compression screw had resulted in a telescoping dislocation of the fracture and pain. Two patients received the gamma nail as the third operative procedure after two occasions of fatigue of a 95° condylar plate.

Results: Postoperative radiographs disclosed good position of the fragments in all but 2 patients where a ventral dislocation of the proximal fragment was observed. One of these patients was reoperated with additional cerlage. One patient died 4 days postoperatively from a pulmonary embolus. Another suffered a femoral shaft fracture 6 weeks after the operation due to an adequate trauma. Twelve of the fractures healed in good position after about 3 months. The remaining fractures are presently less than 3 months old.

Conclusion: Preliminary experiences with the gamma nail on unstable intertrochanteric and subtrochanteric fractures are good.

134. Treatment of trochanteric hip fractures: A comparison between Ender nails and compression hip screw

Ingemar Sernbo and Olof Johnell

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

Material: From July 1983 to December 1985, 534 hip fractures treated with Ender nails or compression hip screw (CHS) were studied consecutively and prospectively. All patients alive (except 5) were followed and clinical and radiographic examinations were performed 6 months postoperatively.

Results: When we compared Ender pinning of the 216 stable vs 117 unstable trochanteric hip fractures, we found significantly better results among the stable fractures treated with Ender pinning regarding time of operation and fluoroscopy, bleeding, limb length shortening, external malrota-

tion, varisation of the fracture, and the need of walking aids. We also found a significantly lower number of secondary operations in the stable group. Among the stable trochanteric hip fractures we found significantly longer time of operation and more bleeding in the CHS group compared to Ender pinning. On the other hand, we had higher number of secondary operations, more patients complaining of pain above the knee or hip on palpation and increased outward rotation in the Ender group compared with the CHS group among stable fractures.

Conclusion: We had better results after Ender nailing of stable vs unstable trochanteric hip fractures, but fewer technical complications with the CHS method in stable trochanteric hip fracture. Our recommendation regarding the method of choice for treating a trochanteric hip fracture is therefore a compression hip screw.

135. Hansson pins vs Uppsala screws in treating femoral neck fractures

Einar Hellqvist, Claes Olerud and Lars Rehnberg

Department of Orthopaedics, University Hospital, Uppsala, Sweden

In a prospective randomized study, the Hansson pin technique for internal fixation of femoral neck fractures was compared with the so-called "Uppsala screw technique". The series consisted of 137 consecutive patients, 114 women and 23 men, with a mean age of 80 ± 9 years. Sixty-seven patients were allocated to the Hansson pin technique and 70 to the Uppsala screw technique. After one year, 22 patients had died, 8 in the Hansson pin group and 14 in the Uppsala screw group (not significant). Twenty-four complications had occurred, 18 in the Hansson pin group and 6 in the Uppsala screw group (highly significant). After exclusion of the complications the remaining patients in the Hansson pin group had significantly more pain, less mobility, and a smaller proportion of the patients were back in their own home both four and twelve months after the injury.

Conclusion: The Uppsala screw technique seems to be more favourable than the Hansson pin technique in treating femoral neck fractures.

136. Treatment of intertrochanteric fractures: Dynamic Hipscrew versus Ender nailing technique

S. Nungu, C. Olerud and L. Rehnberg

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

220 patients with intertrochanteric fractures were randomized to either DHS-fixation or Ender nailing. Randomization was carried out through a closed-envelope technique, by the casuality officer on call at the emergency department. 119 DHS and 101 Ender nailing operations were done. The mean age was 81 ± 10 years, 3/4 of the patients were females and they were 2–15 years older than the males (95% CI, $p = 0.06$).

Patients were evenly distributed amongst the techniques as far as to age, sex, fracture type, bone quality and time interval beteen admission and operation. Operation time for the DHS-group was 70–80 and the Ender group 60–70 ($p = 0.044$), while peroperative bloodloss was the same. Acceptable reduction and positioning of osteosynthesis materials was of the same magnitude in both groups. The patients were followed up for one year and all complications were continually registered. Two DHS and one Ender nailing developed a deep infection. First year mortality was the same in both groups (31%). 20 complications were recorded in the Ender group compared with 9 in the DHS ($p = 0.007$).

Conclusion: DHS-operated patients regained their prefracture status with less complication risk than Ender nailed patients.

137. Femoral neck fractures treated with the Monk hardtop hemiarthroplasty

Kristian Høy, Carsten Juhl Terkelsen and Kjeld Søballe

Department of Orthopaedic Surgery, Kolding Hospital, Denmark

The purpose of this study was to evaluate the results and complications after Monk hip bipolar hemiarthroplasty 3 years after surgery.

Results: During the period from January 1983 to December 1986 152 Monk prostheses were inserted in 145 patients. Median age at operation was 80 (55–96) years. All prostheses were implanted without cement, and the operations were performed without laminar airflow or antibiotic prophylaxis. Seven minor fractures arose during insertion of the prostheses and one of these was later revised to THA. In the immediate postoperative peroid 10 prostheses dislocated. Five of these were revised to Girdlestone hips and three were converted to THA. Another 10 prostheses were revised to THA because of mechanical loosening. There where 5 superficial and no deep infections. At the time of follow-up 78 patients were dead and 11 could not be traced for clinical evaluation. Thus 45 patients with 49 Monk prostheses were available for radiographic and clinical evaluation. Pain, walking ability and hip mobility were 5.5; 3.5; and 4.9 respectively assessed by the D'Aubigne scoring system. Radiography reavealed migration in 61 percent of the femoral stems and acetabular erosion in eight percent of the hips.

Conclusion: Our study has demonstrated a relatively high frequency of dislocations resulting in a high rate of Girdlestone using the Monk hardtop hemiarthroplasty in the treatment of femoral neck fractures. Although the radiographic examination showed a high frequency of migration, we found a good clinical result at the 3-year follow-up.

138. Functional treatment of impact femoral neck fractures

Ernst L. F. B. Raaymakers

Department of Traumatology, University Hospital AMC, Amsterdam, the Netherlands

In a prospective study, a consecutive series of 135 patients with an impacted femoral neck fracture was treated with early mobilization and (at least) partial weight-bearing. 132 patients were followed-up until fracture healing or instability. In 59 patients under 70 years of age, secondary instability was seen twice. Both these patients died within 7 months from illnesses not related to the fracture. Ten fractures in patients over 70 years of age became unstable. In 80 of the unstable patients, one or more additional diagnoses were reported as manifestation of a less than good general condition. This was the case in only 19% of the primary healed group. Logistic regression analysis of our results indicated that, in particular, a poor general condition and, to a lesser extent, age over 70 years were risk factors. None of the other variables, such as retroversion, early full weightbearing and Pauwels type was found to have any influence on the development of secondary instability. Because delayed operation after secondary instability causes no increase of mortality or frequency of avascular necrosis, functional treatment of all patients seems justified.

139. Postoperative scintimetry as a diagnostic tool in nailed femoral neck fractures

Lennart Sanzén, Ingemar Sembo and Olof Johnell

Department of Orthopedics, Malmö General Hospital, Malmö, Sweden

Patients and method: Out of 410 patients with fresh cervical hip fractures randomized to hook-pinning or Rydell nailing, we made a one-week postoperative Tc-DPD scintimetry in 222 selected patients, who were significantly healthier and more often lived in their own home than the whole group. The radiographic results in 172 patients who survived the two year follow-up time was correlated to the ratio of isotope uptake in injuried/ normal femoral head.

Results: The mean postoperative scintimetric ratio was 1.34 ± 0.44 in 92 patients with normal healing and 0.95 ± 0.37 in 80 cases with healing complications ($p < 0.001$). Fifty-nine patients were reoperated with a hip prosthesis. No difference in rate of healing complications or scintimetric values was found between the two methods of osteosynthesis.

Conclusion: The majority of patients who will develop healing complications can be identified by a post-operative scintimetric ratio of < 1.0. The method could be used for selection of patients for follow-up and could diminish patient waiting time for a necessary reoperation.

140. Functional improvment after total elbow arthroplasty in rheumatoid arthritis

Sven-Erik Larsson and Brynjolfur Jonsson

Department of Orthopaedics, University Hospital, Linköping, Sweden

Patients and methods: The function of the hand and arm was studied after total elbow arthroplasty with the Souter prosthesis in a prospective, consecutive series of 18 rheumatoid patients with a total of 20 primary arthroplasties and 1 revision. Extensive clinical evaluation with total locomotion score (11) and Sollerman's hand function test (2) was undertaken preoperatively and at six months postoperatively.

Results: The mean flexion range increased 25° and 16 of the elbows became totally painfree. Hand function score (max 80) improved significantly from 52 to 64, upper extremity score (max 100) from 57 to 68 and subjective score (pain, ADL and ability) (max 100) from 46 to 58. Complications were 2 cases of ulnar nerve paresthesia, one transient and one persistent. A case of long standing ulnar nerve paralysis from entrapment after previous synovectomy remained unchanged despite lysis and transposition. One patient sustained peroperative epicondylar fissure that was revised uneventfully after 18 months due to absence of bony consolidation with secondary occurring migration of the humeral component.

Conclusion: Early results and functional improvement were satisfactory in these disabled patients. Longer follow-up of larger series is justified.

References

1. Larsson S-E and Jonsson B. Locomotion score in rheumatoid arthritis. Acta Orthop Scand 1989; 60(3): 77.
2. Sollerman C. Grip function of the hand. Thesis, Gothenburg, 1980.

141. Results of total hip replacement in patients with ankylotic contralateral hip

M. Røkkum, A. Reigstad, J. Berg, M. Brandt, and K. Bye

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

Hip fusion is compensated for by increased strain in the contralateral hip. It is claimed that this leads to arthrosis, and if such a hip is treated by total arthroplasty, a higher rate of mechanical failure will occur.

Patients and methods: Between 1969 and 1989, 40 patients with a hip fusion were treated by total joint replacement in the contralateral hip, 26 females and 40 males, aged 61 (17–77) years. The interval from the hip fusion to the arthroplasty was 9 (0–63) years. The disorders leading to arthroplasty were primary arthrosis (29), congenital hip dislocation (8), septic arthritis (1), Legg-Calve-Perthes disease (1), and meningomyelocele (1). 26 Müller, 1 Christiansen, 2

Landos, 2 Landos/Endler (cementless socket), 3 Zweymüller/Endler (both components cementless), 2 Landos corail (both components cementless), 4 ICLH cemented double cups, and 1 cementless double cup prosthesis were used. Follow-up was 6 (0.5–18) years.

Results: The hip function was graded according to d'Aubigné/Postel. Pain score rised from 1.5 preoperatively to 5.9 at follow-up. Range of hip motion rised from 2.7 to 4.6 and walking ability from 2.4 to 3.7. Ten prostheses were revised for mechanical loosening during the observation period. The patient with cementless double cup had mechanical failure of the femoral prosthesis after 3 years. One patient with Christiansen prosthesis had failure of both components 12 years postoperatively. Eight Müller prostheses loosened. Five of these had femoral stem failure after 3, 6, 9, 11 and 15 years, respectively. One acetabular failure was diagnosed at 4 years, 2 patients had failure of both components, 2 and 3 years postoperatively. No prosthetic failure is so far seen after the revision operations.

Conclusion: Total hip arthroplasty in patients with fused contralateral hip has higher rate of mechanical failure than hip arthroplasty in patients with mobility of the contralateral hip. However, apart from reduced walking ability the hip function in this group of patients is comparable to ordinary hip replacement patients.

142. Biological articular resurfacing in osteoarthritic knee with carbon fibre implants

Mats Brittberg[1], and Lars Peterson[2]

Department of Orthopedics[1], East Hospital and Gothenburg Medical Center[2], Gothenburg, Sweden

The different treatments available for patellofemoral arthrosis in the young patient have been disappointing. Subchondral drilling give rise to an ingrowth of a repair tissue of fibrocartilage character but not enough to fill up the defects to congruity. We describe our experience with carbon fibre implants used as scaffolds for the ingrowing repair tissue in treatment of localized gonarthrosis.

Patients and methods: 30 patients, 18 males and 12 females; mean age 43 (27–53) years were examined 24 (17–36) months postoperatively. Pre- and postoperatively the patients were evaluated using the rating sheet for knee function described by Larson (1972). All knees were preoperatively rated as "poor". Pads of woven carbon were used for arthrotic lesions on the patellar facets.The carbon-pad was pushed into a burr prepared basin in the cancellous bone of patellar surface. Condylar defects were treated by carbon-rods, pushed into predrilled holes in the subchondral bone, end flush with the surface. Postoperatively, CPM for 2 days and full weight-bearing when 90° of flexion was achieved was used.

Results: Mean total Larson knee score was preoperatively 46.5 and postoperatively 75.2/100p. 25 of the 30 patients were graded in the category of good–excellent (70–100p). There were remarkable effects on pain relief but less on functional recovery.

Conclusion: The carbon fibre implant seems to give satisfying relief of severe, disabling pain in gonarthrosis and some functional recovery. This method might be able to arrest the development from local to generalized arthrosis and restitute a destroyed area of cartilage in a way of armoured, fibrocartilage resurfacing.

143. Gonarthrosis treated by a cemented nonconstrained prosthesis

A. Reigstad, K. Bye, M. Røkkum and T. Husby

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

The knee is the most strained joint of the human body. In active arthrosis patients treated by a semi- or nonconstrained prosthesis, rotational stress transmitted to the bonecement interface, may lead to loosening of the components. A nonconstrained prosthesis in which the collateral ligaments and the posterior cruciate can be spared, may prolong the durability of the arthroplasty.

Patients and methods: From May 1985 to September 1988 we inserted 50 ANC2000 nonconstrained cemented prostheses in osteoarthritic knees. The mean age of the patients was 71 years and 4/5 were females. A tibial osteotomy had been carried out earlier in 11 knees and 2 had a loose unicompartmental prosthesis. A straight anterior approach was used. The mean operation time was 2 hours and the mean blood loss was 0.5 litres.

Results: In 48 knees, the postoperative alignment was 0°–10° degree valgus, 2 knees had > 0° varus. Instability in valgus was seen in 1 knee, the remaining 49 knees were stable. An increase in mean pain rating according to d'Aubigné/Postel from 1.9 preoperatively to 5.7 one year postoperatively, was seen. The mean knee flexion and extension one year postoperatively were 97° and –2°, respectively. 3 deep infections were seen. 2 of the infected prostheses were removed temporarily and 1 was cured by antibiotics. 3 patients were operated for patellar problems (1 dislocation, 1 rupture of the patellar ligament and 1 mechanical failure of the patella prosthesis). No mechanical loosening of the prosthetic components has occurred.

Conclusion: Implantation of a total knee prosthesis is a more demanding operation with a higher rate of complications compared with total hip replacement. The clinical short-term results in uncomplicated arthroplasties in arthrotic knee patients are comparable with those of total hip prostheses.

144. Bone resorbing activity in periprosthetic tissue in aseptic loosening of total hip arthroplasty

Acke Ohlin[1] and Ulf H. Lerner[2]

Department of Orthopaedics[1], Malmö General Hospital, Malmö and Department of Oral Pathology[2], Umeå University, Umeå, Sweden

Bone resorption surrounding cemented total hip prostheses is one step in the sequence of events resulting in prosthetic loosening. Also, massive loss of bone stock is a great problem in revision surgery. Bone resorption is considered to be exclusively mediated by osteoclasts. The bone-cement membrane has previously been considered to play a key-role in this process. The aim of this study was to elucidate and compare the production of bone resorption stimulating factors in different peri-prosthetic tissues obtained from patients revised due to aseptic loosening of total hip replacement.

Material and methods: Tissue specimens from various periprosthetic tissues obtained at 11 exchange operations were cultured in medium for 48 hours. The conditioned medium was added to a Ca45 prelabelled mouse calvaria organ culture and the bone resorption activity was expressed as percent mobilization of Ca45 to the medium.

Results: In the 11 cases studied, a generally greater production of osteoclast activators was found in cultured media conditioned by capsule than by bone-cement membrane. Addition of indomethacin to cultures only partially depressed the formation of bone resorption stimulating factors, indicating that mediators other than prostaglandins are involved in the process of bone resorption.

Conclusion: Various types of periprosthetic tissue may be implicated in osteoclast activation. The joint capsule may even override the bone-cement membrane in promoting bone resorption.

145. Bone-cement interface temperature profiles of Simplex and SCH-457 bone cement

Søren Harving, Kjeld Søballe and Cody Bünger

Orthopedic Hospital, Aarhus, Denmark

Necrosis of bone tissue due to thermal injury during polymerization of bone-cement might be a cause of later mechanical loosening of prosthetic components.

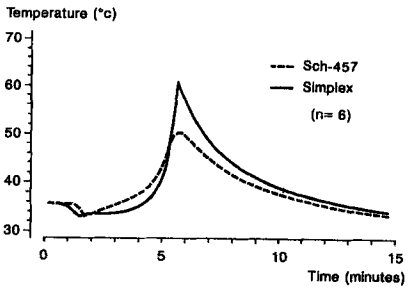
The aim of this study was to develope at technique for exact bone/cement temperature recording at multiple locations in a standardized in vitro model and to compare temperatures at the bone/cement interface during polymerization of a low temperature curing bone cement (SCH457, LVC + Gentamycin, Essex Pharma a/s), versus ordinary Simplex cement (Howmedica).

Materials and methods: Both femurs of six 72-kg pigs were isolated and deep frozen immediately post mortem. Before the experiment the pig-femurs were heated to a temperature of 38 °C. In the medial femoral condyle a 12 x 17 mm canal was drilled over a 1.6 mm guide pin. Through two separate canals 8 thermo-couple electrodes were introduced into the bore hole and by sight placed in contact with the bone. A further two electrodes were looped around the guide pin to measure core temperature in the cementplug. After 90 sec's stirring, the hole was filled with cement and a standardized compression applied.

Results: The initial bone temperatures were 36.0 ± 0.1 °C (mean ± SE) for both cement groups. The drop in temperature seen after 1.5 min. was caused by the introduction of the colder cement into the hole. SCH-457 immediately developed heat and a maximum temperature of 50.0 ± 0.5 °C was reached. Simplex initially gave off no heat, but reached a higher average peak value of 60.2 ± 0.7 °C ($p < 0.01$).

In this series the temperature peak was seen after 5.7 ± 0.2 min (mean ± SE) for both cement types. Within the same cement plug of Simplex and SCH-457 the maximum total range in peak time was 0.7 min and 0.5 min, respectively. Room temperature during the experiments was 26.9 ± 0.3 °C.

Conclusion: SCH-457 developed a significantly lower peak temperature than Simplex cement. The difference in temperature is so pronounced, that it presumably will influence the protein denaturization and bone regeneration around the cement.



