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Experimental orthopedics

Metabolism and hemodynamics in the vicinity of cemented and noncemented hip alloplasty

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The metabolism and hemodynamic response to cemented and noncemented hip alloplasty was investigated in situ in the adjacent endosteal femoral bone of rabbits 3, 6, and 12 weeks after implantation. Mass spectrometry was used for recording partial oxygen pressure (pO_2), partial carbon dioxide pressure (pCO_2), and qualitative blood flow (the relative argon signal), whereas pH was measured by a monocrystalline antimony electrode. The response was further estimated by vital microangiography, intraosseous phlebography, and histology after 12 weeks. Figure 1 shows the metabolic and the blood-flow response after 3, 6, and 12 weeks. Normal values are given by the shaded areas. Initially, anaerobic metabolism (high pO_2 , pCO_2 , and low pH) existed in both situations. However, endosteal

bone in noncemented cases recovered more quickly metabolically, probably because of better revascularization (judged by the blood-flow response). After 12 weeks of implantation, microangiography showed normal vascularization around noncemented implants, whereas cemented cases mainly showed periosteal vascularity and pooling of intracortical vessels. Intraosseous phlebography was normal in noncemented cases, but could not be performed in cemented cases because of the blocking effect of the implant. Histologically, a solid new bone had formed around noncemented implants. Cemented implants showed periosteal bone formation. We conclude that cemented devices in the rabbit femoral canal caused more serious and long-lasting disturbances in bone metabolism and hemodynamics than did noncemented implants.

Experimental realignment after patellar subluxation

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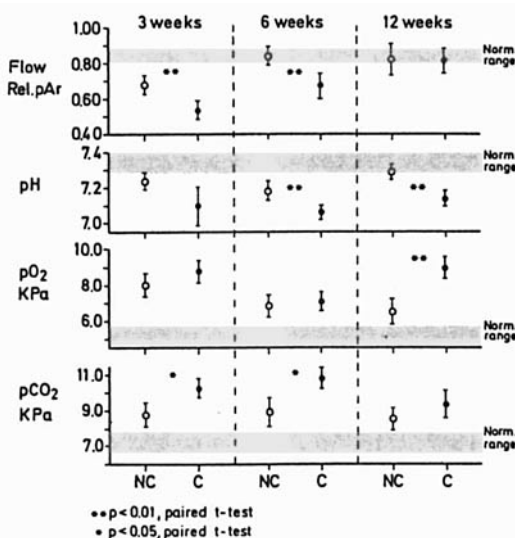
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We attempted to investigate the degree of articular cartilage regeneration following patellar realignment. Patellar malalignment was induced in 12 rabbits by lateral displacement of the tibial tubercle on the right side. On the left side, the tibial tubercle was osteotomized and refixed in situ.

The patella was realigned after 6 weeks. The knee joints were not opened. After the reoperation the rabbits were killed in intervals of 5-20 weeks. Safranin O-fast green-iron hematoxylin was used for histologic-histochemical grading of the articular cartilage degeneration (grades 0-14).

The results were compared with a series of patellar malalignment where a grade 1.9 patellofemoral cartilage degeneration was found after 6 weeks and grade 4.8 after 12 weeks. In the present study, a patellofemoral cartilage degeneration of 3.8 was found.

Our results indicate that even discrete microscopic articular cartilage degeneration following patellar mal-



alignment continues to progress after realignment of the patella ($P<0.05$), but to a lesser degree as compared with prolonged patellar malalignment ($P<0.05$).

Strength in the reinserted patellar tendon

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In 22 rats the patellar tendon was cut near its distal insertion and reinserted by different procedures: to cortical bone, to cancellous bone, and to periosteum. Eight rats were shamoperated on. In order to relax the tendon, the patella was immobilized with a figure of 8 steel wire to the tibial tubercle. After 6 weeks, there was no difference in the strength of the different patella-tendon-tibia complexes. The strength of all operated on tendons was reduced to 70 per cent as compared with the nonoperated contralateral complex. In the operated on specimens, 23 ruptures occurred within the tendon and seven at the site of the reinsertion. In the contralateral knee the figures were 17 and 13, respectively.

Preliminary histologic studies indicated a more normal tissue pattern if the tendon was reinserted to cancellous bone. The study indicates that partial immobilization and stress protection of the tendon might influence the strength of the patellar tendon more than the reinsertion technique.

The influence of indomethacin on the regional acceleratory phenomenon in cortical bone

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In experimental studies, indomethacin and other non-steroid antiinflammatory drugs inhibit bone healing. The influence of the remodelling process in the bone is, however, almost unknown. To investigate the latter, a 2 mm drill hole was made through both cortices in the right tibia in 17 rabbits. One group ($n=8$) received indomethacin 50 mg/day in the drinking water and the other group ($n=9$) served as a control. After 6 weeks the animals were killed and the remodelling processes were quantitated in both tibiae. At a distance of 2 mm

from the tibial drill hole, the traumatized tibia, when compared with the other tibia, had an increased number of dilated canals and formative sites in both the indomethacin and the control group, indicating increased resorption and formation in the traumatized tibia, whereas there was no difference in the porosity and the rate of bone formation between the two legs. In the indomethacin group the number of dilated canals was significantly reduced as compared with the control group, indicating at some period there was a reduced number of resorptive sites.

In conclusion, we found that indomethacin given orally reduces regional acceleratory phenomenon in the bone remodelling around a traumatized area of bone, whereas the rate of bone formation remains normal.

Mechanical properties of bone-cement interface following indomethacin treatment in rabbits

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The aim of the present study was to evaluate the influence of indomethacin on the mechanical properties of the bone-cement interface. Twelve pairs of sex- and weight-matched mature rabbits were randomized for either indomethacin treatment or a control study. A bone cylinder of standardized dimensions was removed from both medial femoral condyles. The hole was packed with CMW acrylic bone cement using a pressurizer device. Indomethacin treatment was administered in the drinking water (10 mg/kg/day) starting 3 days before the operation. After 6 weeks, all the rabbits were killed and one specimen for a push-out test of the cement plug was made from each right femoral condyle. The tests were performed in a universal material testing machine (INSTRON).