146. Injuries with skateboard, BMX-cycle and rollerscate among children

B. E. Lindblad, S. S. Mikkelsen, A. Nafei, G. Teichert, K. Kørner, J. Jensen and J. Sommer

Department of Orthopedics. Accident Analysis Center. Aarhus County Hospital and Aarhus Municipal Hospital, Aarhus, Denmark

The aim of this study is to determine the frequency of accidents with skateboard, BMX-cycle and rollerscate and to describe the etiology and epidemiology of these injuries. These sports has only recently captured the imagination of Danish children. Their popularity has grown at a phenomenal rate in many countries.

In order to illustrate the injuries while using such equipment, children aged 0–15 years are registered during the year of 1989 in the County Hospital and the Municipal Hospital of Aarhus, which serves a population of 256,000 people.

The parameters registered are personal data, anamnesis, clinical examination, diagnosis, time of accident and arrival to the hospital, defect(s) of the sports item, cause of mechanism and trauma, place of accident, treatment and mode of termination, severity of lesion according to thr Abbreviated Injury Scale (AIS) and the absent and economic loss in the family because of the sickness of the child.

147. Outcome after repair of nerve injuries of the upper extremity in children

Carlos Barrios and Julio de Pablos

Department of Orthopedic Surgery, Navarra University Clinic, Pamplona, Spain

Peripheral nerve injury in children is not a frequent feature. The aim of this study was to evaluate retrospectively the results after nerve repair in a series of children with nerve injury of the upper extremity. To our knowledge, this issue has not previously been addressed.

Patients and methods: During a 15-year period, 312 posttraumatic, compressive or iatrogenic nerve lesions of the upper extremity were operated on in our depament. Of these, 37 (12%) corresponded to 33 children 6–15 years of age. There were 19 injuries of the ulnar, 12 of the median and 6 of the radial nerve. Discontinuity of the nerve trunk was found at surgery in 23 cases operated on by interfascicular grafting (18 cases) or epineural suture (5 cases). The remaining 14 lesions with continuity of the nerve trunk were treated by decompressive external neurolysis. After surgery, children were followed-up for a mean period of 2 years.

Results: Useful sensory function (S4–S3) assessed at the autonomous zone was restored in 31 cases. Satisfactory motor recovery was achieved in 25 cases. Independent]y of the type of lesion, the median nerve showed the best ability to regain both complete motor and sensory function. As to clear-cut lesions, grafts restored motor function to useful levels (M3 or better) in 16 of the 18 nerves operated on. Return of the static two-point discrimination (S3+) was obtained in 13 cases, 6/10 ulnar nerves, all 6 median nerves and 1/2 radial nerves. Injuries affecting the radial nerve had inferior prognosis regarding motor function recovery. Unfavorable prognosis was mainly related to a severe trauma including other nerve, vascular or tendinous concomitant lesions, and a long time interval between nerve damage and surgery.

Conclusions: Repair of upper extremity nerve injuries in children provides a high rate of satisfactory results. A superior ability for peripheral neural regeneration may explain the capacity of children for almost complete recovery of both motor and sensory function after nerve damage as compared with adults.

148. Carpal malalignment in Colles' fractures

Derek R. Bickerstaff and Michael J.Bell

Department of Orthopaedics, Royal Hallamshire Hospital, Sheffield, England

The disability after Colles' fracture has been attributed to a number of radlographical features relevant to the distal radius. To our knowledge no-one has studied carpal malalignment with regard to morbidity following Colles' fracture.

Methods: Thirty two patients with unilateral Colles' fractures were assessed one year after injury. This included a functional assessment and standardised postero-anterior and lateral radiographs of both wrists. The various radiographic parameters of carpal alignment were measured on the standardised radiographs taken at one year and those taken at presentation before and after reduction of the fracture. These results were then correlated with the functional score using linear regression analysis.

Results: The most significant indication of a poor result was related to the degree of carpal malalignment as measured by the dorsal tilt ($p < 0.005$), and the radio-lunate ($p < 0.001$), lunate-capitate ($p < 0.009$) and scapho-lunate angles ($p < 0.009$) on the late films. The interrelation between the dorsal tilt and carpal angles demonstrated the progressive collapse of the carpus into an appearance resembling dorsal intercollated segment instability. With regard to early indicators of a poor result, there was no correlation between any of the parameters and the final outcome.

Conclusions: We believe that the carpal malalignment seen following Colles' fracture is not simply a complication but the inevitable response of the carpus to the altered mechanics caused by malunion with dorsal tilt and it may explain the morbidity seen in Colles' fractures.

149. Corticocancellous autografts in hand surgery

M. Røkkum, A. Reigstad, K. Bye and K. R. Hetland

Kronprinsesse Märthas Institutt, National Orthopaedical Hospital, Oslo, Norway

Bone grafting has several indications in hand surgery. Corticocancellous autografts have been used for reconstruction procedures where mechanical stability is important. Most of these cases involve bone defects.

Material and methods: Between 1985 and 1989, 26 patients underwent totally 28 operations by 34 corticocancellous autografts transplanted to the hand. There were 5 females and 21 males aged 31 (2–69) years. The operations were reconstruction of phalangeal or metacarpal pseudarthrosis or defects after trauma or tumor resection (17), digital lentgthening (8), and first metacarpal stabilization in paretic thumbs (3). The bone grafts were harvested from the iliac crest (18), the proximal tibia (5), or proximal ulna (5). The size of the grafts ranged from 10 x 5 mm to 63 x 10 mm. The follow-up period ranged from 3 to 58 months (average 15 months).

Results: One patient with 3 metacarpals reconstructed after a crush laceration developed necrosis of the dorsal soft tissue and infection of the bone grafts. Partial resorption of the bone grafts and pseudarthrosis followed. All the other grafts used for defects and pseudarthrosis healed without problems, and subsequently underwent calcification and remodelling according to their new function. Most of the digital lengthening operations by distally applied bone grafts resulted in some degree of bone resorption, especially in children. Lengthening by metacarpal osteotomy, distraction and bone graft interposition healed without resorption. One of the first metacarpal stabilizations developed pseudarthrosis, but healed solidly after retransplantation. No donor site morbidity was seen.

Conclusion: Corticocancellous autografts combine mechanical stability with good osteoinductive properties. They are well suited for reconstructive procedures in hand surgery, and they can be harvested without donor site problems.

150. Operative technical complications using the interlocking nail in the treatment of 99 femoral fractures

Knut Strømsøe, Bjørn O.Thoresen, Arne Ekeland, Gunnar Folleråas and Antti Alho

Orthopaedic Service, Surgical Department, Ullevål Hospital, Oslo, Norway

The interlocking nail has been used in the treatment of femoral fractures at Ullevål Hospital since 1979.The complications due to any kind of operative technical failures have been analysed.

Material and methods: 99 femoral fractures in 95 patients treated with an intramedullar locking nail were followed for median 4 (3–10) years by the authors. 86 fractures were closed, 13 fractures were open. 32 fractures were caused by high velocity, and 44 were comminuted fractures. 9 fractures were treated with static interlocking of the nail, whereas 60 fractures were locked only proximally or distally.

Results: A total of 13 complications were registered. 10 of them were due to an operative technical failure. Further comminution of the fracture was registered 3 times. This made, because of a rotational instability, a reintervention necessary in one patient. The primarily dynamic nailing was converted into a static one. Lack of hold of the distal locking bolts was observed 3 times and caused reintervention in one patient. In an old nonmobile patient an additional plaster cast was needed for six months due to instability. A fracture of the proximal interlocking bolt was registered in one patient without consequences for fracture healing or endresult. During the introduction of the nail, one patient suffered a femoral neck fracture, which was treated with a screw osteosynthesis. Jamming of the reamer during the reaming process occured in one patient and made a 10 cm longitudinal osteotomy necessary to release the reamer; static nailing was done with good fracture healing.

Conclusion: The interlocking nail is a well documented method in femoral fractures. Complications due to operative technical failures should be avoided by trained surgeons. In our material we had 10 complications in 99 operated fractures.

151. Powered staple fixation in ankle fractures: A 3-year follow-up

Hans Christian Östgaard and Peter Ebel

Department of Orthopedics, Sahlgren Hospital, Göteborg, Sweden

Powered staple fixation in hand and wrist surgery was first introduced by Shapiro 1986. The method appeared suitable for many types of fractures in metaphyseal bone, and this study was made to compare this new method with the well known routine method for ankle fractures presented by Cedell and Wiberg 1967.

Patients and method: During a one-year period, 25 ankle fractures were operated with the 3M staplizer and matched in pairs with 25 similar ankle fractures operated with the routine method at our department. All types of ankle fractures were evenly distributed in the two groups. The postoperative care was the same in the two groups. Our results were based on judgements by radiologists, who were not involved in the study, and the three year follow-up was done by the second author (PE) who was not at our department when the operations were done and had never used the staplizer.

Results: No differences were found between the two groups except for operating time, which was shorter for the staplized group ($p < 0.01$).

Conclusion: Staplizing ankle fractures is a reliable method. In this study all types of ankle fractures were staplized, and the method proved to be as successful as our routine method in all aspects investigated. Operating time was definitely shortened.

152. Anterior knee pain in the post adolescent decade

Ian G. Winson, Juan Miranda and Tom W. D. Smith

Department of Orthopaedics, University of Sheffield, Sheffield, England

Anterior knee pain remains a major problem to diagnose and to manage. The adolescent age group are the most difficult and have therefore been the most frequently observed. The third decade of life produces an equally large number of cases rarely observed as a separate group. The debate as to what is the nature of the underlying pathology has produced a good deal of speculation mainly centred about the type and distribution of articular cartilage changes. More recently, with the use of arthroscopy, the presence of the medial synovial shelf as a potential further cause of anterior knee pain, and the awareness of rotational abnormalities occurring down the length of the limb in some cases of anterior knee pain has led us to question the relevance of these findings as compared with the described articular changes.

Material and methods: Forty patients derived from two age sex matched populations undergoing arthroscopy for differing reasons formed the clinical material of the study. One group consisted of patients undergoing arthroscopy for anterior knee pain, the other consisted of patients who had a history of meniscal or cruciate injury with no history of anterior knee pain. All patients were clinically evaluated using a standard proforma by two observers. All then underwent arthroscopy by one surgeon where careful and detailed observation was made particularly grading the articular cartilage changes seen.

Results: The duration of symptoms prior to surgery differed between the two groups with, surprisingly, the group 2 (non-anterior knee pain) having a longer history than group 1. The maximum severity of pain experienced as assessed by linear analogue showed no difference between the two groups. A medial synovial shelf was present in 60% of group 1 cases and 22% of group 2. In group 1, 70% had an apparent internal femoral torsion with a degree of compensatory external tibial torsion. This only occurred in 33% of group 2. Grade 2 or 3 changes of chondromalacia occurred in 60% of group 1 and 45% of group 2.

Conclusion: Rotational deformity and medial synovial shelf could be of as much significance in the aetiology of anterior knee pain as the presence of articular cartilage changes.

153. Bone tumor in Basrah: A review of 150 cases

T. A. Namdan

Orthopedic Unit, Department of Surgery, University of Basrah, Basrah, Iraq

From 1981 to 1986 at Basrah University Teaching Hospital, one hundred and fifty patients had operative treament for bone tumor in form of amputation, local excision, and wide local excision. Osteosarcoma, fibrosarcoma, exostosis, and metastases from breast cancer were common diagnoses.

Sixty two patients had metastases, forty five had primary malignant tumors, and forty three had benign tumors. All patients with benign tumors were treated by surgical excision. Almost all patients with primary malignant bone tumor had amputation at a suitable level, few had wide local excision. All patients with bone metastases had wide local excision, internal fixation or prostheses, with filling of the defect by methyl methacrylate, which was found to have some inhibitory effects on the growth of malignant cells. Patients with malignant tumors were referred for radiotherapy and chemotherapy in another center in Bagdad.

The follow-up exceeded five years.

Bone biopsies were the best way of achieving the definitive diagnosis. Plain skeletal radiography may give false negative results at the initial stage; for that reason, bone scan is a mandatory investigation in the uncertain cases. Getting an opinion from more than one histopathologist is advisable. Clinical awareness and early diagnosis would help very much in reducing morbidity and mortality. Almost all cases presented very late to the definitive surgical treatment and that was a good reason for the high mortality rate in the cases studied. The late presentation was either due to late diagnosis or the patient's refusal to have surgical treatment and, in particular, amputation.

154. Continous percutaneous recording of muscle blood flow using laserdoppler single fiber technique

Sven-Erik Larsson and Åke P. Öberg

Departments of Orthopedics and Medical Engineering, University Hospital, Linköping, Sweden

Hitherto continuous recording of muscle blood flow in relation to varying loads has not been possible. In the present investigation, muscle blood flow was studied percutaneously in healthy individuals and patients with trapezius myalgia after further development of the fiber optics.

Method: Two optical single-fibers were applied percutaneously via plastic cannula (diameter 1 mm) in the right and left trapezius muscle or in the right trapezius and supraspinatus muscle for continuous recordings under periods of varying isometric contraction of different degrees as well as during subsequent relaxation. The flowmeter building block

constituted photodetector, high-pass filter, amplifier and a filter net-work with the transfer function (Salerud & Öberg 1987). The signals were recorded graphically as well as on tape recorder, digitalized and analyzed by computer.

Results: Rhytmical variations in muscle blood flow value were recorded simultaneously in the two muscles (vasomotion) indicating that the percutaneous, single-fiber did not traumatize the muscle tissue. The arterial pulsations showed elevated amplitude and flow level during post-contraction relaxation. Analysis of the signal frequency spectrum showed that the muscle fiber activity did not interact with the recordings of the signals emanating from the blood cells.

Concluslon: The described technique made possible continuous recordings of muscle blood flow during varying levels of static muscle load and subsequent relaxation as well as simultaneously in different muscles. Patients with work-related trapezius myalgia showed reduced blood flow (microcirculation).

155. Femoral anteversion measured by ultrasound—a normal material

Martinus Bråten and Terje Terjesen

Department of Orthopaedic Surgery, Trondheim University Hospital, Trondheim, Norway

The last years ultrasound has been employed for measurements of femoral anteversion (AV). The aims of the present study were to find the normal AV angle in adults measured by ultrasound, the normal difference between the right and the left side, and the inter-observer variation of the measurements.

Material and methods: We examined 50 adult women and 50 adult men without previous hip disease or femoral fracture. With the patient supine, their knees flexed 90°, and the lower legs in the vertical position, an ultrasound scan of the anterior outline of the proximal femur was obtained. The transducer was tilted until the anterior tangent of the femoral head and greater trochanter appeared horizontal on the monitor screen. In this position, the tilt of the transducer was measured with a clinometer. The real femoral AV was estimated by subtracting 10° from the measured angles.

Results: The mean AV angle was 17.9° in women and 13.7° in men. The range of normal variation (mean ± 2SD) was 2°–33° in women and -2°–29° in men. The average difference in AV angle between the right and the left side was 3.8° (0°–13°). The mean inter-observer variation was 1.9° (SD 1.3°)

Conclusion: 1. Femoral anteversion measured by ultrasound corresponds well with results in normal materials measured radiographically. 2. As no side difference in AV angle exceeded 13°, differences of 15° or more after femoral fractures should be regarded as rotational deformity. 3. The inter-observer variation was small, indicating that the method is reliable in clinical use.

156. Markers of early arthrosis in human synovial fluid

Leif Dahlberg[1], Dick Heinegård[2], Leif Ryd[1] and L. Stefan Lohmander[1]

Department of Orthopedics[1], Lund University Hospital and Department of Physiological Chemistry[2], University of Lund, Sweden

In order to evaluate new pharmacological and surgical treatments for early arthrosis new markers must be identified. We have shown (1) that after knee injury, high concentrations of proteoglycan (PG) fragments are present in synovial fluid. The present study describes the assay of PG epitope in synovial fluid in patients with developing arthrosis.

Patients and methods: Three major groups were studied: (A) reference; (B-E) patients with cruciate ligament or meniscus injury 6 months before sampling; (F-H) no known injury. Patients were graded for arthrosis using an arbitrary scale of 1–10 based on findings by arthroscopy and/or radiography (2, 3). Synovial fluid samples were analyzed for cartilage proteoglycan fragments by immunoassay (4).

Results: With increasing joint changes there was a decreased concentration of proteoglycan fragments in joint fluid.

Discussion: High PG epitope levels persist in injured joints that are normal or almost normal by arthroscopy and radiography. Notably, at the stage of the earliest changes detectable on radiographs the levels were already decreased as compared to joints with only mild degeneration by arthroscopy. This may suggest that the turnover rate of PG fragments decreases during developing arthrosis and that a correlation exists between the mass of cartilage in the joint and the PG epitope concentration in joint fluid.

References

1. Lohmander LS et al (1989) Arthrit Rheum 32:1434-1442.
2. Lohmander LS et al (1990) Ort Trans in press.
3. Ahlbäck S. (1968) Acta Radiol (suppl 277):7-72.
4. Heinegård D et al (1985) Scand J Clin Lab Invest 45:421-427.

157. Use of new hemostatic, bioerodible polymer versus bone wax made of beeswax—a clinical and experimental study

Bjørn Sudmann, Ole-Gunnar Anfinsen, Milan Raitl[1], Gisle Bang and Einar Sudmann

Surgical Research Laboratory, Department of Oral Pathology and Forensic Odontology, School of Dentistry, and Hagavik Orthopaedic Hospital[1], University of Bergen, Bergen, Norway

Patients: In seven women, ordinary bone wax, made of beeswax, was used to stop bleeding after bone resection on

the foot or the shoulder. Postoperatively they all experienced disabling local pain and tenderness. At reoperation, 4-53 months later, granulation tissue was excised and microscopically, chronic inflammation with marked foreign body reaction was seen. At follow up all but one had recovered.

Rats: In rats, drilled holes in the skull, the iliac crest, and the tibia were on the left side filled with beeswax, while corresponding holes on the right side were filled with a new, wax-like, water-labile, bioerodible polymer. Empty drill-holes served as controls. In addition, beeswax and polymer were deposited in the left and the right oblique abdominal muscles, respectively. The beeswax was not resorbed in bone or in muscle, whereas the polymer was. Bone healing was inhibited in the iliac crest and the tibiae filled with beeswax, whereas holes filled with polymer healed readily. In muscle, the beeswax elicited a marked foreign body reaction, whereas the polymer was resorbed, and the foreign body reaction was transient.

Conclusion: Bone wax made of beeswax should be used with caution. Bioerodible polymers seem promising for stopping bleeding from spongious bone.

158. Biologic responses of the normal and bridged physis to distraction

J. Kenwright, S. Apte and C. J. Kershaw

Nuffield Orthopaedic Centre, Oxford, England

Physeal distraction is used for limb lengthening and also to correct deformity due to physeal bridging. Controversy exists about the biological responses of the growth plate under these conditions; these responses are investigated.