Five rabbits or specimens failed, leaving 7 pairs to evaluate. Animals treated with indomethacin exhibited a significantly lower shear strength ($P<0.05$, Wilcoxon's matched pairs test), whereas no difference was observed in the energy absorbed before failure.

This study demonstrates that inhibition of the prostaglandin synthesis during bone-cement implantation significantly weakens the cement anchorage, probably due to an inhibition of the early bone-healing process. Accordingly, it is suggested that the use of anti-inflammatory drugs following bone cement implantation should be limited.

Leukotriene B₄ – an inflammatory mediator of chronic nonspecific arthritis?

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The lipoxygenase products of arachidonic acid metabolism, the leukotrienes, are known to play a prominent role in inflammatory reactions, leukotriene B₄ (LTB₄) being one of the most potent of these mediators. In vitro, LTB₄ is able to induce chemotaxis, chemokinesis, and neutrophil activation. LTB₄ has been isolated in synovial fluid from patients with rheumatoid arthritis, and LTB₄-like activity has been found in plasma from children with juvenile rheumatoid arthritis.

To elucidate the possible role of LTB₄ in the pathogenesis of bone destruction secondary to chronic arthritis, we examined the metabolites in venous blood sampled at regular intervals for 3 months in six immature dogs with unilateral nonspecific Carrageenan gonarthrosis and in a control group of four dogs. Synovial fluid was examined after 8 weeks for the presence of LTB₄. The LTB₄ metabolites were determined by high-pressure liquid chromatography and bioassay (chemokinesis). LTB₄ was undetectable in control plasma and synovial fluid. Neither did plasma from the arthritis group show any LTB₄. The LTB₄ activity in arthritis synovial fluid was 2.71 n. gram/ml $\pm$ 0.20 (mean $\pm$ SEM), which is within the activity range of that found in human arthritis. Our preliminary in vitro studies have shown that LTB₄ in this concentration stimulates the proliferation of synovial cultures.

These results showed that LTB₄ was present in biologically active concentration in a knee joint with a nonspecific arthritis, and that LTB₄ was able to induce one of the most prominent features of arthritis, i.e., the proliferation of synovial cells. However, LTB₄ activity during arthritis could not be monitored in venous blood.

Subcutaneous oxygen tension reflects arterial blood pressure and blood flow

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The subcutaneous oxygen tension (PscO₂) is a valuable

parameter for monitoring homeostasis because of its ready availability. Moreover, the subcutis is the first tissue to be sacrificed in a threatened circulation to maintain an adequate blood flow in vital organs.

To elucidate the relationship between PscO₂ and central hemodynamic parameters, nine pigs were anesthetized for 12 hours and values were recorded at regular intervals.

PscO₂ was determined by a Clark-electrode system in a Silastic® tonometer, which was placed in the subcutis over m. tibialis ant. Blood flow in the aorta abdominalis and a. iliaca communis was monitored by a electromagnetic flowmeter technique. Blood pressure was recorded continuously in the a. carotis communis, a. femoralis, and v. cava superior.

PscO₂ (mean=55 mm Hg, range 34–77 mmHg) correlated significantly with the blood flow in the aorta ($r=0.73$, $P<0.01$, $N=87$) and in the a. iliaca ($r=0.83$, $P<0.01$, $N=17$), as well as with the blood pressure in the a. femoralis ($r=0.81$, $P<0.01$, $N=78$) and the a. carotis ($r=0.72$, $P<0.01$, $N=87$). The sensitivity of PscO₂ to aortic clamping was investigated in one case. PscO₂ fell to 30 per cent of the initial value within half an hour of clamping and increased above the initial value within 4 minutes after declamping, probably due to reactive hyperemia.

Our results showed that PscO₂ was intimately related to blood flow and blood pressure and may be an easily available and minimally invasive parameter for evaluating the total hemodynamic state.

Tumors

Malignant fibrous histiocytoma of bone

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Malignant fibrous histiocytoma is a common soft-tissue sarcoma. Its rare occurrence as a primary malignant bone tumor was first recognized in 1972. Since then, a limited number of cases have been reported.

During the period 1972–1986, 15 cases of malignant fibrous histiocytoma of the bone were diagnosed and treated at the center for bone and soft-tissue tumors in Aarhus. The incidence rate was 1 case per 2 million persons per year. Three of the tumors were post-irradiation sarcomas, two developed in a medullary infarct, one was situated in the wall of an otherwise

benign solitary bone cyst, whereas one developed in a chronic osteomyelitis.

All the cases were grade III malignant tumors. In 12 instances the treatment was a major amputation. One patient had a radical femur resection and osteoplasty; 1 received palliative radiation therapy, whereas 1 had primary chemotherapy and is scheduled for secondary radical local tumor resection. Seven died within 5 years of disseminated disease. One died with no evidence of disease after 5 years. The 7 survivors are all tumorfree, although 1 has had lung metastases that disappeared with chemotherapy. The 5-year cumulated survival rate was 55 per cent, whereas the corresponding tumorfree rate was 46 per cent.

Arthroplasty

Shoulder joint replacement a.m. Neer Mark II

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Total shoulder joint replacement with an unconstrained shoulder prosthesis was used as primary intervention in rheumatoid arthritis and arthrosis.

Forty-three shoulders (35 with rheumatoid arthritis and eight with arthrosis) in 36 patients were included. The average age was 59 (31–78) years, and the follow-up time was 1–3 years. The shoulders were scored prior to surgery and 1, 2, or 3 years after surgery according to the Neer classification.

In the rheumatoid group, total pain relief was obtained in 19 of 36 shoulders. Average active elevation increased from 48° to 76° and the average external rotation increased from 5° to 20° and internal rotation from 56° to 82°. The function of the extremity was normal in nine shoulders and nine had poor function.

In the arthrosis group, seven of eight shoulders were painless. The average active elevation increased from 58° to 75°. External rotation increased from 5° to 15° and internal rotation from 60° to 79°. The function of the extremity was normal in 3 and poor in 3.

Two shoulders were complicated by glenoid loosening.

Total shoulder joint replacement relieves pain, particularly in the arthrotic shoulder joint, but only slight improvement in function and motion can be expected.

Two years' experience of PCA total hip replacement in younger patients

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Initial results of hip arthroplasties fixed with bone cement are entirely satisfactory, but long-term results need improvement. Especially the results in patients younger than 50 years of age have been disappointing.

In 1984, we started a multicenter prospective study at 11 major orthopedic clinics in Scandinavia (university clinics in Göteborg, Malmö, Linköping, Huddinge, Helsinki, Bergen, and Aarhus, orthopedic departments at Örebro, Norrköping, and Gävle Hospitals). In the study, we used the PCA THR.

Material: The prosthesis has been used in 335 patients – 181 women and 154 men. Mean age was 49 years. Indication for the operation was severe disabling hip disease excluding the possibility for osteotomy. Preoperative diagnosis was primary arthrosis in 58 per cent, secondary arthrosis of diseases in childhood in 21 per cent, and posttraumatic arthrosis in 18 per cent. Eighteen patients have been followed 2 years and 175 more than 1 year. Sixty per cent were sick-listed preoperatively.

Results. Clinical results were evaluated according to the Harris hip score system. At the latest follow-up, 87 per cent were excellent or good, 11 per cent were fair, and 2 were poor. One year postoperatively, 75 per cent of the patients were back in full-time employment.

Radiographic examination showed migration of the acetabular component in 2 per cent and subsidence on the femoral stem in 3 per cent. Remodelling of the femoral shaft occurred in 21 per cent of the hips.

Complications. Twelve patients had an undisplaced femoral fissure, 6 had early dislocations, and 2 had peroneal palsy. No major systemic complications have been recorded.

Conclusion. Early results with an uncemented PCA THR in younger patients are promising.

The PCA total hip system

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The PCA hip system is porocoated for cementless

implantation. The method has been used since 1984 primarily to improve the long-term results of THR in younger adults.

The material comprises 52 PCA THRs in 49 patients. All the patients suffered from severe pain at rest and a high degree of motional impairment. The average age was about 50 years. The preoperative diagnoses were primary arthrosis, traumatic arthrosis, rheumatoid arthritis, Perthes' disease, physiolysis, CDH, and necrosis of the femoral head.

We used a lateral approach releasing the medial gluteal muscle. Both the acetabular and the femoral components were inserted with special alignment instruments. The patients were mobilized 2 days after surgery with full weight bearing and were released from the hospital within 14 days. Antithrombotic and antibiotic prophylaxis were used.

Fifteen patients had a follow-up examination 1 year or more postoperatively. They all had pain relief and unimpaired walking ability. Radiographs showed an unaltered position of the prosthesis during the follow-up period.

The method is promising. We have found that the lateral approach is easy to perform and the operative time is shorter than with cemented THR. There were no major operative complications, no infections, and no dislocations. The majority of the patients returned to work.

Press-fit design in total hip replacement: A comparison between the Lubinus and Stanmore prostheses

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In several studies of the Stanmore prosthesis, a dislocation rate of 3 per cent has been reported. Totally, 110 patients selected for total hip replacement were randomized to a Lubinus or Stanmore prosthesis.

At the follow-up 45 months after THR, three dislocations had occurred in the Stanmore group and none in the Lubinus group ($P < 0.1$). The dislocations occurred in the immediate postoperative period. No other differences were found between the two groups.

The press-fit design of the Lubinus prosthesis seems capable of reducing the frequency of postoperative dislocations.

Total hip replacement in obese patients

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The purpose of this study was to evaluate the significance of overweight in patients undergoing THR with respect to surgical difficulties, postoperative complications, and long-term clinical course, with special attention being focused on progressive prosthetic loosening.

In a 5-year follow-up study of 125 consecutive primary total hip replacements a.m. Lubinus, the clinical course of 41 obese and 84 nonobese patients was compared.

Peroperative blood loss was significantly greater in the obese patients. There was, however, no difference in operation or hospitalization time between the two groups. We found no technical difficulties leading to insufficient cementation or varus positioning of the femoral component in the obese compared with the nonobese patients. There was no infection, wound dehiscence, or delay in wound healing. No deaths occurred during the immediate postoperative period.

The overweight patients had a significantly lower preoperative walking-ability score. At follow-up, this difference was eliminated. Radiographic signs of loosening were equally common in the compared groups. Three patients, of which 2 were in the nonobese group, were reoperated on because of prosthetic loosening.

Our results indicate that obese patients undergoing THR are not at an increased risk of having a surgical complication or prosthetic loosening, and overweight has not influenced the 5-year results after THR.

A cost-effectiveness analysis of total hip replacement

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Data on health status and short-term economic costs and benefits were collected before total hip replacement and 6 months afterwards. Ninety-six patients (49 women, 47 men, median age 67 (32–80) years) completed a self-assessment questionnaire. The patients' physical health status was compared with the status of a matched reference group from the general population.

Ninety-eight per cent had a significant postoperative

improvement with regard to hip pain, and 93 per cent had improved physical health status obtaining a function that was comparable to the general population. Of 26 working patients, 22 had limitations in working capacity, and 14 had been absent from work preoperatively. One year after THR, none of the patients were absent from work, but 3 had retired. Help from relatives and friends in daily activities diminished after THR and the patients' social activity increased.

The average costs of outpatient controls, hospitalization, and operation were estimated to be 46,140 Danish kroner. Short-term savings were home help, which decreased from 1.4 to 1.3 hours per week; consultations with general practitioners, decreasing from 0.4 to 0.06 per month; physiotherapy decreased from 0.5 to 0.1 hours per month; and expenditures for medicine dropped from 4.84 to 0.84 Danish kroner per day.

Short-term economic gains were small. However, long-term gains may be larger due to reduction in need for nursing home beds.

Autologous blood transfusion in total hip replacement

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In order to evaluate the possibility of establishing a permanent service with autologous blood transfusions, 17 patients who had unilateral, total hip replacement were given their own banked blood preoperatively and postoperatively. Beforehand, the program excluded 18 patients because of chronic anemia, ischemic heart disease, and arterial hypertension. Of 17 patients, 11 were tapped as planned of 420 ml of blood four times at intervals of 1 week. Four patients were tapped only two or three times because of the development of too low Hb or ECV values; and 2 patients were tapped only once because of a pneumonia and severe fatigue. The Hb and ECV values decreased during the period of tapping.