Methods: In groups of 8 week old New Zealand white rabbits external skeletal fixation was applied across the physis; and different distraction regimes were used; (a) low force constant distraction with spring loading (b) distraction across a bridged growth plate; with the force maintained by strain gauges. Weekly radiographs were taken. Histology was examined at intervals; cell proliferation was studied using tritiated thymidine autoradiography and a mono-clonal antibody to Brd. Urd., a thymidine analogue incorporated by proliferating cells.

Results: (a) With low force distraction significant increases in bone length occurred without plate fracture. There was marked thickening of the distracted growth plate and cellular division was increased in the proliferative zone. No changes in division were seen in other zones. (b) Distraction after 10% bridge formation led to correction of deformity though after fracture of the bridge; high force levels were needed. Following this the bridge reformed and the growth plate closed.

Conclusions: Low distraction forces stimulate cell proliferation, this occurring predominantly in the proliferative zone. High level forces can rupture bony bridges but the growth plate closes following this procedure.

159. The bone movement chamber

Per Aspenberg, Sören Toksvig-Larsen, Leif Ryd, Tomas Albrektsson[1]

Departments of Orthopedics and Handicap Research[1], Lund and Gothenburg, Sweden

The objective of the present study was to develop a method with which the effects of motion, frequency and amplitude, on bony ingrowth could be studied in an animal model.

Material and methods: The bone movement chamber, a development of the bone harvest chamber, consists of an outer shell of titanium which is screwed into bone, where it becomes osseointegrated. This outer shell is pierced by two holes on opposite sides, 1 mm in diameter. Inside the shell is an insert with a 1 mm wide canal connecting the two holes. This canal will receive bone ingrowth from both ends. The insert can be rotated by external manipulation to create an ad latus motion of a predetermined magnitude between the insert and the outer holes. After an adequate time interval, the insert can be extracted and the content of the canal can be harvested without disturbing the outer shell and the surrounding bone. The insert may be put back and the canal will receive bone ingrowth again.

The movement chamber was inserted into the tibial methaphysis of adult rabbits. After six weeks, the chambers were harvested. Osseointegration had occurred and the insert was connected to a cover provided with bars protruding subcutaneously to allow for external manipulation. The rabbits were subjected to daily manipulations of 20 cycles during a one minute period for three weeks.

Results: Preliminary data showed that bony ingrowth into the canal was not prevented by motion of this frequency and a magnitude 250 μm (25% of the pore diameter). The ingrown bone was covered by a fibrous tissue layer of approximately 0.2 mm on those surfaces that had been mechanically loaded.

With a motion amplitude of 500 μm, bone ingrowth was prevented.

Discussion: This project is in the initial stage and primarily engaged in the development of the method. The objective is to develop a model by which the effects of motion on bony ingrowth can be studied and where each parameter of interest, such as frequency, amplitude and size of the pore, can be controlled individually.

In the context of bony ingrowth into porous prostheses, the canal of 1 mm is larger than the pore size, which is 150-400 μm in most devices. The magnitude of the motion was chosen to correspond to that possibly encountered during the postoperative period after an arthroplasty. Also, the frequency of motion chosen is probably not comparable to that encountered in the corresponding clinical situation. However, inhibitory effects of so few cycles per day would point to the futility of attempting to immobilize patients in the postoperative period.

160. Arteriovenous shunting in experimental arthritis studied with microspheres of different sizes

Ebbe Stender Hansen, Shu-Zheng He, Vibeke Elisabeth Hjortdal, Dorthe Kjølseth, Kjeld Søballe and Cody Bünger

Department of Orthpaedic Surgery, Department of Clinical Physiology and Nuclear Medicine, Institute of Experimental Clinical Research, University of Århus, Denmark

The microcirculation of the juvenile dog knee with chronic arthritis was studied with microspheres (MS) of different sizes to localize possible sites of arteriovenous (AV) shunting.

Material and methods: Unilateral arthritis of the knee was induced in 8 dogs by weekly intraarticular injections of 1% carragheenan for 12 weeks. Regional blood flow (RBF) was determined in bones of the lower extremities with 15-µm 141Ce-labeled MS and 50-µm 46Sc-labeled MS. Reference sampling was performed simultaneously from arterial blood and both femoral veins to assess the overall nonentrapment of MS in the lower limbs.

Results: The mean nonentrapment was 14 percent in arthritic limbs and 4 percent in control limbs for the 15-µm MS ($p < 0.01$) and 3–4 percent for the 50-µm MS bilaterally (NS). The overall uptake of 50-µm MS was significantly lower than that of 15-µm MS in all larger bony compartments and in both extremities, presumably due to plasma skimming in central arteries. Considerable variation was found in the relative distribution of the two types of MS within bone. Arthritis caused significant shifts in the relationship between the uptake of 50-µm MS and 15-µm MS between regions within bone, but this relationship remained strictly unaffected by arthritis, when circumscribed bony compartments were examined in toto.

Conclusions: Significant nonentrapment of 15-µm MS occurred in arthritis. The internal shift in the relative distribution of the two MS sizes used is evidence for precapillary vasodilation in bone. This vasodilation clearly did not lead to increased nonentrapment of 15-µm MS in bone. Therefore, the theory of AV shunting in bone as a hemodynamic reaction mechanism involved in the development of trophic bone changes in juvenile chronic arthritis must be rejected. The study was unable to localize the source of increased nonentrapment of 15-µm MS in arthritic limbs, but skin is a likely candidate, as AV shunts are well known in skin.

161. Effect of cyclooxygenase inhibition on intraosseous hemodynamics in Carragheenan induced juvenile arthritis

Ebbe Stender Hansen, Shu-Zheng He, Kjeld Søballe, Dorthe Kjølseth, Tine Brink Henriksen, Vibeke Elisabeth Hjortdal and Cody Bünger

Department of Orthopaedic Surgery, Department of Clinical Physiology and Nuclear Medicine, Institute of Experimental Clinical Research, University of Århus, Denmark

The impact of prostaglandin synthesis inhibition on juxtaarticular hemodynamics in juvenile chronic arthritis was studied in the canine carragheenan injection model.

Material and methods: Arthritis of one knee was induced for 12 weeks by weekly intraarticular injections of 1% carragheenan solution in 8 dogs receiving naproxen (2 mg/kg/day) compared with controls of similar age and weight. Regional blood flow (RBF) was measured with 141-Ce-labeled 15-µm microspheres. Plasma volume (PV) was determined as the equilibrium distribution of 125I-labeled fibrinogen in tissues.

Results: Naproxen significantly reduced the arthritic hyperemia in the joint capsule (RBF: $p < 0.01$, PV: $p < 0.05$) and almost normalized a severe intraosseous RBF increase in patella ($p < 0.001$) and the juxtaarticular epiphyses of femur ($p < 0.001$) and tibia ($p < 0.01$). A similar effect was observed for PV, albeit only significantly in patella ($p < 0.05$) and the distal femoral epiphysis ($p < 0.05$). The juxtaarticular metaphyses generally had increased PV. Overall, metaphyseal RBF was unchanged in both groups, but redistribution of flow from growth plates to cancellous metaphyseal bone seemed to have occurred in arthritic limbs, irrespective of naproxen treatment.

Conclusion: Naproxen was able to reduce the capsular and juxtaarticular intraosseous hyperemia in canine juvenile chronic arthritis. Since the hemodynamic changes in bone appear intimately linked to the development of growth abnormalities and bone loss following synovial inflammation, it is suggested that prostaglandin synthesis inhibition in juvenile chronic arthritis in addition to symptomatic relief offers protection against secondary structural derangement of juxtaarticular bone.

162. Strength retention of SR-polylactide acid in the bone tissue and in subcutis: An experimental study in rabbits

Ari Majola, Seppo Vainionpää, Pertti Törmälä and Pentti Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Finland

In experimental studies polylactic acid (PLA) implants were used with success in fixation of cancellous bone fractures and osteotomies of nonweight-bearing bones. Recently

Törmälä et al. reported that PLA can attain many times higher strengths compared with earlier materials when they are self-reinforced (SR) with highly oriented structural elements, such as polylactide fibers. The purpose of present study was to investigate whether the mechanical properties of SR-PLA-rods are sufficient for fixation of weight loaded bones.

Materials and methods: Rods made of SR-PLLA and SR-PDLLA/PLLA were used. The Mw of PLLA was 260,000 and of PDLLA 100,000.

Strength loss in the bone tissue: 21 adult rabbits were used, 3 rabbits (6 implants) in each group. SR-PLLA implants (length 50 mm and diameter 4.5 mm) were placed inside both femurs.

Strength loss in subcutis: 14 rabbits were used. 5 implants (length 40 mm, diameter 3.2 mm) were implanted in the subcutis of each rabbit. After killing the rabbits, the flexural, and shear strengths of the implants were measured. The follow-up times varied from 1 to 48 weeks.

Results: The loss of flexural and shear strengths of the SR-PDLLA/PLLA was faster than of SR-PLLA. At 12 weeks there was 50 percent (100 MPa) of the initial flexural strength left of the SR-PLLA in the bone tissue and in subcutis. At 36 weeks the flexural strength had decreased to the level of strength of cancellous bone (10–20 MPa). In this preliminary study the strength retention was found sufficient for fixation of cortical bone osteotomies. On the basis of these promising results we have continued our research by experimental studies of SR-PLA intramedullary nails.

163. Treatment of traumatic hand deformities in children

A. A. Danilov and D. Y. Krivchenya

Department of Children's Surgery of Kiev State Advanced Training Institute for Doctors, Kiev, Soviet Union

The surgical treatments were conducted in 165 patients aged 1–14 years with traumatic hand deformities. The deformities were caused by severe traumas of hand and forearm accompanied by tissue defects and injuries of bones, joints, vessels, nerves, and tendons.

Epiphysiolyses of phalanges and metacarpal bones, with fragment displacements, required open reposition and fixation during the first 4–7 days following trauma. Later, primary callus was formed and partial closing of the growth zone occurred, which resulted in both deformity and growth lag of the finger. The fragments were fixed with thin wires conducted from the lateral epiphyseal aspects. Unstable diaphyseal fractures were fixed with wires or with the use of compression-and-distraction devices. In case of bone deformity, osteotomy and correction of the segmental axis with the compression-and-distraction device was used. The radial graft was used in case of arthrodesmogenic contractures of fingers. Included in the graft was a piece of cutaneous nerve, which was used for digital nerve plasties. The blood supply of the hand was controlled using the Allen test before and after the transplantation. In cases of lowered arterial inflow, an autovenous plasty of the radial artery was carried out. When fractures were combined with osteomyelitis and soft tissue defects, a microsurgical transplantation of the thoracodorsal graft was conducted followed by a correction of the deformation using the compression-and-distraction device after the inflammatory process was stopped.

The interphalangeal articulation defects were replaced with articular allotransplants and subsequent plasty of the bursoligamentous apparatus with autofascia. Large blood vessel defects were treated with autovenous plasty. When nerve defects were > 2 cm, an autoneuroplasty was carried out. Old injuries of flexor tendons required two-stage tendinous plasty. At first, the fibrous sheath was formed by covering a perforated catheter with autofascia. Heparin solution was instilled in the catheter. The second stage of the tendinous plasty was carried out 1.5–2 months later.

Injured extensor tendons were repaired with closed Supramid stiches without splitting the skin or isolating the injured tendon ends.

The important points of hand deformity prevention are the accurate anatomical apposition of bone fragments of the fractured hand, the replacement of tissue defects with composite grafts and the early repair of injured anatomical structures following the trauma.

164. Vascularized free flaps in hand surgery

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

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

Conventional flaps such as the groin flap, the abdominal flap, and the pectoral flap have been extensively used to obtain skin cover in upper extremity defects. However, microvascular free tissue transfer may solve many of the problems of reconstructive upper extremity defects in a more convenient way.

Material and methods: Between 1985 and 1989, we transferred 28 free flaps to the distal forearm and hand. The donor tissue comprising of 2 dorsalis pedis flaps, 4 scapular flaps and 22 lateral upper arm flaps were all transplanted to defects caused by trauma. 11 of the transfers were carried out as an emergency procedure, the remaining 17 were elective surgery. There were 27 male patients and 1 female. The mean age was 38 (10-67) years. The flap artery was anastomosed to the forearm radial and ulnar artery in 4 and 4 transfers, respectively, and to the radial artery in the anatomical snuffbox in the remaining 20 transfers. In 2 cases of lateral upper arm flap we included a strip of the triceps tendon for reconstruction of an extensor tendon. We carried out a sensory upper arm flap in 3 cases. One scapular flap was raised

as a triple flap consisting of 2 skin flaps and the lateral margo of the scapular bone for reconstruction of the third metacarpal bone and the volar and dorsal skin defect caused by a shotgun. The remaining 22 flaps were raised as simple skin flaps. The tissue to be covered was a larger skin loss or scar in 7 cases, exposed tendon or tendon grafts in 10, exposed bone or joints in 8, exposed nerves in 2 cases and in 1 case the graft was used in reconstruction of a thumb.

Results and discussion: In total, 26 flaps healed. A partial necrosis of one upper arm flap occured and led to amputation of the long finger. Another upper arm flap which covered an electrical burn at the volar distal forearm failed totally and was replaced by a conventional groin flap. The donor site morbidity was minimal. Our study shows that free microvasculare flaps are a safe, convenient alternative to conventional flaps in hand surgery. The upper lateral flap is very suitable in hand surgery as it can be raised in a bloodless field with a supine patient under plexus anesthesia, it is less bulky than several other skin flaps and it has a neurosensory potential.

165. Foot function following second toe transfer for hand reconstruction

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

Kronprinsesse Märthas Institutt, National Orthopaedic Hospital, Oslo, Norway

Toe-to-hand transfer by microanastomoses has become one of the most important methods in reconstructing a severely injured hand since the operation in 1969 for the first time was performed in man. The choice of toe to be transferred usually involves the first or the second. We chose the second toe for hand reconstruction because we felt that the function and appearance of the foot are less influenced than after removal of the big toe. In the present study we evaluated the consequences of removal of the second toe for the foot.

Patients and methods: In the period 1983 to 1989 we removed 26 second toes from 25 patients, 4 females and 21 males. Their age at the time of the operation was 31 (4–65) years. In 21 cases the toe was exarticulated through the metatarsophalangeal joint and in 5 cases through the shaft of the metatarsal bone. A nonweight-bearing period of two weeks postoperatively was prescribed.

Results and discussion: The wounds healed primarily in 25 cases. In one case where the toe had been removed together with a big dorsalis pedis flap, split skin transplantation was performed. In 23 of the 26 cases no foot problems occurred. In 3 patients a second operation was performed. One female patient had a moderate bilateral hallux valgus before the left second toe was removed. She had to be treated by bilateral osteotomy of the first metatarsal bone and resection of the left second metatarsal bone 2 year after the removal. In one male patient with midtarsal second toe amputation, the big toe adopted a valgus position. He was treated by MTP-I arthrodesis as there was arthrosis of the MTP-I joint. The third reoperation was performed in a male patient with metatarsalgia caused by the head of the remaining second metatarsus. We performed an oblique osteotomy of the second metatarsal bone. The 3 reoperated patients became painfree. No patient had to use special footwear.

Conclusion: The second toe may provide a mutilated hand with a mobile and sensible thumb that may convert a 50 percent reduced hand function to an almost normal function. The toe can be removed either through the MTP joint or through the metatarsal bone with minor cosmetic and functional foot sequelae.

166. Surgical treatment of pathological thoracolumbar fractures

Lennart Sjöström, Göran Karlström, Halldor Jonsson and Claes Olerud

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

Pathological fractures in the thoracolumbar spine are known for severe pain and risk for paraplegia. Surgical treatment is often necessary for pain control and decompression of neural tissue. We have retrospectively analyzed all cases operated at our institution 1981–1987.

Materials: 37 patients have been treated. 13 had fractures in the thoracic and 24 in the lumbar spine. Mild or moderate paraparesis was present in 20 cases. The most common primary tumor was renal cancer. Minimum follow-up was two years.

Methods: Stabilization was during the first years carried out with Harrington rods or Roy-Camille plates, later with the PSF transpedicular device. Decompression was early done with laminectomy in all cases with paraparesis but later anterior and/or posterior decompression was done after careful analysis of the type of compression.

Results: 6-month survival was 16/37, one-year survival 9/37. Pain relief was good and lasting in 29 cases. 5 patients had inadequate pain relief, mainly Harrington-stabilized lumbar fractures. 3 had recurrent pain due to rod displacement. Only 3 of 13 patients with paraparesis treated with laminectomy retained walking ability until their death, in contrast to 6 out of 7 treated with anterior decompression. Reduction of the fracture through ligamentotaxis was found to be an alternative to vertebrectomy for severely diseased patients in need of anterior decompression.

167. Disc degeneration and angular movement of the lumbar spine: A comparative study of 77 patients using plain radiography, discography, and flexion-extension radiography

Juhani Soini[1], Ilkka Antti-Poika[1], Kaj Tallroth[1], Yrjö T. Konttinen[2], Visa Honkanen[2] and Seppo Santavirta[1]

The Orthopaedic Hospital of the Invalid Foundation[1] Helsinki, Fourth Department of Medicine, Helsinki University Central Hospital[2], Helsinki, Finland

We studied the association between disc degeneration seen both in plain radiographs and in different discogram types and abnormal angular movement (instability) of lumbar vertebrae. In addition, the association between exact pain reprodution on pressure during disc injection and instability was studied. In total 169 discs in 77 patients (42 men, 35 women), whose mean age was 34 (16–46) years comprised the present series. Discography was more sensitive than plain radiography in the diagnosis of disc degeneration (Spearman's rank correlation, r = 0.447, $p < 0.01$) and disc degeneratian was more common in men than in women (Chi square test, X2 = 9.88, $p < 0.05$). Increase in disc degeneration was observed in lower lumbar segments (X2 = 48.63, $p < 0.001$). However, no association was observed between instability and different discogram types (X2 = 2.63, $p > 0.05$) or exact pain reproduction on pressure during disc injection.

Conclusion: Angular movement seen in flexion-extension radiography gives little information about lumbar instability and its use should be questioned. In addition, the clinical relevance of exact pain reproduction in the assessment of lumbar instability remains indistinct and should be further studied.

168. Analysis of 214 nonoperated cases with lumbar disc herniation

Arto Herno, Outi Leskinen and Maria Vatanen

Department of Surgery and Diagnostic Radiology, Kuopio University Central Hospital, Kuopio, Finland

The majority of patients with acute lumbar disc herniation need only conservative treatment. The purpose of this study was to evaluate the results concerning 214 patients with herniated lumbar disc diagnosed on myelographic and/or CT-scanning examinations.

Material: During the period from 1980 to 1987, 269 patients with disc herniation were treated conservatively and 214 patients (80%) with adequate data were involved in this study. There were 97 women (45 %) and 117 men (55 %). The mean age of these patients was 43 (17–77) years and the mean follow-up time 4.8 (1.6–9.5) years. None of thee patients had previous lumbar surgery.

Methods: A history concerning the beginning of the symptoms and the radiologic findings were collected on the basis of medical records. A questionnaire concerning subjective disability, working capacity, retirement and recurrent symptom was filled in by every patient.

Results: The herniation was at L3–4 in 3 % , at L4–5 in 53 % and at L5–S1 in 44 %. The indication for conservative treatment was in 58 % pain relief , in 8 % patient refusal of surgical treatment and in 34 % there was no indication for operative treatment. The symptoms were relieved in 38 % within three month, in 64 % within six months and 20 % of the patients had persistent pain after one year. 70 % of the patients returned to work and nine percent were retired before the herniation. Only 8 % of the patients had been pain-free after the attack of the herniation. Subjective functional status was excellent or good in 74 % and fair or poor in 26 %. The subjective working capacity was excellent in 14 %, good in 38 %, fair in 30 %, poor in 13 %, and very poor in 4 %.

Conclusion: The results of this study are comparable with the results of lumbar discectomy.

169. Position of the patient, blood loss, and operating time in lumbar disc surgery

0. Böstman, J. Hyrkäs, E. Hirvensalo and E. Kallio

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

Many text books and papers on lumbar disc surgery still, nearly forty years after the first description of a variant of the kneeling position, pay no attention to the positioning of the patient. In this study the association between intraoperative blood loss, operating time and position of the patient was studied.

Patients and methods: The study comprised 436 patients undergoing a standard macrosurgical operation for lumbar disc herniation. Prone position on bolsters was used in 216 cases, 192 of which were primary operations, and a frame-supported kneeling position in 220, 203 of which were primary operations.

Results: The mean blood losses in prone vs. kneeling positions in the primary operations were 376 mL vs. 150 mL ($p < 0.001$), and the mean operating times were 74 minutes vs. 52 minutes ($p < 0.001$). The 99 % confidence interval for the difference between the mean operating times was from 15 to 29 minutes. A moderate, non-linear positive correlation was found between intraoperative blood loss and operating time. No intraoperative complications attributable to the position of the patient emerged.

Conclusion: On the basis of the findings in this study the use of kneeling position is strongly advocated.

170. Back pain in pregnancy and maternity back training

Hans Christian Östgaard, Bernhard Svanberg, Gunilla Zetherström, Eva Roos and Ann Nilsson

Department of Orthopedics, Sahlgren Hospital, Gothenburg, Sweden

Back pain is common in pregnancy and often results in sick-leave. Most maternity care units have a training program for delivery, but no prophylaxis against back pain. The aim of this study was to determin the impact of information and back training led by a physiotherapist on back pain in pregnancy.

Patients and method: At registration all women were allocated into one of three groups according to day of birth. Group A: 145 women, was the control group. Group B: 93 women, who had two one-hour classes. Group C: 124 women, who had five individual one-hour lessons. The two first lessons were given before the 20th. week of pregnancy and later on one lesson was given every five weeks. Also, group C were given a home training program on a music casette.

Results: In the 36th. week 2/3 of all women had experienced some period of back pain. In half of the cases the pain began before the 20th week. Women with back pain answered as follows (percent):

Group	A	B	C
Ease back pain through back training	20	51	69
Ease back pain through change of working position	52	52	69
Sick-leave for back pain in pregnancy	50	52	37

Groups A and C differed significantly ($p < 0.05$).

Conclusion: Back pain in pregnancy can be reduced through purposeful information and an individual training program. The beneficial effect of changes in workingposition on back pain can be expanded and sick-leave be reduced.

171. Can anesthetic lumbar discpuncture define the paincausing level in low back pain and sciatica?

Karl Akke Alberts, Hans R. Larsson, Olle Marions and Lennart Hult

Karolinska Institute and Departments of Orthopedic Surgery and Diagnostic Radiology, Södersjukhuset, Stockholm, Sweden

The causes of chronic low back pain and sciatica are often obscure especially in patients who have no radiologically demonstrable pathologic process.

Material and methods: Lumbar discpuncture with injection of anesthetic and contrast medium was conducted in 14 patients with chronic low back pain or sciatica with the aid of a two-plane image intensifier, with the object to identify the pain causing level. All patients had a negative CT-scan and/or myelogram. They were resistant to conservative treatment. A positive test was defined as at least two hours pain-free interval in spite of symptom provoking exercises.

Results: Eleven patients had a positive test at one disc level, two patients had an inconclusive test result and in one patient there was a technical failure due to leakage of anesthetic and contrast medium. Eight patients with a positive test were operated on by spinal fusion. Seven of them became pain-free and one remained unchanged. Two patients with a positive test were not operated on due to medical reasons, while one had an explorative laminectomy. The three patients without a positive test were also operated on by spinal fusion. One of them improved.

Conclusion: The results show that diagnostic anesthetic discpuncture seems to be an aid in defining the pain causing disc level, and selecting patients for spinal fusion.

172. Operative reduction and stabilization of severe spondylolisthesis in adolescents

Dietrich Schlenzka, Mikko Poussa, Kalevi Österman and Seppo Seitsalo

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

Eleven patients underwent a two-stage operation consisting of posterior decompression and root exploration of L5, reduction of L5 by means of Magerl's external fixation device, fixation using Dick's internal fixation device and anterior as well as posterolateral fusion. The primary results after a mean follow-up of 2 years are presented. The mean improvement of the lumbo-sacral kyphosis was 65 %, and slipping improved on average 40 %. There were complications in four cases (loosening of sacrum pins, partial loss of correction, pseudarthrosis). No neurological complications were seen.

Conclusion: The method in safe. It is recommended only for those few patients with severe unstable displacement combined with significant lumbosacral kyphosis.

173. MRI and discography in adolescents with symptomatic isthmic L5 spondylolisthesis

Dietrich Schlenzka, Mikko Poussa, Seppo Seitsalo and Kalevi Österman

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

The frequency of intervertebral disc changes in adolescent patients with spondylolisthesis is unknown. In the present

study the lower lumbar discs in adolescent spondylolisthesis patients were evaluated using radiography, discography and MRI. The material consisted of 27 patients, 14 girls and 13 boys. The age on admission was 14 (11–18) years. The slip in girls was 45 ± 23 % and in boys 27 ± 17 % ($p < 0.05$) on average. Discography of three lower levels was performed in 23 and MRI in 16 patients. In 12 patients both examinations were done.

On plain radiographs, a normal presacral disc was seen in 11 patients with 15 % slip, narrowing of the disc height < 50 % in 4 patients with 24 % slip, and > 50 % in 12 patients with 53 % slip ($p < 0.01$). In discography and MRI the presacral disc was degenerated in all patients. In discography the L4-5 disc was normal in 3, ruptured in 7 and degenerated in 12 patients. Degeneration seems to be associated with retroposition of the L4 vertebrae. MRI-findings correlated fairly well with the discography on that level.

The results of this small series show that in adolescent spondylolisthesis, early disc degeneration seems to be more common than expected in the disc below as well as above the slipped vertebra.

174. Correction of posttraumatic kyphosis with a transpedicular reduction device and simultaneous anterior and posterior approach

Lennart Sjöström, Göran Karlström, Halldor Jonsson and Claes Olerud

Department of Orthopaedic Surgery, University Hospital, Uppsala, Sweden

With a simultaneous anterior and posterior approach a transpedicular device can be used to support correction of kyphotic and translatory posttraumatic deformities. The postoperative stability is improved and staged procedures are avoided.

Material and methods: Eight patients with posttraumatic kyphosis in the thoracolumbar spine were treated. A PSF transpedicular device was inserted and posterior bony reduction restraints resected through a dorsal approach. Access to the kyphotic area was gained through an anterolateral exposure. The vertebrae and discs were resected sufficiently to allow for reduction. Special reduction handles were connected to the PSF device. With these, lordosing and translatory forces can be applied and full correction of the deformity was possible. An anterior bone graft was inserted and put under compression by shortening of the posterior device which was then locked. A posterior fusion was performed and both wounds closed.

Results: Operation time averaged 5 h 20 m and peroperative blood loss 4,600 mL. No complications were seen. Correction averaged 24° of kyphosis. Minimum follow-up is one year. All fusions have healed with minor correction losses.

175. Pathoanatomical findings in surgical spinal specimens

Halldór Jónsson Jr, and Wolfgang Rauschning

Department of Orthopaedic Surgery, Academic University Hospital, Uppsala, Sweden

Despite the fact that both degenerative, traumatic and metastatic spinal changes may be be of high clinical significance, the spine is rarely autopsied, not even following major surgical interventions. Detailed pathoanatomical assessment of the surgical results is essential for developing and improving surgical procedures.

Modifying a precision technique for cryoplaning of undecalcified specimens, spines were studied in which virtually every type of surgical procedure and instrumentation had been performed. The arterial system of the spine was injected with red contrast medium to distinguish the arteries from the veins. By freezing of the spines in situ before removal of the specimens, the soft tissue-bone relationships were preserved in the spine segments in which surgery had been performed.

Metallic implants and devices were extracted from the frozen specimens, the screw tracts and implant cavities were casted with a colored barium contrast medium. Bone cement was left in place although it severely dulled the microtome blades. CT scans of the specimen were obtained in relevant imaging planes. The specimens were then cryosectioned in the plane of imaging and high resolution overview and closeup photographs were obtained at submillimeter intervals.

The pathological anatomy as well as the results of both anterior and posterior surgery were documented in both spinal fractures and metastatic spinal disease as well as decompressions and fusions in degenerated spinal conditions.

Correlation of cryosectional images with in vivo diagnostic studies such as plain radiography, CT and MR-scans rendered valuable data with respect to surgical approaches and safety margins for placement of facet joint and pedicle screws. Detailed pathoanatomical assessment of spines in which surgery has been performed is crucial both improvements of diagnostic modalities as well as refinements of surgical techniques and instrumentations.

176. Rheumatoid arthriris evaluated by locomotion score: A population study

Sven-Erik Larsson and Brynjolfur Jonsson

Department of Orthopaedics, University Hospital, Linköping, Sweden

To map out destructive RA a total study was performed of an epidemiological population using total locomotion score[1].

Patients and method: A representative Swedish population of 12,707 inhabitants (Åtvidaberg) was surveyed. 82 patients were found fulfilling ARA criteria 5–8 (Rome 1961). All patients were evaluated clinically with total locomotion score1 (max 100). A thorough cost calculation was done.

Results: Prevalence was 0.51 for men, 0.78 for women and 0.65 in the overall population. The ratio women:men was 1:0.67. Mean age was 65 (30–92) years, age at onset 47 (7–91) and disease duration 19 (1–65) years. Total locomotion score was 72 (24–96) overall; 76 (24–96) for men and 68 (30–94) for women. Among the ages above 64, women had significantly ($p < 0.02$) lower score than men. Mean subjective score (max 100) was 62 (4–93) overall; 67 (5–93) for men and 58 (9–92) for women, and objective score (max. 100) 82 (23–100); 85 (44–99) for men and 78 (23–100) for women.

Through the years, a total of 108 reconstructive operations had been performed on 36 out of the 82 patients (44 percent). Indication for further reconstructive surgery was found in as much as 56 percent of the patients including 58 major joint replacements. Score for patients in need of operation was significantly lower than that of those who were considered not to need operation. Scores 50 or below were associated with a 12-fold cost increase to society.

Conclusion: Destructive RA is in great need of reconstructive surgery to improve tho patients' subjective and objective locomotion status. Costs of the disease may become reduced.

Reference

1. Larsson S-E and Jonsson B: Locomotion score in rheumatoid arthritis. Acta Orthop Scand 1989; 60(3): 271-277.

177. Bone loss in women—a longitudinal study of 15 years

Per Gärdsell, Olof Johnell and Bo E. Nilsson

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

The objective was to compare the predictive value of low bone mass for future fragility fractures with the subsequent bone loss.

Material and method: 366 women who had their bone mineral content (BMC) measured before 1976, were remeasured (after on average 15 years). All fractures that had occurred between 1975 and 1987 were recorded.

Results: 96 women in the age group 40–69 years sustained a fragility fracture where 97 women had not had any fracture during their adult lives. The initial BMC was less in those who were to have a fragility fracture during the observation period. The rate of loss decreased with age and was not correlated with fracture risk. A high initial BMC was associated with a high rate of loss. However, a subset of rapid losers with subsequent fracture was found in the highest quartile of BMC in women 50–69 years of age. The risk ratio for sustaining a fragility fracture was about doubled in the quartile with the lowest rate of loss compared with the highest.

Conclusion: There seems to be a small subset of "rapid losers" but only in women with high bone mass. The initial BMC value is a better predictor of fracture, therefore preferable when screening for high risk patients.

178. Femoral anteversion in adolescent and adults measured by ultrasound

Terje Terjesen, Svein Anda and Svein Svenningsen

Departments of Orthopaedics and Radiology, Trondheim University Hospital, Trondheim, Norway

We have previously found that femoral anteversion (AV) in children can be reliably measured by ultrasound. The aim of the present study was to evaluate the reliability of our ultrasound technique in adolescents and adults.

Patients and methods: Femoral anteversion was determined by real-time ultrasound and biplanar radiography in 40 adolescent and adult patients. With the patient supine, their knees flexed 90°, and their lower legs strapped in the vertical position, one ultrasound scan only of the proximal femur was needed. The linear transducer was tilted until the anterior tangent of the femoral head and greater trochanter (head-trochanter tangent) appeared horizontal on the monitor screen. The angle of tilt of the transducer, which represented the AV angle, was measured with a clinometer attached to the transducer.

Results: There was a high correlation between the AV values by ultrasound and radiography ($r = 0.94$). However, greater AV angles were consistently measured by ultrasound; the mean discrepancy between the methods was 11°. Thus, a correction factor has to be employed, and 10° should be subtracted from the ultrasound values measured in order to obtain the real AV angles. When this was done, the discrepancy between ultrasound and radiography was 5° or less in 61 hips and 10° or less in 79 of the 80 hips.

Conclusion: The present ultrasound technique with tilted transducer and the head-trochanter tangent as the reference line represents a reliable method for measurement of femoral anteversion in adolescents and adults. This method is recommended as a screening technique in adults as well as children with clinical signs of increased femoral anteversion and other rotational disordes of the femur.

180. Preoperative profylactic and short term postoperative treatment with piroxicam in arthroscopic meniscectomy

Ove J. Fasting, Bjørn 0. Thoresen and Gisle Uppheim

Aker-, Ullevål- and Menighetsøsterhjemmets Hospital, Oslo, Norway

It is well documented that treatment with non-steroidal anti-inflammatory drugs (NSAIDs) reduces inflammation and pain, and improve rehabilitation after trauma and operations. In previous studies profylactic NSAIDs were administered 3 to 6 weeks after operations, a long term treatment hardly acceptable as routine in connection with not major operations. This study was designed to document the effect when piroxicam was administered preoperatively and two days postoperatively.

Methods: Patients who were suspected to have a meniscal tear were randomised into two groups. One group was treated with piroxicam (Felden®), the other group received placebo. Treatment began the evening prior to the operation and continued through the second postoperative day. The dose of piroxicam was 40 mg daily for the first two days and 20 mg for the next two days.

Pain at rest, pain on knee motion and reduction from normal activity level were recorded subjectively by the patients at a 100 mm visual analog scale (VAS) every day for the first two weeks and at 3 weeks. Physical examinations were performed 1 and 3 weeks after operation.

Materials: Totally 332 patients were entered into the study. 88 had other internal derangements or no pathology found at the arthroscopy, leaving 244 patients operated with *partial meniscal resection to be evaluated in this study. 115* received piroxicam and 129 placebo.

Results: In the first week after operation the patients treated with piroxicam had significantly less pain, especially on the day of operation, better motion and less swelling and had less need for further analgesics. In the first two weeks the difference in reduction from normal activity level were not significant. However, at 3 weeks the treated group had not been able to normalize their activity to the same degree as the placebo group.

Discussion: With modern arthroscopic technique, operation for a meniscal tear has been reduced to a minor operation. However, there is still discomfort for the patients mainly caused by pain, swelling and lack of motion particularly in the first week. Piroxicam can effectively reduce this discomfort and if started preoperatively it does not seem necessary to continue treatment for more than a few days. The possibility of complications are thereby minimized and there may be an indication to use piroxicam also in minor surgery.

Early motion and activity are usually beneficial for the rehabilitation. It must be balanced against too vigorous activity which may later cause increased soft tissue reaction. In this study this may have been the case. The treated group were later set back in rehabilitation compared with the untreated group.

181. Does short term administration of NSAIDs prevent heterotopic bone formation in THR patients?

Leif Ahrengart and Hans Törnkvist

Department of Orthopaedic Surgery, Karolinska Institute, Huddinge University Hospital, Huddinge, Sweden

Periarticular heterotopic bone (HB) formation constitutes one of the most frequent complications following hip arthroplasty. Ibuprofen is effective as prevention against HB when given daily for three months. We have investigated the efficiency of ibuprofen as prevention against HB if given only for 10 days.

Material: Fifty-seven patients with primar arthrosis of the hip participated in a prospective, double-blind, randomized study. *A cemented HD II prosthesis was implanted via* the direct transgluteal approach in all cases. Suppositories containing 500 mg of ibuprofen or placebo were given three times daily, beginning on the evening before surgery, and continued for 10 days. The amount of HB was graded 0–3 on radiographs after 12 months according to the classification by Rosendahl et al. (1977). Forty-seven patients completed the study.

Results: No significant difference in the occurrence of HB between the two groups could be detected (Table 1). The total prevalence of HB seemed somewhat greater in the ibuprofen-group (67%) than among controls (58%) but only one thus treated patient (5%) developed Grade 3 of HB compared to four (15%) among controls.

Table 1. The occurrence of HB at 12 months postoperatively (number of patients)

Grade of HB	0	1	2	3	n
Ibuprofen	7	10	3	1	21
Controls	11	6	5	4	26

A tendency (NS) that ibuprofen seemed to prevent large, but not small, amounts of HB was also seen when male patients were analysed separately (Table 2).

Table 2. HB among men when dividing the amount of HB into two categories: none/insignificant (0/1), significant (2/3) (number of patients)

Grade of HB	0/1	2/3
Ibuprofren	9	3
Controls	7	6

Conclusion: Ibuprofen, which is effective as prevention against heterotopic bone formation after hip arthroplasty when given for three months, was not found to have any significant effect on the development of HB when given for 10 days. A tendency that ibuprofen may counteract the more advanced forms of HB was seen. Our study is, however, small and no significant differences were found.