Twelve patients received only autologous blood transfusions. With autologous blood transfusions, the risk of transmission of infectious diseases is eliminated. The method demands elective surgery, well-known loss of blood, increased supervision of the patients, and changes in laboratory procedures. The method is unsurpassed in patients with rare blood groups.

Bone mineral content of the proximal tibia following PCA arthroplasty in the knee joint

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Bone mineral content (BMC) and bone mineral density (BMD) of the proximal tibia were followed after total knee replacement in order to estimate the possible influence of stress shielding. Measurements were made by dual photon absorptiometry and scanning performed transversely to the bone axis with the patient supine and the knee extended in neutral rotation. In the tibial condyles distal to the subchondral plates, BMC was determined with a precision of 1.1 per cent, expressed as the coefficient of variation in normal persons, and for BMD (g/cm^2) in selected areas of the scanogram, a precision of 3 per cent was obtained.

Following 10 total knee replacements with an uncemented PCA prosthesis, BMC and BMD were measured with 3–6 months' intervals during the first 2 years, and in 2 patients determinations were made 2–4 years after the operation.

During the first 3 months, great individual variations in BMC and BMD were seen, but in the following time, the values stabilized, showing an average increase in BMC and BMD of around 10 per cent. From about 2 years after the operation, a gradual decrease of about 5 per cent per year took place. Measurements locally under the prosthesis showed no evidence of stress shielding neither in relation to measurements around the fixating pegs or between the medial and the lateral tibial condyle.

Revision arthroplasty after failed knee joint replacement

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The object of the present study was to evaluate the outcome of revision arthroplasty after failed knee replacement. A comparison was made between revision results and primary results of the Insall-Burstein (IB) total condylar prosthesis.

Between 1979 and 1985, a total of 32 knee arthroplasties were revised in 28 patients. Two knees were revised twice and 2 patients had both knees revised. The average age at the primary replacement was 60 (16–77) years. The primary replacements were performed because of rheumatoid arthritis in 61 per cent. The mean time

between replacement and revision was 35 (2–131) months. The most frequent reason for revision was a painful knee with radiographically loose components (47%). Two patients with three knees died during the observation period. The remaining 29 knees were followed for 46 (12–81) months.

Twenty-three of the followed knees were revised to an IB prosthesis. All of them were evaluated with the NYHSS knee-rating scale. Based on the total score, the overall results were excellent or good in 55 per cent of the knees revised as compared with 88 per cent after primary arthroplasty. Moderate or severe pain during walking was present in 24 per cent after revision and in 7 per cent after primary arthroplasty. In 3 cases, serious complications were recorded. After primary arthroplasty, 4 per cent of the cases were recorded with serious complications.

Our results showed the overall outcome after revision knee arthroplasty to be inferior to that of primary replacement.

Upper extremity

Ultrasonography in the evaluation of injuries to the shoulder region

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Clinical and radiographic examinations of injuries to the shoulder region are often inconclusive if fractures and dislocations can be excluded. The purpose of the study was to try to establish a more accurate evaluation of the traumatic soft-tissue lesions.

In the prospective study, 45 consecutive patients are included who were admitted to the casualty department because of trauma, strain, or shoulder pain. After fractures and dislocations had been excluded by radiographs, ultrasonography was performed. One month later, all the patients were examined clinically. If persistent symptoms were present, ultrasonography was repeated.

The clinical diagnoses were mostly contusion of the deltoid region (35 of 42), whereas the results of ultrasonography were more detailed. A normal pattern was found in 12 cases. Pathologic findings were muscular hematomata (8), tendinitis (13), partial or total tendon rupture (4), and distension of the acromioclavicular joint (8).

At follow-up, only 1 of 12 patients with normal ultrasonography had complaints, whereas 70 per cent

with pathologic findings still had pain and/or restricted movement.

Conclusion. Ultrasonography is a useful method for locating traumatic lesions in the soft tissue around the shoulder.

Treatment of clavicular fractures: Late results

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No differences were found in the early results of uncomplicated, middle-shaft fractures of the clavicle treated with either a simple arm sling (SAS) or a figure-of-eight dressing (FO8). SAS was more comfortable. However, the late results of the two methods in an unselected population of patients with a clavicular fracture are not known.

A 100 consecutive patients with an isolated clavicular fracture were randomized to treatment with either FO8 or SAS. After 4–5 years, 5 patients had died and 4 were excluded for various reasons. The remaining patients received a questionnaire.

Results:	FO8	SAS
Regular pain from a healed fracture	19%	19%
Reduced movement of shoulder	6%	0%
Visible deformity of the clavicle	38%	53%
Not satisfied (cosmetic result)	16%	22%
Neurologic symptoms from the arm	6%	11%

The differences were not significant.

Conclusion. The late results after treatment with SAS in this material were not different from those after FO8. In any case, the figures could indicate that SAS is inferior to FO8. The two methods should be compared in a larger material that can weight the different types of fractures.

Hip injuries

CT evaluation in traumatic posterior dislocation of the hip joint

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A postreductional CT scanning of the hips in patients

with traumatic dislocation of the hip was carried out in order to test the value of additional CT scanning with regard to the classification of the dislocation.

Twelve adult patients were treated for traumatic posterior dislocation of the hip. Employing the initial radiographs, all of them were classified according to Stewart & Milford. In one of two hips with simple dislocations (Grade I), the CT scan disclosed a dislocated fracture of the acetabular rim. CT scanning was carried out on four of six hips with a fracture of the acetabular rim (Grade II). In one of these a comminuted fracture of the acetabular floor was seen: in another a fracture of the femoral head; and in a third, a loose fragment in the hip joint was observed. CT scanning demonstrated loose intraarticular fragments in two of three hips with comminuted fractures (Grade III). In a hip with fracture dislocation of the femoral head (Grade IV), CT scanning also showed a fracture of the acetabular rim. The loose intraarticular fragments were removed or fixed by open procedures.

The study showed that CT scanning is a valuable diagnostic tool in the management of traumatic hip dislocations and should be carried out as soon as possible after closed reduction.