182. Improvement in bony deformity in diphosphonate treated patients with Paget's disease

Derek R. Bickerstaff, David L. Douglas, Declan P. O'Doherty and John A Kanis

Department of Human Metabolism and Clinical Biochemistry, University of Sheffield, England

Treatment of Paget's disease with diphosphonates induces long remissions of disease activity. It is not certain however whether suppresion of disease activity is associated with alteration of bony deformity.

Methods: We studied the long-term effects of diphosphonate treatment (etidronate or clodronate) on facial contours in nine patients, six with maxillary and three with skull disease, utilising a stereophotogrammetric technique.

Results: In eight patients, treatment was associated with a marked reduction in serum alkaline-phosphatase to 25% of initial values, effects which were sustained by intermittent retreatment when necessary. In those patients with maxillary disease, volume decreased by 8 (3–22) % over 2 years and continued to decrease for the subsequent 3 years of observation (yearly decrease 2.2 %). In those with skull involvement, the volume decrease was more marked (13.6 (12.5–13.6) %) over one year. The remaining patient with maxillary disease showed biochemical resistance to treatment and no change in maxlllary volume. The stereophotogrammetric technique had a long-term reproducibility of 2% assessed by repeated measurements of skull volume in patients with no skull disease.

Conclusions: These data suggest that long-term control of disease activity in Paget's disease is associated with the restoration of more normal skeletal shape and support the view that good biochemical management is causally related to clinical benefit.

183. The physical and psychosocial effect of moderate osteoarthrosis of the knee

Eva Mattsson and Lars-Ake Broström

Department of Physical Therapy and Orthopedics, Karolinska Institute, Stockholm, Sweden

Sixty patients with medial, moderate gonarthrosis, Grades I–III, mean age 63 years, 35 female, have been clinically and radiographically examined as well as reviewed using "Sickness Impact Profile" (SIP). All patients were planned for knee surgery.

The total SIP was 7.4 ± 5.6, the physical SIP was 10.8 ± 7.2 and the psychosocial SIP was 3.6 ± 5.5.

184. Anterior-posterior laxity measurement of the knee joint: A comparison between KT-1000 and roentgen stereophotogrammetry

Håkan Jonsson, Lars-Gunnar Elmqvist and Johan Kärrholm

Department of Ortopedic Surgery, University Hospital of Umeå, Umeå, Sweden

We have compared the KT-1000 arthrometer with anterior-posterior tractions and roentgen stereophotogrammetric (RSA) measurements of knee laxity.

Material and methods: Eighty-one patients with anterior cruciate ligament injury were evaluated. KT–1000 was used with 89 N traction and the RSA examination with 150 N anterior and 80 N posterior traction. Fifty-three pre- and postoperative examinations were done.

Results: The mean AP-laxities in intact knees were 5.9 mm with both KT–1000 and RSA (SD [KT–1000] 2.6 mm; SD [RSA] 1.9mm). On the injured side KT–1000 recorded a mean laxity of 11.3 mm (SD 3.8mm) and the RSA technique 13.7 mm (SD 4.5mm). The preoperative paired difference (injured-intact) was less than 2 mm in 7 using KT–1000 and in 1 of the patients when measured with RSA. After reconstruction of the ligament a side difference of more than two mm was recorded in 30 patients with KT-1000 and in 44 with RSA.

Conclusion: The RSA technique seems to have a higher sensitivity than the KT–1000. The tendency of KT–1000 to underestimate abnormal knee laxities may question its value in the assessment of reconstructive knee surgery.

185. Frontal plane morphology of the femur in patients with arthrosis of the knee

Pentti Kinnunen and Timo Väyrynen

Department of Surgery and Therapeutic Radiology, University Central Hospital, Oulu, Finland

The basic pathophysiological event in the idiopathic arthrosis of the knee is an increase in and an asymmetrical distribution of the compressive stresses across the joint, which will lead to the overloading on the medial or lateral compartment and to the varization or valgization of the knee, respectively (Maquet 1985, Coventry 1989). The causes of these unfavorable progressive angular deformities are unknown. Minor heritable and developmental anatomical abnormalities will permit identification of the population at risk of degenerative hip and knee disease.

Frontal plane morphology of the femur was examined in 127 patients treated for gonarthrosis. 107 were operated on (high tibial osteotomy) for varus deformity and 20 for valgus deformity. The follow-up examination included orthoradiographic evaluations. The present study was based on measurements of the following angles:

1) collum-diaphysis angle,

2) condyle-diaphysis angle
3) frontal inclination angle of femur (FIA) (Figure 1).

Results (degrees):	Deformity		t-test
	Varus	Valgus	
Collum-diaphysis	120.1 ± 8.4	122.0 ± 11.0	NS
Condyle-diaphysis	82.4 ± 2.9	77.0 ± 2.5	***
Frontal inclination	37.7 ± 9.1	46.4 ± 9.5	**

In this material a great variation in the shape of femur in the frontal plane was seen. Roughly there can be found two types of abnormality, abduction type femur (FIA low) and adduction type femur (FIA high).

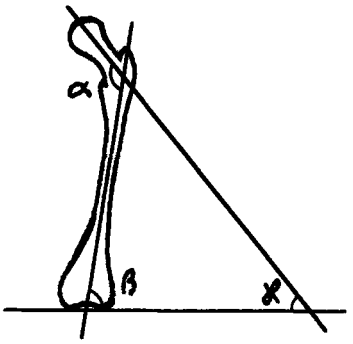


Figure 1. The three angles determined from orthoradiography
1. collum-diaphysis (alpha)
2. condyle-diaphysis (beta)
3. frontal inclination angle (gamma=alpha-beta)

References
Maquet P. Clin Orthop 1985: 192: 108–112.
Coventry M. Orthop Rev 1989: Vol XVII, 5: 456–458.

186. Treatment of acute patellar dislocation with medial reefment and lateral release

Pekka Jalovaara, Timo Niinimäki, Markku Päivänsalo and Ralf V. Lindholm

Department of Surgery, University of Oulu, Finland

Patellar dislocation is a multietiological problem for which many different treatments have been devised. Several authors have recommended early surgical repair hypothesizing that there is continuing disability and lack of pain relief with nonsurgical treatment. In this series the operative results of lateral release and medial reefing operations used at our institution from 1978 as the initial treatment for acute patellar dislocations are analyzed.

Material and methods: Eighty-five patients (21 male, 64 female) with a median age of 21 (10–45) years were obtained for a follow-up study. At the follow-up examination the patient's postoperative history especially with regard to recurrences and status were recorded. The radiographic examination included anteroposterior, lateral and patellar views.

Results: The average lenght of the follow-up was 4 (1–8) years. General joint laxity was seen in 38 patients, pathological Q-angle in 38, quadriceps atrophy greater than 1 cm in the circumference of the thigh in 44. The results based on the subjective evaluation of the patients showed 37 excellent, 29 good, 15 fair and 4 poor responses. The objective evaluation according to Turba et al. (Am J Sports Med 1979; 7: 91–94) was more favourable; excellent 22, good 51, fair 11 and poor 1. Fourteen patients had had redislocation and 20 had experienced feeling of subluxation. Twenty-eight patients experienced recurring chondromalacia like patellar pain.

Conclusion: The recurrence rate of 12% is clearly lower than that of the conservative treatment, which has been reported to be 40–50. A considerable number of patients have milder symptoms such as feeling of patellar instability and anterior knee pain.The future development of the surgical treatment of acute patellar dislocation should consider also this group of patients.

187. Reconstruction of patellofemoral joint with free periosteal graft

Veijo Ritsilä, Veijo Hoikka and Heikki Jaroma

Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

Reconstruction of damaged articular surface of the patellofemoral joint with free periosteal grafts was performed in 13 patients (6 men and 7 women) with a mean age of 3 (16–55) years. Previous conservative and operative treatment had failed to alleviate pain. The mean follow-up was 4 (2/3–9) years.

The damaged articular surface was debrided and multiple holes were drilled on the bare surface to be covered with periosteum. The periosteal graft taken from the anterior surface af the tibia was sutured or glued with the gambium in layer towards the subchondral bone. In 2 cases both the patellar and femoral surfaces of the patellofemoral joint were covered with periosteum. Postoperatively, the knee was mobilized immediately after the surgery or within 2 weeks in most cases.

The result was good in 8 cases (the knee did not restrict the patient's daily activities), fair in 4 cases (remarkable alleviation of pain), and poor in 1 case (the knee remained very painful). The patient with the poor result was a 55 year old man with patellofemoral and femorotibial arthrosis.

Conclusion: Resurfacing of the patellofemoral joint with free periosteal graft is a suitable method in the treatment of painful patellofemoral articular damage.

188. Patella osteotomy: A cadaver study

Christopher M. Blundell, Ian Winson and Michael Saleh

Department of Orthopaedics, University of Sheffield, England

Anterior knee pain remains a major problem throughout life. A number of conditions appear to cause the symptoms leading to confusion in diagnosis and management. The most obvious cause is established arthrosis confined to the patello-femoral joint. Studies by Maquet and others have suggested that alteration of the mechanics of the patello-femoral joint by realignment of the extensor mechanism would produce a reduction of symptoms. Recent work has suggested that though the Maquet procedure may produce a reduction in forces occurring in the patello-femoral joint there comes a point where the reduction in contact area is such that the force per unit area (pressure) increases.

The disappointing results of these procedures and the possibility of influencing the contact area and hence the pressure by other means led us to investigate the effect of opening and closing wedge osteotomies of the patella.

Materials and methods: Seven cadaver knees were studied by mounting them in a jig designed to apply a force to the quadriceps tendon whilst the knee was held in different degrees of flexion. Pressure and contact area were studied before and after opening and closing wedge osteotomies using pressure sensitive film. Subsequent analysis was carried out using a Seescan Image Analyser allowing quantification of the results.

Results: Between 15° and 60° of flexion at each angle tested the total contact area was increased with closing wedge osteotomy, whereas at 75° and 90° it was reduced. Within this contact area the peak pressure was increased at all angles of flexion tested. Opening wedge osteotomy reduced the contact area at each angle tested between 15° and 90° of flexion. Peak pressure was increased at all angles of flexion except 60°.

Conclusions: This study shows an ability to alter contact area with patella osteotomy. Closing wedge osteotomy in increasing the contact area in the functional range of motion (0–60°) in these studies suggested that it may have a role to play in the management of patello-femoral arthrosis. The presence of the high peak pressures suggested that caution should be used in clinical application.

189. The effects of liquid cooled orthopedic sawblades

Søren Toksvig-Larsen, Leif Ryd and Anders Lindstrand

Department of Orthopedics, University Hospital, Lund, Sweden

Bone cutting gives rise to significant heat generation, which results in subsequent bone necrosis (temperatures greater than 44–47 °C). This may have clinical implications, for example in the context of bony ingrowth into porous coated prostheses, but may also be one reason for delayed union after osteotomy. Previous studies during knee prosthetic surgery has shown that the usual "squirt cooling" has no effect. Alteration of the sawblade geometry do not affect the temperature elevation.

Methods: Temperature measurements using a 3M 122 oscillating saw blade, provided with a thermocouple, was done in a laboratory set up on ox-bone, using a hand-held 3M Maxi Driver power tool. Cooling of the cutting process was done in four ways.

1. Saline was applied by a syringe manually as in the usual clinical situation ("squirt cooling") with an estimated flow of 0–100 mL/min.
2. External cooling with a pump delivering 600 mL/min.
3. A new prototype sawblade was built from two standard 3M "122" oscillating saw blades adapted to each other (thickness 2 mm) with canals inside, so that a cooling agent was directed to the saw-teeth. This saw blade was connected to an arthroscopy pump with a flow of 80 mL/min. Measurements were done with the pump delivering 80–10 mL/min in decrements of 10 mL/min.
4. A 1-mm-thick sawblade built after the same principle as the prototype (Mitab) was tested with a flow of 80mL/min and 40 mL/min.

Results: Test without cooling gave a mean maximum temperature of 101 °C ± 36. "Squirt cooling" decreased that temperature to 61 °C ± 18. Cooling by pump yielded a maximum temperature of 42 °C ± 7. Internal cooling was found to control the temperature in the most satisfactory manner with mean max. temperatures of 23–30 °C ± 1–3. Decreasing the flow of saline resulted in gradual increase in temperature, which reached critical levels below 20 mL/min. Test of the 1-mm internally-cooled blade gave mean max. temperature of 28 °C ± 4 at a flow of 80mL/min and 32 °C ± 4 at a flow of 40 mL/min.

Discussion: The internally-cooled sawblade consistently lowered the cutting temperature to subcritical values by the cooling itself as well as by removing the chips form the kerf of the saw.

190. A method to evaluate the precision in bone cutting

Søren Toksvig-Larsen and Leif Ryd

Department of Orthopedics, University Hospital, Lund, Sweden

Biological fixaion of orthopedic implants through bony ingrowth into prosthetic surfaces was developed to provide long-term stable fixation, but this fixation has been shown to be unreliable and variable. Carlson et al. has shown that gaps between bone and implant is a powerful determinant

for osseointegration. Gaps of 0.35 mm is a critical distance which may prevent bony ingrowth. The objective of this study was to develop a method with which the flatness of the cut bone surface could be quantified.

Method: Saw cuts were performed on cadaver knees and negative imprints were made on the bone. Positive imprints were done from dental plaster cast. The surface flatness was measured by a Zeiss Universal Measuring Centres UMC 850. Measurements were done both on the frozen bone pieces and on the corresponding plaster models.

Results: The comparison of the bone surface and the plaster was acceptable. The cut surfaces were uneven with a difference between the lowest and highest measuring points of 1.05–2.61 mm on the bone and 1.22–2.30 mm on the plaster models. The standard deviation, which describes the flatness quality of the surface, varies between 0.20 and 0.40 mm. The diagram showed problems with the cut surfaces in the middle of the plateau in front of the posterior cruciate ligament. (Figure 1).

Discussion: A clinically flat surface shows a considerable lack of flatness despite the use of guide instruments and despite the fact that these surfaces were judged to be acceptable for non-cemented insertion. Our measurements indicated that the tibial component may not have optimal support, which could be an additional explanation for the small amount of bony ingrowth (0–40 %) in retrieval studies.

Conclusions: This study should be seen as an attempt to objectively analyse the flatness of the bony surface. The method is well adapted for further studies also in the clinical situation.

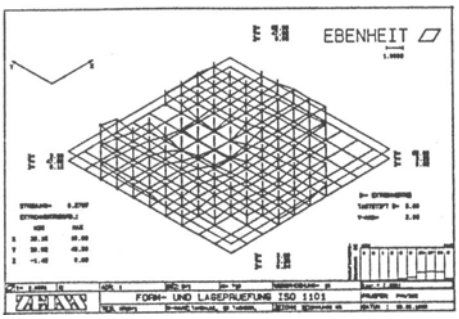


Figure 1. Diagram showing the configuration of the flatness, magnification x10.

191. Bone banking for allograft surgery

Allan J. Aho, Tuomas Yli-Jama, Hannu T. Aro and Sakari Einola

Department of Surgery, University Central Hospital, Turku, Finland

Since 1972 bone banking has been in use to provide allogenic bone grafts for human bone tumor surgery in our department. The first femoral head for revision hip surgery was storaged and used some years later. Tissue retrieval from cadavers has been legal in Finland since 1957.

Donors and methods: The allograft material was harvested from young healthy individuals after sudden accidental death. Cadaver donors are particularly suited in the theatre for acquisition of long bones. The retrieval requires permission of a next-of-kin or so called donor card legality of the deceased. At present, a typical cadaver donor serves for kidney or other visceral organ transplantations. Cadaver donors were screened for transmissable infections, such as hepatitis, AIDS, and cytomegalovirus infection. Blood cultures and Rh-factor determination were also made. The living donors for retrieval of smaller allografts for hip surgery should meet the same criteria in principle.

Techniques: Bone retrieval is usually performed in a sterile operating theatre environment—earlier in the 70's it was made in autopsy rooms of the Department of Pathology. After dissection and cleaning of soft tissues (ligaments, periosteum) samples for bacterial cultures are taken from every bone. The bones are washed in antibiotic solution and packed in plastic bags. The storage temperature has been -70°–80°C according to Imamaliev's method (1971). The organization requires compulsive record keeping. During 1972–1989, the total number of bones harvested was 195, 131 of them being femoral heads from living donors. Our bone bank is the only one in Finland for large osteoarticular allografts. In 1972–1989, over 100 allograft operations have been performed, 23 of them being massive osteoarticular transplantations.

192. Computerized dynamic posturography for measurement of dynamic posture and balance in amputees

Sven-Erik Larsson

Department of Orthopaedics, University Hospital, Linköping, Sweden

Postural control and balance in leg amputees depend on movement coordination and ability to guide the prosthesis provided that the three sensory balance systems (vestibular, visual and proprioceptor) function. Amputees' ability to manage unforeseen fall situations has not been measured earlier.

Methods: Dynamic posturography was performed using Equitest (Newocom, USA). This employs a computer-controlled menu-driven moveable platform and visual surround described by Nashner 1987. These move to track the patient's body sway. Motor response to various computer-induced platform perturbations is measured, i.e., front-to-back and back-to-front as well as toes-up and toes-down. Normally, most people move about the ancle joint as a fixed point.

Results: Patients with below-knee prosthesis showed dynamic assymmetry applying increased force (amplitude) to the intact foot. Reaction time (latency) was increased on the amputated side and reduced force was used to manage platform movement. Adaptation to platform movements was normal. In comparison, above-knee amputees deviated more from normal as to dynamic symmetry, amplitude and latency. Abnormality increased with age.

Conclusions: Dynamic posturography now can be applied for measurement of postural control in amputees. Factors related to the amputation stump or the prosthesis as well as rehabilitation can be evaluated objectively.

193. Prognostic value of distal blood pressure measurements with regard to primary healing and amputation level in diabetic foot ulcer

J. Larsson, D.C. Agardh[1], J. Apelqvist[1], J. Castenfors[2] and A. Stenström

Departments of Orthopedic Surgery, Internal Medicine[1] and Clinical Physiology[2], University of Lund, Sweden

Foot ulcer is a common complication of diabetes and associated with a high risk of amputation. Conflicting findings have been reported with regard to the prognostic value of distal blood pressure measurements.

Patients and methods: In a prospective and consecutive series, 314 diabetic patients with foot ulcers have been investigated with strain-gauge or Doppler techniques.

Results: In total, 197 patients healed primarily and 77 healed after amputation. Fourty patients died before healing had occcured, 8 of them having had an amputation prior to death. Primary amputation level was below the ankle in 41, below knee in 32 and above knee in 4 patients. Healing after amputation was achieved below the ankle in 26 patients, below knee in 45 and above knee in 6 patients. Ankle and toe pressures were higher among patients who healed without amputation compared with those who underwent amputation or died before healing and also in patients who healed after an amputation below the ankle compared with those who required a higher amputation ($p < 0.001$). No patient with an ankle pressure < 40 mmHg healed primarily. An upper ankle pressure above which amputation was not required, could not be defined. A toe pressure level > 45 mmHg indicated a good prognosis with regard to primary healing or low amputation level.

Conclusion: A combination of ankle and toe pressure measurements is a useful tool to predict primary healing in diabetic foot ulcers. In a considerable proportion of patients where an amputation is nessecary, healing can be achieved after minor amputations below the ankle. Also with regard to amputation level, distal blood pressure measurements have a great predictive value.

194. Heat generation during the cement curing process in THP

Søren Toksvig-Larsen, Herbert Franzén and Leif Ryd

Department of Orthopedics, University Hospital, Lund, Sweden

A radiolucent zone frequently develops at the bone-cement interface following arthroplasties and has been linked with mechanical loosening. One explanation for the zone has been the heat injury. Eriksson (1984) found the threshold temperature for impaired bone regeneration in the range of 44–47 °C for a one minute exposure.

Method: The temperature was measured in vivo using thermocouples placed at the bone cement interface during 26 total hip arthroplasties, performed with modern technique, including lavage and precooled, vacuum mixed bone cement. The thickness of the cement of the corresponding sites was measured radiographically.

Results: The maximum temperature in the acetabulum was 43 (38–52) °C. In 5 patients the registration were above 44 °C with a duration from 50 sec. to 4 min 50 sec. In the femur the max. temperature was 40 (29–56) °C. There were two patients with a temperature above 44 °C— duration of 7 and 3 min. The thickness of the cement in the acetabulum and the femur was 4.4 mm and 4.8 mm, respectively.

Discussion: Heat injury has been suggested as one explanation for mechanical loosening. In our measurements, 8 out of totally 69 registrations in 26 THP, mainly on the acetabular side (6 of 32) were above the limit of impaired bone regeneration. There was a slightly higher temperature at the acetabular than in the femur region, which could be explained by a heat sink phenomenon, especially since the amount of cement was greater at the femoral region. Efforts to decrease the temperature during cement curing seem appropiate.

195. Immune response to methylmethacrylate

Seppo Santavirta, Yrjö T. Konttinen, Ville Bergroth and Mats Grönblad

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

In order to analyze whether methylmethacrylate is immunologically inert, density-gradient-isolated peripheral blood mononuclear cells were cultured in 0.2 mL of FCS-RPMI 1640 culture medium supplemented with 10 mg fine pulverized methylmethacrylate. Phytohemagglutinin (PHA) lectin, a purified protein derivate of tuberculine (PPD) antigen and culture medium alone were used as positive and negative controls. Lymphocyte activation kinetics on culture days 0, 1, 3, and 5 were studied. Major histocompatibility complex locus II antigen (MHC locus II antigen, Ia) and interleukin-2 receptor (IL-2R, Tac) expression were analyzed using the avidin-biotin-peroxidase complex (ABC)

method and lymphocyte DNA synthesis by using 3H-thymidine incorporation and betascintillation counting.

Especially on culture days 1 and 3, lymphocytes and monocytes were seen under the light microscope attached to methylmethacrylate particles. However, results show no methylmethacrylate-induced DNA synthesis, but methylmethacrylate-induced MHC locus II antigen and IL-2R activation marker expression was seen more than in negative controls but actually less than in PHA or PPD antigen driven lymphocyte response. These results suggest that methylmethacrylate is essentially an immunologically inert implant material, but it seems to induce inflammatory mononuclear cell migration and adhesion leading to slight nonspecific (nonimmunologic) lymphocyte reaction. This activation is lower than that seen in mitogen and antigendriven lymphocyte responses.

196. The Wagner resurfacing endoprosthesis: A 10-year survivorship analysis

Pär Slätis, Pekka Paavolainen, Jan-Magnus Björkenheim and Juhani Ahovuo

The Orthopaedic Hospital of the Invalid Foundation and the Surgical Hospital, Helsinki University Central Hospital, Finland

The aim of the study was to define the longevity of the Wagner resurfacing endoprothesis, and to assess the results of revision arthroplasties after failure of this implant.

Patients and method: 64 hips in 60 patients were reviewed. The mean age of the patients was 63 (21–77) years and the follow-up time on an average 11 (8–12) years.

Results: 8 patients had died and 2 were lost for follow-up examination. 54 hips were available for assessment. 9 were symptomless, 5 were painful and 40 had been subjected to revision arthroplasties. The first symptoms of loosening occurred 3.4 years after the resurfacing arthroplasty, with a steep decline in the survivorship curve during the following years. At 5 years 47% of the implanted hips were still functioning, and at 10 years the corresponding figure was only 38%.

The cause of failure of the resurfacing endoprothesis was loosening of the femoral component, or loosening of the acetabular implant, or both. Excessive wear of the polyethylene liner was a common finding. At revision, 25 hips were replaced by conventional cemented implants, and 15 by noncemented implants.

The use of a reinforcement ring in the acetabulum was frequently needed; in favourable cases a screw ring was used. All revision arthroplasties were functioning at follow-up.

Conclusion: Resurfacing arthroplasty of the hip by the Wagner technique can not be recommended.

197. Cementless hip arthroplasty in diastrophic dysplasia

Jari Peltonen, Veijo Hoikka, Mikko Poussa and Timo Paavilainen

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

Diastrophic dysplasia is a rare hereditary disorder producing a short limb dwarfism recognizable at birth. This disease of recessive inheritance is the most common skeletal dysplasia in Finland. The clinical problems are related to the severe joint contractures and secondary hip arthrosis, which develops at the early middle-age.

Patients and methods: During the years 1983–1988, a total hip arthroplasty was performed in 11 patients (16 hips) with diastrophic dysplasia. The mean age of the patients (7 women and 4 men) was 38 years at the time of operation. The mean height was 133 cm and the mean weight 41 kg. A Lord endoprosthesis was used in 10 hips and a Biomet in 6. Acetabuloplasty with bone graft and simultaneous osteotomy of the proximal femur with transposition of the greater trochanter were performed in 3 hips. Tenotomies were performed in 10 hips.

Results: The mean follow-up time was 2.6 (0.5–5.5) years. In all cases, evaluated by Charnley's scoring scale, a clear relief of pain and improvement of the range of motion of the hip joint were achieved. There were no aceptic loosenings of the conponents. As complications 2 femoral nerve lesions and 2 peroperative fractures of the proximal femur were noted. They healed spontaneously except one femoral nerve lesion which was treated by a secondary operation.

199. Femoral neuropathy after total hip replacement

Martti Vastamäki

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

Patients and method: Seven patients with femoral nerve lesion after total hip replacement were reviewed 4 years after the arthroplasty. There were one male and six females, aged 59 (38–72) years. Five patients had been treated operatively by the author 3 (1–6) months after the replacement. The neuropathies were due to damage by the retractor and scar tissue in 2 cases, to compression under the inquinal ligament in one case, to heat of the polymerization in one, and to cutting the nerve in one case.

In 3 cases external neurolysis and in one case reconstruction using free nerve grafts have been performed. The nerve of a 72-year-old patient had been burnt by cement so severely that repair was not considered reasonable.

Results: The final result was satisfactory in all except the cement case. However, one of the two unoperated patients

later sustained a femoral fracture due to the weakness of her quadriceps muscle. This shows that this patient probaly should have been operated on.

Conclusion: Femoral nerve lesion after hip arthroplaty can recover spontaneously. Operative treatment is simple and is indicated if there is no evidence of recovery within 2 months.

200. Roentgen stereophotogrammetric analysis of acetabular prostheses

Finnur Snorrason and Johan Kärrholm

Department of Orthopedics, University Hospital, Umeå, Sweden

Patients and methods: Total hip replacement was performed in 107 patients (108 hips) with arthrosis (A), rheumatoid arthritis (RA), and sequele after fracture of the femoral neck (SFFN). There were 51 cemented primary arthroplasties (oA 20, RA 15, SFFN 16), 15 cemented revision arthroplasties and 44 cementless (20 threaded and 22 press-fit, screw-fixed) cups (A). The patients were examined 1–3 weeks, 6, 12 (all cups), and 24 (all but the press-fit cups) months after the operations using roentgen stereophotogrammetric analysis.

Results: Migration occurred significantly more often in patients with RA (11 of 15 hips; $p < 0.04$) and SFFN (12 of 16 hips; $p < 0.02$) compared with A (8 of 20 hips). All but one cemented revisions migrated during the follow-up. No threaded cup was fixed at one year and these prostheses also showed the largest mean proximal migration of all the cups. Only one press-fit cup migrated during the first 6 months and further 6 between 6 and 12 months.

Conclusions: The increased frequency of migration of the cemented, primary acetabular cups in the patients with RA and SFFN compared with A might be explained by inferior bone quality.

The initial fixation of the cemented, revised cups seems to be inferior compared with primary arthroplasties.

Threaded cups are poorly fixed compared with press-fit cups probably because of a small contact area and unfavourable load transfer between the threaded cup and bone. Migration of cemented and threaded cups usually started before 6 months. Migration of press-fit cups started later.

201. Simultaneaous bilateral THR with one cemented and one uncemented socket—a stereophotogrammetric analysis

Lars Linder, Acke Ohlin and Göran Selvik

Department of Orthopaedic Surgery, Malmö General Hospital and the Department of Anatomy, University of Lund, Sweden

This report addresses the question of whether or not to use a cemented socket in a total hip replacement.

A 25-year-old female with RA had a simultaneous bilateral Charnley hip replacement. The left acetabulum was bone grafted centrally because of a slight acetabular protrusion and a cemented Charnley socket was inserted. On the right side an uncemented Harris-Galante cup was used. Tantalum markers were inserted into both sockets and the surrounding bone. Weight-bearing was allowed on the cemented side whereras on the uncemented side protected weight-bearing was prescribed for 8 weeks.

The postoperative radiographs were satisfactory. At one year a minimal radiolucent line had developed around parts of the cemented socket but not around the uncemented one. Both femora showed excellent acceptance of the cement and both trochanters had healed by bone.

Stereophotogrammetry was performed at 0, 6 and 12 months. At 6 and 12 months no significant migration of either socket was detected ($\leq$ 0.2 mm).

Conclusions: 1. Bilateral simultaneous hip artroplasty is a safe procedure in selected patients. The inevitable early weight-bearing on one of the hips does not necessarily entail an inferior quality of fixation. 2. Neither rheumatoid disease nor young age seem to have a negative influence on the bony reaction to implants. 3. After careful surgery and proper postoperative mobilization, the fixation of an uncemented socket can be comparable to that of a cemented one.

202. Postoperative instability of tibial components

Leif Ryd, Sören Toksvig-Larsen, Anders Stenström, Lars Carlsson[1], Peter Herberts[1] and Göran Selvik[2]

Departments of Orthopedics and Diagnostic Radiology[2], University Hospital, Lund and Department of Orthopedics[1], Sahlgren's Hospital, Gothenburg, Sweden

Initial mechanical stability is a prerequisite for bony ingrowth into porous structures and the lack of such stability may be one reason why most porous noncemented prostheses have been found to be bonded by fibrous tissue. Laboratory investigations have shown that micromotion ranging up to 200 μm may occur in the postoperative period at low physiologic loads.

Using roentgen stereophotogrammetric analysis (RSA), inducible displacement of tibial components of different

both cemented and noncemented designs have been found after one year. The objective of the present study was to investigate the in-vivo stability of cemented and noncemented tibial components in the immediate postoperative period using RSA.

Material and methods: 20 cases of tricompartmental knee arthroplasty for gonarthrosis were included. There were 16 females and two males; two patients were operated bilaterally. 12 arthroplasties were cemented PCA primary knees, two were noncemented PCA primary knees, three were noncemented PCA Modular knees with screw fixation and two were noncemented Miller-Galante knees. Cementation was done using lavage and pressurization techniques. The selection was not randomized but was done according to whether the patient was judged to be able to participate in the rather demanding investigation, which, in these patients, could be performed without any undue discomfort.

The tibial components and the tibial methaphyses were prepared for RSA during the operation by the insertion of 4–6 tantalum markers. Two to eight weeks postoperatively the patients were subjected to a stress examination. After examination in the supine position, where two biplanar radiographs were obtained with the knee inside a calibration cage, the cage was raised to a vertical position and radiographic stereo pairs were obtained while the knee was subjected to external forces of a physiologic magnitude. These forces were 1/ weight-beating, 2/ weightbearing and a 10 Nm external and 3/ internal torque. In 11 cases a squatting position was included, where the patient, in the weightbearing position, bent the knee approximately 60 degrees. The accuracy of RSA in this application has been determined to 200 μm. Results were given as the maximum total (3-D vector) point motion (MTPM).

Results: Inducible displacement was found in all cases except two, both cemented. The magnitude of the displacement was 0.5 (0.3–1.2) mm. Excluding the flexion position, the displacement was 0.3 mm for cemented and 0.5 mm for noncemented cases (NS). When the flexion position was included in 11 cases, the corresponding values were 0.2 and 0.7 mm ($p < 0.05$)

Discussion: This investigation illustrates that motion occurs between prosthesis and bone in the clinical situation also shortly after the operation. In the cemented cases it was presumed that a fibrous tissue membrane had not developed after this short postoperative time and that the bone and prostheses were, therefore, mechanically coupled. The conclusion must then be that the displacement occurred within the bone.

204. PCA total knee replacement: 3-year results

A. Eskola, V. Vahvanen, S. Santavirta and P. Slätis

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

During 1984–1986, we used the PCA-total knee replacement system in 92 patients and 74 of them were followed-up for an average of 3 (2.2–4.5) years. Of these 74 patients, 42 were treated for rheumatoid arthritis and 32 for either primary or secondary arthrosis. The patients age averaged 60 (32–78) years. Thirty-two out of the 42 knee replacements in rheumatoids were inserted totally without cement, and fixation screws for the tibial part were used in 8 cases. Twenty-nine of the 32 knee replacements for arthrosis were inserted without cement. One case of loosening appeared; an uncemented tibial part had to be revised due to loosening. According to Hungerford and Renna (1983), 47 patients had an excellent result, 23 of them belonging to the RA group and 18 to the A group, and there was only one poor result in a RA knee. Our primary results reflect that also cementless PCA-total knee appears to provide a good fixation in both RA and A knees.

205. Preliminary results with the Miller-Galante total knee prosthesis

Jerker Sandelin, Jari Peltonen and Veijo Vahvanen

The Orthopaedic Hospital of the Invalid Foundation, Helsinki, Finland

The purpose of the present study was to analyse the preliminary clinical, functional and radiographic results with a titanium total knee arthroplasty.

Patients: During the years 1987–1989, 252 primary knee artroplasties with the Miller-Galante prostehesis were performed at the Orthopaedic Hospital of the Invalid Foundation in patients with arthrosis and rheumatoid arthritis. A closer analysis was performed of the first 51 knees with an follow-up of more than two years. In 35 knees the diagnosis was arthrosis and in 16 knees rheumatoid artrhritis. Cementless fixation of the components was performed in 41 knees and in 10 knees the tibial plate was fixed with cement. The patella was resurfaced in all knees, in the majority of cases without cement. Major bone grafting due to tibial defects was performed on 8 knees. The results were evaluated clinically and radiographically. A pain scoring scale from mild (1) to severe (4) was used.

Results: The postoperative pain scoring averaged 1.3 (scale 1–4), the mean preoperative value averaging 3.5. The extension-flexion range increased at follow-up from 10°–94° to 3°–104°. Three fourth of the knees were within 3° of the ideal femorotibial valgus angle (5°–7°) at follow-

up. Complications included patellar dislocation in two knees. Ligamentous laxity was seen in 3 knees. Technical failure was found in one femoral and one tibial component and postoperative complications of wound healing was seen in two knees.

Conclusion: The preliminary results after an average of 27-months follow-up with the Miller-Galante total knee prosthesis are encouraging both from a clinical and functional standpoint.

206. Osseointegrated total ankle joint replacement—a 2-year follow-up

Lars Linder[1], Åke Carlsson[1] and Per-Ingvar Brånemark[2]

Department of Orthopaedic Surgery[1], Malmö General Hospital, Malmö, and the Institute for Applied Biotechnology[2], Göteborg, Sweden

This is the first total ankle joint replacement based on Brånemark's osseointegration principle. The patient is a woman, born in 1961, who has seropositive RA and requires steroid medication. In 1986 her left ankle became severely painful, and radiographs revealed a completely eroded talocrural joint without simultaneous affection of the subtalar joints. Fully informed about the experimental nature of the procedure, she encouraged us to design an osseointegrated ankle replacement.

Both the talar and tibial components have as anchorage elements two transcortical screw-shaped bars of pure titanium, connected by a plate. These elements were implanted in April 1987. In September 1987, the articulating elements were connected to the healed-in anchorage elements. The articulation is a spherical Ti-Al-V alloy talar component against UHMW polyethylene. Tantalum markers have been placed in the talus and tibia as well as the plastic component.

The patient has been completely symptomfree and has regained perfect motion in her ankle joint. She has had one severe exacerbation of her disease, requiring systemic steroids for a short period, without any adverse effects on ankle function.

Radiographs reveal no radiolucent zone adjacent to the weight-bearing elements and no migration of either component 2 years postoperatively. The bone has become denser in areas of load. Stereophotogrammetric data are being evaluated. Together, our findings indicate that the implants are in fact osseointegrated.

The results of this case have been extremely gratifying, and indicate that the principle of osseointegration may well improve the long-term prognosis for this kind of joint replacement.

208. Preoperative embolization of vertebral metastases of renal cancer

Claes Olerud[1], Lars-Erik Lörelius[2], Annmarie Löfberg[2], Halldor Jonson[1], Lennart Sjöström[1] and Göran Karlström[1]

Department of Orthopaedics[1] and Radiology[2], University Hospital, Uppsala, Sweden

Spinal metastases of renal cancer are highly vascularized and the peroperative blood loss can be tremendous. We have applied preoperative embolization of spinal metastases of renal cancer to minimize the bleeding. The peroperative blood loss was measured in five consecutive patients operated for thoracolumbar spinal metastases of renal cancer after embolization of the tumour. Two cases had laminectomy and posterior stabilization with transpedicular fixation device, three cases had anterior resection and fixation with bone cement and screw plates. A historical control group (before embolization) consisted of ten cases of posterior procedures and one case of anterior decompression. The results are presented as 95% confidence intervals. The blood loss for posterior procedure after embolization was 1,160–2,540 mL compared to 3,790–7,970 mL without embolization. The blood loss after anterior resection was 5,210–8,530 mL with embolization. The only case with anterior resection without embolization died after an uncontrollable bleeding of 20,000 mL. Preoperative embolization is an easy technique that brings the peroperative blood loss under control.