Ischemia of the femoral head following femoral neck fractures

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After femoral neck fractures the circulation of the head may be diminished due to lesions of the vessels or tamponade of the hip joint. The purpose of this study was to evaluate the circulation of the femoral head by measuring the intraosseous pressure and the partial pressures of O_2 and CO_2 .

In 8 patients with Garden Stage III and IV fractures, the intraosseous pressure was measured in the center of the femoral head using the greater trochanter as a reference. The measurements were performed peroperatively with the fractures reduced. The partial pressures were measured by a mass spectrometer.

The mean caput/trochanter ratios were intraosseous pressure as follows: 1.81 (SEM 1.00); pO_2 : 0.59 (SEM 0.19) and pCO_2 : 1.59 (SEM 0.39). A similar study of unaffected hips showed values of 1.15, 1.13, and 1.10, respectively.

Ischemia of the femoral head can be measured. For clinical relevance, further studies and the results of long-term observation are necessary.

Thromboembolic prophylaxis with DHE and dextran in emergency hip surgery

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The frequency of deep-vein thrombosis (DVT) following emergency surgery of hip fractures is 50–70 per cent, but different methods of prophylactic treatment reduce this frequency considerably. Dextran treatment reduces the risk to about 30 per cent, and Ljungström (1983) reported that combined treatment with dextran and dihydroergotamine (DHE) further reduced the frequency of DVT to 3 per cent.

A confirmation of such major therapeutical advancement would require a prospective, randomized study with 20 patients in each group at a 5–10 per cent significance level.

Forty-four consecutive patients with a hip fracture entered the study. They were operated on with a sliding screw device within 24 hours and were preoperatively randomized to either dextran alone or combined dextran and DHE until mobilization.

On the first and fourth postoperative day, a Tc-plasmin scintigraphy was performed. If positive, a perfusion/ventilation scintigraphy of the lungs was performed.

The two prophylactic methods had similar effectiveness in reducing thromboembolic risk (Fischer's exact test).

Knee injuries

Arthroscopy in the diagnosis of acute injuries to the knee joint

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The purpose of this study was to evaluate the use of arthroscopy in the diagnosis of acute injuries to the knee joint. The indications for arthroscopy were suspected injuries to the knee ligaments and/or knee joint effusion following trauma regardless of the amount or nature of the effusions.

In 136 consecutive arthroscopies, hemarthrosis was found in 86 per cent and nonhemorrhagic effusions in 9 per cent of the knees. Meniscal tears were found in 16 per cent of the knees, and in two thirds of these there

were concomitant old or new ligament lesions – mainly old anterior cruciate ligament (ACL) ruptures. Fresh partial or total ligament ruptures were found in 66 per cent of the knees, and were invariably associated with hemarthrosis. Sixty-two per cent of these injuries were combined lesions of two or more ligaments – the most prominent combination being ACL and the medial ligament complex (40 per cent of the whole series). The most common single ligament lesion was partial or total rupture of ACL (15 per cent of the whole series).

In 73 per cent of the cases, arthroscopy revealed intraarticular pathology not detected at the clinical examination and of significance for the treatment. In 37 per cent of the cases, arthrotomy, arthroscopic operations, or combined operations were performed. There were no serious complications following arthroscopy.

Conclusion: Arthroscopy provides a more complete diagnosis of acute knee injuries and is especially valuable in acute knee injuries with hemarthrosis where clinical examination alone is often insufficient.

Arthroscopic meniscal repair

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Repair of a peripheral meniscal tear permits salvage of this structure in a high percentage of cases. The aim of this investigation was to find out whether suturing meniscal lesions using an arthroscopic technique could produce the same results as open meniscal repair.

Eighteen peripheral vertical tears of the meniscus (15 medial, 3 lateral) in 18 patients were sutured using an arthroscopic technique. The age of the lesions varied from 1 day to 4 years. Six patients had concomitant old anterior cruciate ligament (ACL) ruptures. Three of these were reconstructed on the same occasion by arthrotomy performed after the arthroscopic meniscal repair. One patient had a fresh ACL rupture sutured in the same way. Postoperatively, the patients were immobilized in a plaster cast for 6 weeks.

Eleven patients with an average follow-up period of 11 (6–15) months had a clinically apparent healing. Average knee score (Lysholm): isolated meniscal tears 94 (91–98), meniscal and ligament tears 86 (71–100). Seven patients were not evaluated because the follow-up period was less than 6 months.

Advantages of arthroscopic meniscal repair as compared with repair using arthrotomy are precise placing of sutures and minimal damage to the knee capsule.

Suture of meniscal tears and arthroscopic evaluation

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In order to preserve the meniscus, we have sutured all peripheral lesions of the menisci if technically possible. The repair of the meniscus and associated lesions was performed through an arthrotomy and the leg was immobilized for 4 to 6 weeks in a plaster cast. During the period 1.1.80 to 1.7.85, 35 patients had 37 meniscal lesions sutured. Six of the tears were total and 31 were partial. In 10 patients the meniscal tear was combined with a rupture of knee ligament or a condylar fracture.

At follow-up 12 to 63 months after the repair, 22 of 24 arthroscopic-examined meniscal tears were healed and two were not healed. Ten patients refused control arthroscopy. However, 9 of these had no clinical signs of meniscal lesions, while 1 patient showed signs of a meniscal lesion, although he had a Lysholm score of 95. One patient was dead and 1 patient lived abroad. In 1 patient with serious ligament ruptures and fracture of the condyles, a prosthesis was inserted 18 months after the injury.

In conclusion the repair of the meniscus proved to be successful in more than 80 per cent of the cases.

Effect of hamstring contraction on the anterior drawer sign in the knee

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The aim of the present study was to compare the effect of hamstring contraction on the anterior drawer sign in 15 degrees of knee flexion versus 90 degrees of knee flexion.

Twenty physicians were tested on a knee phantom for force used during testing for anterior drawer sign. The force averaged 109 (70–180) N.

Fifteen patients were examined by stress radiography. Radiographs were obtained in 90 degrees of knee flexion (the drawer test position) and with the knee flexed to 15 degrees (the Lachman position). A comparison was made between the laxity measured on forward traction in the relaxed knee and during traction while the patient was instructed to counteract the forward displacement of the tibia by tensing the hamstrings, thus producing

muscular defence. The test procedure was executed first with 80 N, secondly with 160 N applied.

The opposing effect on the anterior shift of the tibia of tensing the hamstrings was significantly lesser in 15 degrees of knee flexion than in 90 degrees ($P < 0.0001$). With the hamstrings tense and the knee flexed to 90 degrees, no significant gain in the drawer sign was achieved by increasing the force from 80 N to 160 N. In the Lachman position, increasing the force produced a significantly greater anterior drawer sign ($P < 0.05$). Thus, the Lachman position seems to be superior to the classical drawer position in overcoming muscular guarding.

Reconstruction of the ACL using a Dacron prosthesis: Early results

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Since November 1984, we have operated on 46 knees with chronic anterior laxity, performing anterior cruciate ligament (ACL) replacement with a knitted Dacron prosthesis. In spite of a 3 months' physiotherapy program preoperatively, all patients had functional impairment, such as inability to work or participate in sports. The cruciate substitute was placed in the ACL's original position through drill holes and fixed with staples. The knee was exercised from the first postoperative day, and after 2 weeks the patients were allowed to use the knee at will. The first 15 patients (aged 19–42 years) with an isolated ACL reconstruction have been followed for at least 1 year. Their Lysholm score improved from 65 preoperatively to 98 postoperatively. The stability of the knee and the activity level of the patients improved. There was one graft rupture. Thus, early results with the Dacron ligament prosthesis seem very promising.

Histologic response to Dacron prosthesis used for ACL reconstruction

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Two knitted Dacron prostheses that were inserted in human knees for reconstruction of the anterior cruciate ligament were excised 5 and 6 months, respectively, after insertion because of graft rupture. They were both

studied histologically. There was no sign of synovial inflammation in the knees, and the prostheses showed tissue ingrowth. The tissue ingrowth induced had a functional orientation of the collagen fibers in the peripheral part and a random orientation of the fibers in the central part. In all the areas, many foreign-body-type giant cells were seen in connection with the Dacron fibers, which sometimes contained engulfed fragments of Dacron-like material, which may be due to an abrasion of the synthetic material. The fact that an abrasion of the Dacron prosthesis occurred indicates that tissue ingrowth is essential for long life of the reconstructed ligament.

Lower extremity

A randomized study of three different methods for treatment of ruptured lateral ankle ligaments

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The purpose of this study was to compare three different methods of treatment for ruptured lateral ankle ligaments: 1) operation followed by a walking cast, 2) walking cast only, and 3) taping.

After arthrographic verification of rupture of at least one of the three lateral ligaments, 200 consecutive patients were randomized to one of the methods. All the patients were treated for 5 weeks.

At follow-up 1 year later, 175 patients were examined, including radiographic examination (talar tilt). There was no difference between the groups concerning age, sex, athletic performances, or numbers of ruptured ligaments.

In all three groups, 90–95 per cent of the patients were satisfied with the treatment; clinically and radiographically there was no significant difference between the number of stable ankles. However, there was a tendency that patients treated with taping returned to work and sports faster than those in the other treatment groups.

In conclusion, all three methods of treatment gave good results, but we recommend taping because it is simple and more convenient for the patient.

Saphenous nerve injury caused by stripping of the long saphenous vein

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Stripping of the long saphenous vein is a common surgical procedure. Sensory disturbances in the cutaneous distribution of the saphenous nerve is a recognized complication. To evaluate this, a follow-up study and autopsy studies were done.

Ninety-one patients (112 legs) were included. Eight patients suffered from disabling paresthesias proximal to the scar at the medial malleolus (from 29 to 209 cm²), and 6 of these had a history of superficial thrombophlebitis. In 104 legs without sensory disturbance, 12 had a history of superficial thrombophlebitis. Two patients were anesthetized in an area distal to the scar, and 40 patients had minor discomfort in small areas around the scar.

Twenty cadaver operations were done. After stripping the long saphenous vein, the stripping canal was opened and injuries of the saphenous nerve were studied. In all the cases, abundant denuded nerve tissue was found. In 8 cases, several branches of the nerve were found adherent to the vein and followed it by the stripping procedure, on an average 18 (4–29) cm nerve tissue. In 1 case, a total tear of the saphenous nerve was found below the knee.

Conclusion. Sensory disturbance is a common complication of stripping of the long saphenous vein. A history of superficial thrombophlebitis seems to be an important disposing factor.

In vitro studies of a new method of Achilles tendon repair

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The mechanical factors in Achilles tendon repair have been studied and a new design for increasing the tensile strength of the repair has been developed. In addition, the new technique does not constrict the blood supply of the tendon.

Laboratory experiments were carried out to modify a continuous six-strand suture (CSSS) technique for Achilles tendon repair.

Ten tests each of Bunnell, Mason, and CSSS tendon repair were carried out. The tensile strength was measured in a tensiometer, and the gaps appearing

between the tendon ends under load were measured. A Ticon® O suture was used in all cases.

In the autopsy study, the Bunnell suture has a tensile strength of 7.7 (5–11) kg, the Mason suture 4.5 (2–6) kg, and the CSSS suture 26.3 (16–30) kg. The gap between the two tendon ends at a load of 6 kg was on an average 19 mm when sutured by the Bunnell method, more than 30 mm by the Mason method, and 4 mm by the CSSS method.

Conclusion. A continuous six-strand suture of a tenotomized Achilles tendon had three times the tensile strength and minimized the gap between the tendon ends to one fourth in comparison with the Bunnell and Mason techniques.

Examination of blood flow and gas tensions in muscle

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A method for measuring blood flow and partial pressures of oxygen and carbon dioxide in the skeletal muscle would be an advantage in early diagnosis of compartmental syndrome and occlusive diseases.

The aim of this study was to determine the partial pressures of oxygen and carbon dioxide, interstitial hydrostatic pressure, and blood flow in the skeletal muscle of normal subjects. Ten healthy adults aged 30 to 40 years were examined under resting conditions using a blood-gas catheter in connection with a mass spectrometer and pressure transducers. The measurements were performed in the anterior tibial muscle. The blood flow was measured using the disappearance rate of argon washed out by breathing an argon-free gas mixture.