209. Accidents among fishermen in Bornholm

Steen Christensen and Erik Kjærsgaard

Surgical Department, Bornholms Centralsygehus, Rønne, Denmark

1/10 of the Danish fishermen are living in Bornholm (850 persons). During two years, all accidents among the fishermen were investigated in cooperation with the privat doctors.

There were no deaths but a few serious accidents and more "minor" accidents.

210. Accidents with playground equipment among children

S. S. Mikkelsen, B. E. J. Lindblad, A. Nafei, G. Teichert, K. Krøner, J. Jensen and J. Sommer

The Departments of Orthopedic Surgery, Accident Analysis Center, Aarhus County Hospital and Aarhus Municipal Hospital, Denmark

The aim of this study was to determine the frequency of accidents with playground equipment and to describe the etiology and epidemiology of these injuries. In order to illustrate accidents with playground equipment, children aged 0–15 years who sustained injuries while using such equipment during 1989 were registered in the Municipal Hospital and the County Hospital in Aarhus.

This survey is compared with a 10 years older investigation made on the same subject in the same geographical area.

The investigation was undertaken on all playgrounds (day-care institutions, school playgrounds, private playgrounds and municipal playgrounds) according to each playground equipment and its construction, safety and safety areas. Each playground equipment was compared with the Danish Standards Association recommendations.

The parameters registered were personal data, anamnesis, clinical examination, diagnosis, time of accident and arrival, cause of contact, place of accident, mechanism of accident, treatment, mode of termination, severity of lesion according to the Abbreviated Injury Scale (AIS) and absence and economic loss in the family because of the sickness of the child.

211. Oculomotor test for prognostication after whiplash injuries

Christer Hildingsson, Britt-Inger Wenngren[1] and Göran Toolanen

Departments of Orthopaedics and Otorhinolaryngology[1], University of Umeå, Sweden

Recently oculomotor dysfunction was reported in patients with chronic and disabling symptoms after whiplash injury of the cervical spine (Hildingsson et al. 1989). The purpose of the present investigation was to prospectively study the oculomotor function in relation to the clinical symptoms in patients with acute whiplash injury and thus evaluate the oculomotor test as a prognostic indicator.

Patients and methods: A prospective study was carried out in 40 patients with a whiplash injury of the cervical spine due to car accident. The first test was performed on average 1.7 month after the accident and the follow-up and a second oculomotor test on average 15 months after the accident.

The oculomotor test was performed according to the method described by Bergenius.

Results: At initial examination eight patients showed pathologic oculomotor values. At follow-up the eight patients with initial oculomotor dysfunction remained pathological. Besides, five additional patients had changed from normal to pathological test results. All 13 patients with oculomotor dysfunction had disabling symptoms.

Twenty-five patients showed normal test values. Twenty of these had recovered with no or only minor discomfort. The remaining five patients with normal test results had all persisting symptoms influencing their working ability. Two cases with initially normal test results did not return for follow-up. Thus, thirteen of the 18 cases with persisting symptoms in the present study had pathologic oculomotor test results.

Conclusion: It seems that a pathologic oculomotor test, early after the accident or later, is accompained by persisting symptoms in patients with a previous whiplash injury of the cervical spine.

212. Fractures of the elbow

Mohammed Zayer and Toomas Mathiesen[1]

Department of Orthopaedic Surgery and Radiology[1], Ängelholm Hospital, Sweden

Fractures of the olecranon and the radial head present fewer problems of treatment than (especially intraarticular) fractures of the humerus. Opinions diverge regarding treatment of choice. 194 elbow fractures were treated and followed. For clinical evaluation the classification of Lasinger et al. (1982), based on motion, pain, and patient's opinion, was used. Radiologically, the fractures were classified according to site (humerus 97, ulna 40, radius 38, mixed 19), severity, and healing.

Generally, radiographicl and clinical remarks considering end results did not accord well. 25 cases had persisting clinical symptoms of pain and/or impaired motion. Knowing these results, a prognostic algorithm was constructed from initial post-traumatic features.

48 % of the unsuccessfully healed fractures were flagged by the algorithm, allowing 65 % false positives (or 32 % correctly flagged allowing 2.4 % false positives, or 63 % and 12 % respectively).

213. Characteristics of patients with hip fracture and Parkinson's disease

Brynjolfur Jonsson, Olof Johnell and Ingemar Sernbo

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

Material: In Malmö, Sweden, patients with hip fracture significantly more often have Parkinson's disease compared

with controls. Parkinson's disease is also significantly more common in the 1980's as an associated condition among patients with hip fracture in our city compared with the 1950's. From 1982 to 1985, 369 men and 1,060 women with hip fracture were studied prospectively. Their background factors were noted and their rehabilitation was followed for at least 1 year.

Results: 23 men and 51 women with hip fracture had Parkinson's disease as an associated condition. They had significantly more often already had a hip fracture and were more often institutionalized, needed more home aid, could not do there own shopping and more often had changed mental status before the fracture compared with those with hip fracture but without Parkinson's disease. Postoperatively, the Parkinson's disease group was less mobilized within 2 weeks, and had less often returned to their original residence within 1 year and could less often stand on one leg, 1 year after a cervical hip fracture. Among men with Parkinson's disease at the time of the hip fracture, we found less range of motion in the hip at the follow-up and among women we found that they were slender, more often had sustained their fracture after a fall in the same level indoors compared with women with hip fracture but without Parkinson's disease. Women with a cervical hip fracture and Parkinson's disease stayed longer in hospital but they were less often reoperated with a hip arthroplasty compared with women with cervical hip fracture but without Parkinson's disease, in spite of similar failure rate after internal fixation.

214. Characteristics of women with hip fracture and diabetes mellitus

Brynjolfur Jonsson, Olof Johnell and Ingemar Sernbo

Department of Orthopaedics, Malmö General Hospital, Malmö, Sweden

Material: From 1982 to 1985, 1,060 women with hip fracture in Malmö, Sweden, were studied prospectively. The women with diabetes mellitus were compared with those without diabetes mellitus.

Results: The 95 women with hip fracture and diabetes mellitus had significantly more need of walking aid, more eyesight deficiency, more home aid and had less often been smokers at the time of the fracture, compared with the non-diabetic women. Furthermore, the women with diabetes mellitus had to stay longer in hospital and had increased mortality compared with the women without diabetes mellitus, in spite of absence of significant differences regarding the mean age of the two groups.

Conclusion: Women with hip fracture and diabetes mellitus have incrceased risk of sustaining a hip fracture, probably because they are more prone to falling and have less bone mass.

215. Screw fixation of femoral neck osteotomy—an autopsy study

Torstein Husby[3], Jan Benterud[1], Antti Alho[1] and Arne Høiseth[2]

Orthopaedic Service[1] and Department of Radiology[2], Ullevål Hospital, University of Oslo, and Kronprinsesse Märthas Institutt[3], Oslo, Norway

Previous studies have shown that too thin pins, with shank diameter of 4 mm, do not give adequate stability in femoral neck fractures (Husby et al. Acta Orthop Scand 1987;58:637; 1989;60:69). In the present study we focused on the number of pins or screws.

Material and methods: 40 femora (mean 72 years) had a vertical femoral neck osteotomy fixed with 2 von Bahr screws, 2 Olmed screws, 2 LIH hook pins, and 3 Ullevål screws. CT bone mass related measure (MRM) was recorded. In an Instron machine, a static load of 5 mm/min was applied on the femoral head.

Results: 3 Ullevål screws were significantly stronger than all the other implants, and 2 Olmed screws and 2 LIH pins were significantly stronger than 2 von Bahr screws (Table 1). The mode of failure was medial dislocation of the femoral head.

Conclusion: The strength of the bone-implant construct depends on the number of screws that fix the femoral head. The critical factor is the fixation of the screws in the femoral neck/head.

Table 1. Loads (mean kN) and ratios load/diaphyseal MRM at 2-mm and 5-mm displacement and at maximal load

Osteosynthesis	2-mm deform.		5-mm deform.		Max. load	
	Load	Ratio	Load	Ratio	Load	Ratio
Ullevål Screw	1.5	0.19	3.1	0.38	3.6	4.7
Olmed Screw	1.0	0.15	2.4	0.32	2.7	3.7
LIH Hook Pin	1.1	0.13	2.6	0.32	2.9	3.6
Von Bahr Screw	1.1	0.12	1.6	0.20	2.2	2.9

216. Femoral shaft fractures in children: Long-term results of conservative and operative treatment

Hannu Miettinen, Antero Mäkelä and Jyrki Vainio

Department of Surgery, Kuopio University Central Hospital, Kuopio, Finland

Conservative treatment of the femoral shaft fractures in children is well documented in the literature. Operative treatment of these fractures in children is usually considered unnecessary and avoidable. The general management of the femoral shaft fractures in children in Finland is mainly conservative. The purpose of the present study was to compare the long-term results of the conservative and the operative treatment in children and adolescents.

Patients and methods: 131 patients, 0–15 years of age, suffering from a femoral shaft fracture were treated in Kuopio University Central Hospital from 1976 through 1985. 114 (87%) patients came to clinical and radiographic follow-up.

Results: The follow-up time was 7.6 (3–12) years. The mean age of the patients was 15.4 ± 5.2 years at control. The conservative treatment included Bryant's, tibial and femoral tractions (92 patients, 81%).The operative treatment included intramedullary nailing according to Rush or Küntscher and plating (22 patients, 19%). The length of the traction and the hospital stay of the patients treated conservatively were in average 26 (5–35) and 32 (10–55) days, respectively. The hospital stay associated with the operative treatment was in average 23 (6–99) days. After conservative treatment, the injured leg was 0.15 mm shorter than the opposite leg at control. In the operatively treated group according to Rush and plating the injured leg was 8.6 mm longer than the opposite leg. The correction of valgus and varus deformities during the follow-up interval in the Bryant's and tibial traction groups were 6°–7°. The corresponding correction of the recurvatum and antecurvatum deformities were 3°–4°.

Discussion: Considering the clinical and radiographic results there were no differences between the long-term results of the groups. The hospital stay associated with the conservative treatment was remarkably longer. It seems that operative treatment of a femoral shaft fracture of a child older than 7 years of age should be considered to save economic costs and psychic stresses associated with a long traction treatment.

References

Saxer U. Fractures of the shaft of the femur. In: Weber B G, Brunner Ch, Freuler F: Treatment of Fractures in Children and Adolescents. Berlin-Heidelberg-New York, Spinger Verlag, 1980:268-336.

Shapiro F. Fractures of the femoral shaft in children.The overgrowth phenomen. Acta Orthop Scand 1981;52:649-655.

217. Isolated traumatic dislocation of the fibula

Denis A. Dartee and W. Frits Draijer

Department of Orthopaedics, Maasland Ziekenhuis, Sittard, The Netherlands

Traumatic dislocation of the proximal fibula is a rare phenomenon. The exact mechanism of trauma, in which hyperflexion of the knee is an important factor, has not yet been fully documented. After seeing two patients with a solitairy anterolateral dislocation of the fibula, we performed two laboratory experiment to imitate this mechanism. These experiments show that the muscle mass of the lateral gastrocnemius plays a major role in evoking dislocation of the proximal fibula. Our two patients were treated by direct reposition under local anesthesia with the knee in 90° flexion.

218. Intramedullary nailing of tibial shaft fractures: Immediately or after failed conservative treatment?

Antti Kyrö, Markku Lamppu and Ole Böstman

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

Tibial shaft fractures, which are primarily treated conservatively, sometimes lose their acceptable position. Many such fractures can subsequently be treated successfully by intramedullary nailing. Can we save some of the time spent in an attempt at conservative treatment with immediate intramedullary nailing?

Material and methods: During a three-year period, 71 tibial shaft fractures were treated by intramedullary nailing. Three patients had bilateral fractures. Of the 68 patients, 48 were male and 20 female, and the mean age was 38 (15–74) years. The tibial shaft fractures were mainly treated conservatively, apart from the operatively treated fractures of multitrauma patients and the most severe open fractures, which were treated by external fixation. If it was not possible to obtain or maintain an acceptable position, the fracture was treated operatively using an intramedullary nail or Kaessmann intramedullary compression nail. A unilateral tibial fracture was the only significant injury in 45 patients, of these 13 fractures were treated using primary intramedullary nailing, and 32 fractures were nailed secondarily after an attempt at conservative treatment. Of the latter, 10 were open, and 23 had some degree of comminution or extension to the ankle joint, and more than half the fractures were displaced at least one half of the width of the diaphysis. 48 patients, two with bilateral fractures, were re-examined on average six years after the injury.

Results: The mean clinical union-time for closed, solitary fractures after primary nailing was 85 days, and after secondary nailing 99 days. Infections were more common afterprimary nailing: six superficial, one deep infection in soft tissues and one osteomyelitis in 13 fractures (infection in every grade II and III open fracture), bone union was delayed in four fractures with infection. Among the secondarily nailed 32 fractures there were seven superficial and one deep infection in soft tissues. Delayed union occurred in 3/32 cases. Malunion occurred in 4/13 cases after primary and in 8/32 cases after secondary nailing.

Conclusion: With immediate nailing of closed, solitary tibial shaft fractures the mean clinical union time was two weeks shorter than with secondary nailing. Infectious complication occurred in every open grade II and III solitary fracture primarily nailed.

219. The measurement of fracture movement in vivo during healing of tibial fractures treated with external fixation

J. Kenwright, C. J. Kershaw and J. L. Cunningham

Nuffield Orthopaedic Centre, Oxford, England

Though the mechanical characteristics of most external skeletal fixation frames is known in the laboratory it is not known what loading and movement may be occurring at the fracture site during healing in patients. Axial fracture site movement during weight bearing has been determined in vivo during healing in patients.

Method: A strain gauge transducer attaches to the column of an external fixator and measures the deflection of the bone screw adjacent to the fracture and the movement at the fracture site is calculated. The loading of the limb was measured using a force platform.

Results: 45 subjects with tibial fractures treated with unilateral external fixation showed very small axial fracture movement during the early weeks post-fracture (mean = 0.30 mm at 3 and 6 weeks post fracture). If a pneumatic actuator is used to drive a micromovement module, significantly larger amounts of fracture movement can be generated.

Conclusion: Very little axial movement occurs at the fracture site in the first 6 weeks when using external skeletal fixation for the treatment of tibial diaphyseal fractures despite using a frame which allows 1 mm of axial movement when tested in the laboratory under physiological loads.

220. Arthroscopic fixation of a stage 4 fracture of the lateral talar dome using Biofix®

P. Albrecht-Olsen, G. Kristensen, T. Lind and P. Lavard

Department of Orthopaedic Surgery T, Gentofte Hospital, University of Copenhagen, Denmark

A stage 4 osteochondral fracture of the antero-lateral part of the talar dome in a 42-year-old sports active woman was treated arthroscopically using biodegradable fixation (Biofix®). She returned to the previous sport after 3 months without any complaints, and 15 months later she is still without any symptoms from the ankle joint. CT scan after 15 months showed normal conditions with the totally avulsed fragment healed in anatomic position. The operating technique is described and arthroscopic surgery is proposed in the treatment of osteochondral lesions of the anterior part of the talar dome.

221. Operative technique in fixation of cancellous bone fractures with totally absorbable SR-PLLA and SR-PGA screws

Esa K. Partio, E. Hirvensalo, O. Böstman, S. Vainionpää, K. Vihtonen, H. Pätiälä and P. Rokkanen

Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, Finland

This presentation is based upon experience of 291 operations with absorbable screws. The SR-PGA (self-reinforced polyglycolide) and SR-PLLA (self-reinforced poly-L-lactide) screws are more elastic than metallic implants. In the strength of fixed bone fracture even 70 % is based on the bone, when exact reduction is achieved. In the fixation of fractures with absorbable screws the exact reduction is presumed. The fracture will be compressed firmly together with clamps before the insertion of the screw. The compression all the time during the healing is not necessary, and perharps not possible. The screw is inserted against the dislocating force, not necessary perpendicularly to the fracture line. When using the lag-principle, which seldom is necessary, the first cortex will be overdrilled with 4.5 mm. Otherwise the drill used is 3.2 mm in diameter. A special screwdriver and tapping device is needed because of the head and threads of the screw. The use of the special countersink is necessary in order to avoid bending the head of the screw. Irrigation of the tapped drill-channel is recommended. Insertion of the screw with a rapid movement is better for these screws. The head of the screw will be cut with a small saw to avoid the irritation of subcutaneous tissue. If the screw is too long, the whole screw can be cut, even the use of one screw into the two drill-channels is possible. In ankle fractures, usually one screw for each fragment put not perpendicularly to the fracture line is enough to have a sufficient fixation. If necessary, as additional fixation for small fragments small absorbable rods have been used. The syndesmosis is fixed with two screws. In olecranon fractures, two screws through both cortices is an adequate fixation, and if there are small fragments, an additional tension band of absorbable material may secure the fixation. In simple vertical patellar fracture, two screws perpendicularly to each other is sufficient fixation. In humeral neck fractures, three screws put distally into the head has shown to be an adequate method. Postoperatively in ankle fractures, the use of plaster is recommended.

The main principle in this method has been to use as little foreign material as possible with sufficient fixation so that the damage to the bone is as small as possible instead of the many drillholes when using plates and screws. The special properties of these screws should be taken into consideration in the choice of the direction of fixation.

222. Fixation of fractures with totally absorbable SR-PLLA (self-reinforced poly-L-lactide) screws or with combination of SR-PLLA and SR-PGA screws. A clinical study of 51 patients

Esa K. Partio, Ole Böstman, Eero Hirvensalo, Hannu Pätiälä, Seppo Vainionpää, Kimmo Vihtonen, Pertti Helevirta[1], Pertti Törmälä1 and Pentti Rokkanen

Department of Orthopaedics and Traumatology Helsinki University Central Hospital, Helsinki and Biomaterials Laboratory[1], University of Technology, Tampere Finland

Encouraged by good results of SR-PGA (self re-inforced polyglycolic acid) screws in the fixation of cancellous bone fractures we have developed SR-PLLA (self-reinforced poly-L-lactide) screws for fixation of fractures and osteotomies. The initial strength values of these SR-PLLA screws are lower than SR-PGA screws, but the strength retention is longer, even 48 weeks. These screws are workable during the operation, if necessary.

Material and methods: 51 patient with cancellous bone fractures were treated with totally absorbable screws. The mean age was 32 years. In 34 out of 51 patients, pure SR-PLLA fixation were used. The series consisted of 42 ankle fractures (Weber A (2), Weber B (34), Weber C (6)), two comminuted patellar fractures, two tibial condylar fractures, two humeral neck fractures, two olecranon fractures and one fracture of the femoral head. Small SR-PLLA pins were used as an additional fixation for small fragments. 24 of 42 ankle fractures were treated without plaster postoperatively. The initial strength of SR-PLLA screws used in this study was: in bending 200 MPa, in shear 100 MPa and torque 0.3 Nm.