The partial pressure of oxygen and carbon dioxide in the anterior tibial muscle was 19.6 ± 3.1 and 46.4 ± 2.7 mmHg. The tissue interstitial pressure was 8 ± 1.3 mmHg. The muscular blood flow was 4.5 ± 0.7 ml/min $\cdot$ 100 g⁻¹. The results accord with earlier reports of oxygen tension and blood flow in skeletal muscle. Thus, it is possible to directly measure blood flow, PO₂, and PCO₂ under clinical conditions.

Unguis incarnatus hallucis

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A series of 46 patients with 56 ingrown toenails of the

first toe were followed for 3.5 years. The patients were randomized to either Dubois' resection or wedge resection. At follow-up, 40 per cent in the wedge-resected group had a spica. Two of these spicae had to be resected. There was no difference in the frequency of relapses in the two operated on groups. The Dubois resected toes were cosmetically superior to the wedge-resected ones, and spicae did not occur.

We concluded that Dubois' resection is to be preferred if an operation is indicated among younger patients with a slight to moderate transverse curve of their nails.

Pediatric orthopedics

Epiphyseal plate lesions

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An analysis of all the patients under the age of 20 who were examined radiographically at Herning Hospital in 1984 revealed 130 patients with 134 epiphyseal plate lesions. The male/female ratio was 83/47. The mean age of the boys was 13 (2–18) years, and of the girls, 9 (2–14) years. Eighteen Salter-Harris Type I, 109 Type II, 4 Type III, 1 Type IV, and 2 Type V lesions were found. Almost all the localizations were represented with lesions in the distal radius and in the hand dominating in both sexes.

At follow-up in 1986, 127 patients were examined clinically and 124 radiographically. Ten boys and 2 girls (10%) showed growth disturbances.

This risk of growth disturbances stresses the importance of information to the parents and a radiographic examination 6 months after injury.

Irregular ossification of the femoral condyles

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Irregular ossification (IO) is frequently seen in the femoral condyles of children below 13 years of age. The radiographic appearance is often misinterpreted as osteochondritis dissecans (OD).

A study by Caffey of children 3–13 years of age without symptoms from the knee showed that 66 per

cent of the boys and 41 per cent of the girls had irregularities, which in 30 and 17 per cent, respectively, could be misinterpreted as OD. The incidence was found to decrease with age to almost zero at aged 13 years.

IO is distinguished from OD by 1) its location on the posterior aspect of the femoral condyles, whereas OD is found on the weight-bearing parts; 2) the occurrence in children below aged 13 years, where OD is mainly seen in teenagers above aged 15; 3) often being found bilaterally and sometimes in all four condyles.

IO is due to the rapid growth of the distal femoral epiphysis. The condition is asymptomatic, and the radiographic appearance normalizes before the age of 14. No treatment or control is necessary.

Amputations

Prophylactic antibiotics in amputation surgery

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In a multicenter, randomized, double-blind and clinically controlled study, the value of penicillin versus cefuroxime as a prophylactic antibiotic in amputation of the lower extremity was studied. Totally, 457 consecutive patients were included; 228 were randomized to penicillin and 229 to cefuroxime prophylaxis. The patients were stratified to group I (313 patients) and group II (88 patients); 56 patients were drop-outs according to protocol regulations. Patients in group I did not receive other antibiotics within 48 hours before amputation, whereas patients in group II did.

The patients were evaluated 21 days after surgery or earlier if complications occurred. In group I, 20 of 158 penicillin-treated and 27 of 155 cefuroxime-treated patients had wound sepsis. Five patients treated with penicillin and 4 treated with cefuroxime had been reamputated within 21 days. The differences found were not significant. It is concluded that penicillin seems as efficacious as cefuroxime as a prophylactic agent for nontraumatic lower extremity amputation.

The predictive value of preoperative hemoglobin and hematocrit for the outcome of below-the-knee amputations in arteriosclerotic and diabetic gangrene

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A high preoperative hemoglobin value has been found to be an important predictor of failure in minor diabetic amputations (1). An intentional lowering of the hemoglobin seems to improve the local perfusion, especially in ischemic tissue (2). The purpose of this study was to determine whether the preoperative hemoglobin and hematocrit levels affect the healing potential of below-the-knee amputations in arteriosclerotic and diabetic gangrene.

We reviewed the medical reports of all the patients discharged between April 1, 1977 and March 31, 1983 after a below-the-knee amputation because of gangrene. In 104 amputations due to arteriosclerotic gangrene, the complication rate was 57 per cent and the reamputation rate 37 per cent. The complication rate increased significantly with increasing preoperative hemoglobin and hematocrit values (chi-square test, $P < 0.05$) (Figure 1). In 82 diabetic amputations, the complication rate was

43 per cent and the reamputation rate 24 per cent. No relationship between the preoperative hemoglobin or hematocrit and the surgical outcome was found in diabetics. No significant influence on the healing prognosis could be demonstrated in any of the groups for the following parameters: age, sex, wet or dry gangrene, skin perfusion pressure, failed arterial surgery, competing serious illness, serum protein or serum cabamide. We concluded that a preoperative hemoglobin above 8.0 mmol/l or a hematocrit above 0.40 is a risk factor of importance in arteriosclerotic below-the-knee amputations.

1. *Lancet* (July 28, 1979), 168–170.

2. *Eur. Surg. Res.* (1986), 254–263.

Estimation of amputation level with a laser Doppler flowmeter

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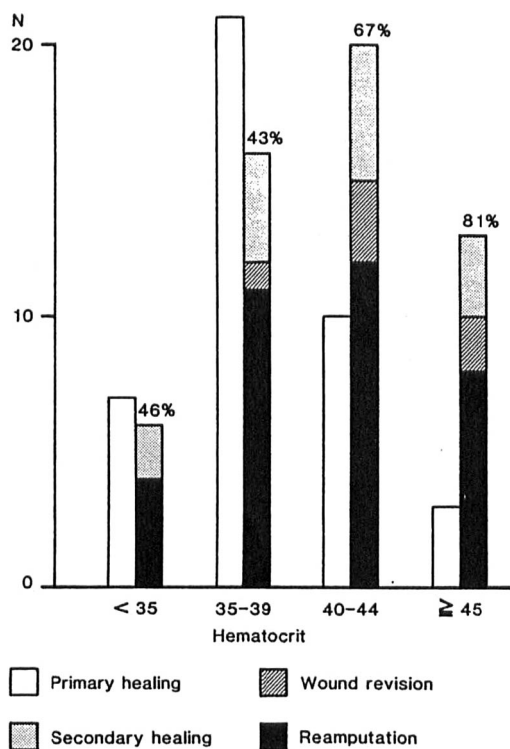
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Laser Doppler flowmetry (LDF) records the microperfusion of tissue. It is a noninvasive technique that is based on the Doppler shift of coherent (laser) light that is reflected from the tissue.

The present study included 10 patients between 62 and 89 years of age. LDF recordings were carried out at skin temperature and with local vasodilatation to 44°C. The sternum was used as a reference.

Level blood pressure was recorded and radioisotope clearance performed blind from the LDF results. The amputation level was determined without regard to the LDF results. No limb recording exceeded any sternal recording. At higher blood flow, the effect of local heating was more pronounced. Six malleolar and three calf recordings yielded no flow increase on temperature stimulation. These 9 patients had amputation performed one level more proximal than the "heat-stable" point. One patient had a flow increase on all recordings. This patient was not amputated.

LDF seems to be a safe, easy, and painless device, and a valuable tool in skin microflow evaluation.



Infections

Incision versus primary suture under antibiotic cover in acute subcutaneous abscesses: A prospective randomized trial

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To evaluate the treatment of acute subcutaneous abscesses with incision, curettage, and primary suture under antibiotic cover in orthopedic patients, a prospective study was carried out.

Meticillin was given before surgery. After incision and curettage, the patients were randomized if primary suturing was technically possible. Fifty-one patients were included, 24 of whom underwent primary suturing and 27 had conventional treatment with saline dressings. In the primary suture group, the mean healing time was 15 days, the mean sick-leave period 9 days, and the mean number of outpatient nurse attendances 4, including 4 failures in which the sutures had to be removed and conventional treatment was carried out. In the failures, the mean healing time was 32 days. In the group of conventionally treated abscesses, the mean healing time was 28 days, the mean sick-leave period 15 days, and the mean number of outpatient nurse attendances 25.

In terms of healing time, postoperative sick leave, and cost of nursing care, the treatment of acute abscesses with primary suturing under antibiotic cover was superior to conventional dressings.

Incidence of nontuberculous spondylitis in Denmark from 1978 through 1982

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The incidence of osteomyelitis of the vertebral column is not known. The aim of this study was to analyze the incidence and anatomic distribution of acute, pyogenic spondylitis in Danish hospitals during a 5-year period.

From the national patient register, we obtained the data of all the patients discharged from Danish hospitals from 1978 through 1982 with a diagnosis of nontuberculous spondylitis. All the information was obtained from patient files. Of the 182 who had a diagnosis of spondylitis, 23 did not suffer from the acute, nontuberculous form, leaving 159 patients for the study.

Based on the number of patients submitted, the

incidence rate was 0.61 per 100,000 per year. The male:female ratio was 1.2:1. Twenty per cent were children and 54 per cent were aged 50–79 years. The anatomic distribution in the spine was cervical 6 per cent, thoracic 26 per cent, lumbar 66 per cent, and sacral 2 per cent.

Traumatology

Fatal motorcycle accidents from 1978 to 1982

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The rate of motorcycle fatalities with respect to the total number of Danish traffic fatalities increased from 3.5 to 9.7 per cent in the years 1970–1983. Despite the compulsory use of helmets and head lamps, as well as a lowering of speed limits, the number of motorcyclist and passenger fatalities did not decrease, whereas the total number of fatalities in Danish traffic did decrease during this period.

A nationwide analysis of the accidents in which a motorcyclist or passenger was killed was made. Totally 255 motorcyclists and 55 passengers were killed. The mean age was 23 years.

In 103 cases a medicolegal autopsy report was available. These cases were AIS coded (Abbreviated Injury Scale) and ISS calculated. The traumas were multiple and major. A mean of 4.7 body regions were injured. The mean ISS was 52, and 89 per cent suffered from cranial traumas with a mean AIS of 4.0. Helmets were worn by 80 per cent. Thoracic and abdominal traumas were also major (mean AIS 3.5 and 2.6, respectively). Fifty-nine per cent had multiple rib fractures and 50 per cent had liver or spleen ruptures.

Delays in treatment of stab wounds

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Findings at legal autopsy were compared with information from hospitals and police records concerning all persons stabbed to death in the eastern part of Denmark from 1970 through 1984.

Seventy-one persons were killed by stab wounds. Nine persons were found dead. Fifty-seven persons died

from 5 to 293 minutes after being assaulted. Twenty-six persons reached hospitals alive 8–90 minutes after the assault, but only 13 lived long enough to be submitted to surgery. Heart lesions alone or in combination with lung lesions were the cause of death in 28 cases. Ten persons died at the scene of the crime and 10 died during transportation to the hospital. There were 22 cases of isolated lung lesions and 13 of these subjects were alive on admission to hospital. Twelve persons died of lesions of major vessels.

Retrospectively, 15 persons might have survived if circumstances had been more favorable. There were 7 cases of delayed transport and 8 patients might have been saved by earlier definite treatment.

Lesions caused by exploding oil or gas drums

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A review was made of 21 men injured by exploding oil drums. Sixteen attempted to divide a drum with a disc grinder or a cutting blowpipe; 4 were welding a drum or used drums as a support when welding iron materials; and 1 man was moving a drum with paint wastes, which exploded because of heating by the sun.

The lesions were caused by fire or when the persons were hit by the top or bottom of the drums, being ejected with great force at the explosion.

Five were killed; 3 died from burns; and 2 were hit on the head with fatal brain and facial injuries. Two men with several facial fractures survived.

Five were hit on a lower extremity (one or both legs) with a total of six major comminuted open fractures of the tibia, necessitating treatment with local and free flaps and bone grafts. The last 9 men had burns covering from 2 to 50 per cent of the body surface, with up to 30 per cent being third degree burns.

Conclusion. It is most dangerous to cut oil or gas drums with a disc grinder or a blowpipe. The drums must be totally empty, or better, filled with water.