Results: No radiographical abnormalities were observed in 48 patients. The clinical result was good in 49 patients. One patient had a refracture of the proximal fibula due a new accident, but did not need any operative treatment. One deep venous thrombosis were observed and two superficial wound infection. There was no sinus formation in this series. One patient with a fracture of the femoral head and luxation of the hip had a sciatic palsy. One patient with a lateral condylar fracture of the tibia and proximal fibula had an injury of the peroneal nerve and probably needs reoperation. Both nerve damages were observed preoperatively.

Discussion and conclusion: SR-PLLA screws only or combined with SR-PGA screws are suitable for the fixation of fractures. Patients with ankle fractures treated with the methods presented are possible to mobilize without plaster postoperatively. High initial strength and a long strength retention will be possible by combining SR-PGA and SR-PLLA screws in the same fixation.

223. Good results after nontreatment of lateral malleolar fractures with minor displacement (SE-2)

Leif Ryd and Sten Bengtsson

Department of Orthopedics, University Hospital, Lund, Sweden

Treatment of fractures of the lateral malleolus remains controversial. Operative treatment with exact reduction is mandatory according to some authors, while others consider the fracture stable and requiring no reduction (1). A displacement after healing of < 3 mm has been shown to be nonrelated with arthrosis after long term follow-up (2). We report the results of lateral malleolar fractures (SE-2), displaced ≤ 2 mm, treated with a soft bandage and encouragement to walk on the foot as soon as possible, i.e., no treatment at all.

Material: 58 consecutive cases of fracture through the lateral malleolus with a displacement of ≤ 2 mm were included in the study. Open physes or pain over the medial malleolus were criteria for exclusion. The patients were followed prospecively according to a predetermined protocol including radiography after 1 and 12 weeks. During the first half of the study, the patients received a plastic bandage with air-cushions; Air-Cast®, while the patients during the latter half received only an elastic bandage.

Results: After a mean follow-up of 1.5 years, < 1/10 of the cases had serious complaints. 2/3 had no complaints. The remainder had insignificant complaints such swelling and slight reduction in range of motion. The mean time out of work was slightly over 6 weeks. Two cases suffered a redislocation after one week and were excluded from further treatment according to the protocol; one had an initial displacement of 3 mm while the other had considerable tenderness on the medial side suggesting rupture of the deltoid ligament.

Discussion: Bauer et al. have previously shown that fractures of the lateral malleolus, healed with slight displacement, do not cause arthrosis. This study has shown that these fractures are stable enough to allow immediate weight-bearing without immobilization. Thus treated, the clinical results are good and the patients can return to work after about 6 weeks.

References

1. Wilson F C, Fractures. Eds. Rochwood and Green. JB Lippincott, 1975:1361.
2. Bauer et al. Acta Orthop Scand 1985; 56: 103-10.

224. Nonsurgical treatment of chronic lateral insufficiency of the ankle joint

Jon Karlsson, Olle Lansinger and Eva Faxen

Department of Orhopaedlcs, East Hospital, Gothenburg, Sweden

Injuries to the lateral ligaments of the ankle are amongst the most frequent injuries to the lower extremity. Most agree that acute injuries are best treated nonsurgically, with good functional results in 80–89 % of cases. This means that 10–20 % will suffer from chronic functional instability. The purpose of this study was to evaluate the results of conservative treatment of chronic functional ankle instability.

Material and method: One hundred consecqutive patients (66 men and 34 women) with chronic functional instability (more than 6 months) have been treated with functional R.O.M. exercises, peroneus strengthening and co-ordination training using tilt-boards for 3 months. All patients were evaluated before and after treatment using a scoring scale. The mechanical stability was evaluated with standardized stress radiographs, measuring both anterior talar translation (ATT) and talar tilt (TT).

Results: Fourty-nine patients gained excellent or good results, while the rest did not. Patients with painful functional instability had better results, while patients wlth mechanical instability (increased ATT and TT) had the worst results.

Conclusion: Patients with chronic functional instability and low-grade mechanical instability should be treated conservatively, while those with real mechanical instability, i.e., high values of ATT and/or TT should be treated with early ligamentous reconstruction.

225. CAD/CAM of orthopedic shoes

Sven-Erik Larsson and Mats Schröder

Department of Orthopaedics, University Hospital, Linköping, Sweden

Hitherto, orthopaedic shoes are produced manually, the result depending upon the skill of the shoe maker. We have developd the present techniques to make the production less timeconsuming, less expensive, more objective and with an improved end-result for the patient.

Method: Optical measurement of foot deformity and CAD/CAM (Computer Aided Design and Computer Aided Manufactoring) of lasts was developed for orthopedic shoes. The optical signals from a laser equipment with 6 digital CCD cameras positioned one in each corner of a movable recording box were transferred to computer (PC) analysis. The operator needed also the kind of deformity (hallux valgus, rheumatoid arthritis or diabetes) and a few foot measures. On the computer monitor, the operator analysed the shape of the foot and if necessary included minor corrections (e.g., a pelot). Data were stored on floppy discs. A computer-stored last "library" could be built up for future use. The patients floppy disc was placed in a CNC milling machine, which with high precision produced the desired last in polyurethane plastic for manufacturing.

Results: This new technique resulted in orthopedic shoes with improved lasts allowing improved distribution of the forces acting on the foot.

Conclusons: Objective recordings of foot deformity and objective production of shoe-last was made possible with high degree of precision.

226. Flail chest

Aarne Kivioja, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

Flail chest used to be treated with early tracheostomy and controlled mechanical ventilation. Later the development of IMV and PEEP and softer endotracheal tubes have changed the picture.

Patients and methods: Two groups of 25 and 21 patients were analyzed, the older was treated for flail chest with continuous mechanical ventilation and tracheostomy, the newer with long endotracheal intubation, intermittent mandatory ventilation and positive endexpiratory pressure.

Results: The duration of respirator treatment was 24 days for flail chest patients treated by controlled mechanical ventilation and primary tracheostomy versus 13 days for those treated by IMV and PEEP ($p < 0.001$). The inhaled oxygen concentration on the second day of treatment were 52 percent and 35 percent, respectively. Three patients in the follow-up study of most severely injured trauma patients complained of respiratory difficulties and all of them had been treated with tracheostomy.

Conclusion: Flail chest injuries should be treated by endotracheal intubation, IMV and PEEP to shorten the time of treatment on a respirator, and to get better oxygenation with lower oxygen concentrations.

227. Early deaths from blunt injuries

Aarne Kivioja, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

Two threats loom when treating patients with multiple injuries, immediate death or permanent disability. By immediate death we mean death during the first 48 hours.

Patients and methods: During the last twenty years we have treated more than 2,000 blunt trauma victims at our intensive care unit with a mortality of 12 percent. Those who died within the first two days after accident were analyzed.

Results: There were 63 patients, 35 percent of them female with an average age of 37 years. Only one patient was a later admission to the ICU with myocardial infarction occurring in the bed ward. 70 percent of all injuries were caused by traffic accidents, 13 percent by domestic injuries, 10 percent by industrial accidents and 8 percent by attempted suicide. Compared to the whole series of 2,002 patients there were significantly more abdominal injuries (52 percent), pelvic injuries (48 percent), and brain injuries (70 percent). 59 percent of the patients had a critical brain injury. There were more operated brain and urogenital injuries and less operated facial and upper extremity injuries among the dead. Complications were mainly renal, pulmonary, cardiovascular, cerebral and hemorrhagic. The patients received 21 (0–99) units of blood during the first 12 hours after injury, the mean pH at admission was 7.26, the lowest blood sugar was 11.6, the highest creatinine was 181, the pO2/FiO2 ratio was below 260 during treatment. Respirator treatment was necessary for 84 percent (53/63).

Conclusion: Our mortality numbers in the treatment of polytrauma patients are low nowadays. Generally, patients die during the first 48 hours (on the average 3 patients per year) because of overwhelming injuries mainly due to severe brain injury or seriously bleeding injuries.

228. Trauma deaths 3–7 days after injury

Aarne Kivioja, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

Death from trauma is initially mainly due to overwhelming injury and later to complications. Where this border goes is a little controversial.

Patients and methods: 31 patients, 19 male and 12 female, who died between 3 and 7 days after trauma were analyzed from the consecutive material of over 2,000 trauma patients treated in our intensive care unit.

Results: Patients were generally admitted to the intensive care unit primarily. Only two patients were admitted to the ICU later, one for fat embolic and the other for thromboembolic complication. Regionally there were 19 thoracic, 11 abdominal, 15 pelvic, 11 urogenital, 20 brain, 8 cervical spine, 5 lower spine and 22 lower extremity injuries. The number of injuries was greater than in the total series for thoracic, brain, abdominal, pelvic, urologic and cervical spine injuries. Pelvic injuries included two that had to be reoperated, whereas no lower spine injury was operated in this series. Complications included only 1 infection, but 4 renal, 4 fat embolic, 2 thromboembolic, 4 pulmonary, 4 cardiovascular, 6 bleeding, and 2 brain complications. The occurrence of fat embolism, 13 percent, was twice that in the whole series. Respirator treatment was necessary for 87 percent, of them 3 were due to later respiratory insufficiency, and on the average 50 percent oxygen concentration in inhaled oxygen was necessary. The occurrence of alcoholism was twice and of diabetes three times as high as in the total material.

Conclusion: Previous alcoholism and diabetes predispose to trauma death occurring 3 to 7 days after injury. The same is true for fat embolism.

229. Massive transfusions in multiple injury

Aarne Kivioja, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaeaics and Traumatology, University Central Hospital, Helsinki, Finland

The initial blood loss in severe injury is compensated with intravenous infusion of crystalloids, colloids, and blood and early operative hemostasis. The amount of the severity of injury is correlated to the amount of transfusions needed, although bleeding during initial operative treatment is not only due to the injury.

Patients and methods: More than 100 patients are treated yearly in our intensive care unit. Patients that had received more than 40 units of blood during the first 12 hours after injury were chosen for this analysis.

Results: There were 30 such patients, 25 male and 5 female with an average age of 40 years. The amount of blood units transfused was 56 (40–106). The proportion of abdominal injuries and the amount of reoperated abdominal injuries was notably high.

Table. Injuries regionally

	n	Operated	Reop.
Thorax	17	3	1
Abdomen	22	22	9
Pelvis	17	11	2
Urogenital	10	5	0
Brain	9	2	0
Face	6	1	0
Cervical spine	0	0	0
Lower spine	3	2	0
Upper extremity	11	7	1
Lower extremity	18	15	3

No thromboembolic complications were seen, whereas the most common complication in addition to bleeding was renal. 18 patients died. The pH at admission was 7.37 and dropped to 7.21 during the first six hours. The lowest thrombocyte count was 67 on the average. Respirator treatment was necessary for 90 percent.

Conclusion: Initial hemorrhage in excess of 20 liters of blood is still compatible with survival. The main source of profuse bleeding is abdominal injury.

230. The role of intensive care in the treatment of orthopedic patients

Aarne Kivioja, Pertti Myllynen, Eero Wilppula and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

As operative possibilities grow there is an increasing number of orthopaedic patients needing long and intensive postoperative follow-up either because of big operations or because of poor general health.

Patients and methods: The patients that were treated in the Intensive Care Unit for selective orthopaedic surgery were analyzed.

Results: The series consists of 245 patients with 120 male and 125 female. During the first ten years with a heavy load of trauma victims only 57 patients with orthopaedic disease were treated in the ICU. Nowadays 20 to 30 patients are treated yearly. The mean age of the patients was 55 years (9–90). 80 patients were over 65 years old. 24 percent of the admissions were later admissions, 15 times due to myocardial infarctions, 13 times to thromboembolism, and 19 times to respiratory distress. The ICU treatment time was 3.7 days and the mean hospital treatment time was 46 days. The regions operated were mainly lower extremity 109, thoracolumbar spine 92, pelvis 13 and cervical spine 10. Only 24 patients needed respiratory treatment, most of them due to late respiratory insufficiency. The incidence of previous diseases was high: cardiovascular 105, pulmonary 28, diabetes 12, renal insufficiency 7. Fifty-three patients were treated for malignancy. Complications included: 27 cardiovascular, 15 bleeding, 12 pulmonary, 9 thromboembolism, 8 gastrointestinal, 7 infections, 3 tracheal, 2 renal, and 2 brain complications. 11 patients were resuscitated. The patients had received 6.7 units of blood on the average perioperatively. 7 patients died in the ICU and 8 later in the orthopedic ward, a total mortality of 6 percent. 70 patients were transferred to other hospitals. 64 percent were able to discharge home.

Conclusion: Due to increased possibilities in orthopaedic surgery and anesthesiology there are a number of patients that benefit from short intensive postoperative treatment.

231. Sequelae from severe multiple injuries

Aarne Kivioja, Pentti Rokkanen and Pertti Myllynen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

The treatment of patients with multiple injuries is challenging and needs a large organization. Is it useful?

Patients and methods: 92 severely injured patients—with injuries to at least four body regions and a mean ISS of 39—were examined at the outpatient department 5 to 20 years after the trauma.

Results: At the time of the accident the patients were on the average 31 years old with 29 percent of them female. 71 patients had been injured in road traffic accidents, 15 in falls from heights and 6 in other accidents. It took 23 (3–120) months, on the average, to recuperate to a physical and mental level corresponding to that of today. Usually, the patients had returned to work earlier, on the average 12 (2–60) months after the trauma. Of those who were not retired before the accident 59 out of 82 (72 percent) had been able to return to work and most of them were still working at the time of the follow-up. The main reasons for inability to work were brain and spinal cord injuries, blindness and 'failure in re-education'. Most complaints arose from sequelae of brain, pelvic, and upper and lower extremity injuries.

Conclusion: We cannot state a limit beyond which not to treat multiply injured patients, as we can return these patients to working life for years. We have to accept, though, the long time of recuperation. The treatment of even the most severely injured patients with multiple injuries is certainly worth the effort.

232. Platelet activation during acute phase after multiple trauma

Aarne Kivioja, Jari Petäjä[1], Pertti Myllynen, Veikko Avikainen, Gunnar Myllyla and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, and Laboratory of the Finnish Red Cross Blood Service, Helsinki, and Middle Finland Central Hospital[1], Jyväskylä, Finland

The acute phase after multiple trauma is often associated with both thrombotic phenomena and bleeding diathesis.

Patients and methods: To evaluate the possible activation of platelets, beta-thromboglobulin (BTG) from plasma and serum and thromboxane B2 (TxB2) were measured in 14 patients with multiple trauma on the posttraumatic days 1, 2, 3–4, 5–7, and 10–14. The reference values measured 4 weeks to 13 months after trauma were used as controls.

Results: BTG in plasma was increased ($p < 0.05$) on the posttraumatic days 1, 2 and 10–14. The highest median value (80.0 ng/mL) was measured on posttraumatic day 1. The corresponding level of the control samples was 32.2 ng/mL. BTG in serum was significantly reduced in the samples obtained 1, 2, 3–4 and 5–7 after trauma (median levels 4,450–8,681 ng/mL). The median level of the control samples was 16,650 ng/mL. TxB2 was significantly reduced (median level 26–97 ng/mL) on days 1, 2, 3–4 and 5–7 when compared with the control samples (288 ng/mL).

Conclusion: The increased plasma level of BTG indicates that platelets are activated in vivo during the first days after trauma. Reduced levels of both BTG and TxB2 during the immediate posttraumatic period suggest deficient functional capacity of circulating platelets, which probably constitutes one risk factor for bleeding complications in these patients. This functional deficiency of platelets also indi-

rectly suggests that platelet count may correlate poorly with hemostatic potential of the patient and may result in underestimating the need of platelet transfusions in polytrauma patients.

233. Fractures of the humerus in patients with multiple injuries

Aarne Kivioja, Seppo Vainionpää, Pertti Myllynen and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, and Maria Hospital, Helsinki, Finland

The treatment of humeral fractures is mainly conservative. One indication for operative treatment is multiple injury. The aim is stability for mobilization and aggressive pulmonary physiotherapy, and alignment of the fracture in the supine and uncooperative patient.

Patients and methods: 126 patients with humeral shaft fractures treated at our intensive care unit were analyzed.

Results: 130 humeral shaft fractures were treated in 126 patients with multiple injuries, consisting 11 percent of multiple injury patients. Four fractures were bilateral, 52 right-sided, and 70 left-sided. There were less occupational and domestic accidents than in the whole multiple injury series (8.4 percent and 4.7 percent respectively) and more attempts of suicide (8.4 percent). A total of 43 percent (52/125) were female compared to 30.5 percent in the whole series. 18 percent of the fractures were complicated. The major fracture sites were humeral shaft in 54 percent, upper humerus in 27 percent and distal humerus in 19 percent. Simultaneous injuries in the upper extremity were scapular fracture in 2.3 percent, glenohumeral luxation in 6.9 percent, arterial injury in 1.5 percent, brachial plexus injury in 0.8 percent, nerve injury in 10.0 percent and a more distal fracture in 28.5 percent.

Conclusion: When treating patients with multiple injuries a humeral fracture should mainly be treated operatively in contrast to patients with solitary humeral fractures. Other injuries connected to the humeral injury must be actively searched for.

234. The timing of operative treatment after proximal femoral fracture

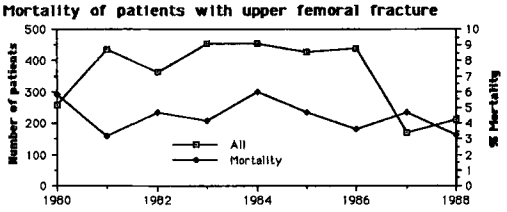
Aarne Kivioja and Pentti Rokkanen

Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, Finland

The treatment of upper femoral fracture has generally been delayed for a couple of days after the accident. The reason not to operate immediately has often been limited resources. It has also been said that these patients have many illnesses whose treatment is at a suboptimal level, e.g., cardiovascular disease, pulmonary disease, diabetes. So, bringing their treatment to optimal level preoperatively has been the main reason not to operate early after the injury.

Patients and methods: About 300 patients with upper femoral fracture are treated yearly at our department. We used to operate on the second to fifth day after injury. Around 1985 we changed our policy and started to operate as soon as possible, usually during the first 24 hours after the injury. We looked for eventual change in the mortality of these patients.

Results:



The number of patients dropped in 1987 due to reorganizationin the treatment of these patients in Helsinki. The fluctuation in mortality was not statistically significant. No other significant change in the material occurred.

Conclusion: There is no contraindication to operate early after a proximal femoral fracture, although increased vigilance is required due to underlying illnesses of these patients. We recommend operating these patients as soon as possible after the injury to shorten the total hospital time and thus lowering the total costs of treatment.