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Hip

Postoperative oxygen saturation after hip fracture measured by pulse oximetry

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Episodic arterial oxygen desaturation may cause postsurgical confusion, a condition often encountered in elderly patients with a hip fracture.

In this study, we monitored the incidence and severity of hypoxemia during the first postsurgical day.

Patients and methods: Twenty-two consecutive hip fracture patients, median age 73 years, were acutely operated on (sliding screw osteosynthesis).

After observation in the recovery room (median 6 hours), oxygen saturation was monitored continuously for a median of 24 hours using a pulse oximeter. Preoperatively, all the patients had an oxygen saturation ≥ 90 percent,, and they had no signs of cardiopulmonary incompensation.

Results: Twenty-one out of 22 patients were hypoxemic, with oxygen desaturations between 90 and 80 percent a median of 605 minutes. Five patients had values below 80 percent a median of 7 minutes. Hypoxemia was noted in a median of 35 percent of the total number of observations. Postsurgical confusion was seen in 10 patients. No correlation was, however, found between confusion and oxygen desaturations. Nor was there a correlation between the severity of the hypoxemia and duration of hospitalization.

Hematomas after total hip replacement—an ultrasound study

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The ability of two different subcutaneous suture techniques to prevent subcutaneous hematomas was compared, and the number of hematomas seen clinically was compared with the number diagnosed by ultrasound.

Thirty-five patients with a total hip replacement (Lubinus SP-II®) due to primary arthrosis were randomized into two groups. In group A the subcutaneous tissue was sutured, but not including the fascia in the suture. In group B the subcutaneous suture included a stitch in the fascia. Subcutaneous drainage was not applied, but two deep drains were used, both being removed the second day after the operation. An ultrasound examination was performed on the third postoperative day to diagnose subcutaneous and deep hematomas.

Among 16 patients in group A, three subcutaneous hematomas were found. Among 19 patients in group B, six subcutaneous hematomas were found. Deep hematomas were found in 9 of 33 patients. Three patients had both subcutaneous and deep hematomas. Clinically, hematomas were seen in 3 patients, whereas 15 patients had hematomas diagnosed by ultrasound.

We found no significant difference ($P \geq 0.2$) between the number of hematomas in the two groups with different suture techniques. Ultrasound revealed more hematomas than clinical examination ($P \leq 0.05$). Hematomas appearing clinically are of importance as regards late deep infection in hip arthroplasty. Ultrasound examination should be included in prospective studies of risk factors associated with late deep infections.

Naproxen (Naprosyn®) for a week can prevent formation of heterotopic ossification after total hip replacement

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The incidence of heterotopic ossification (HO) after total hip replacement (THR) has been reported to be 0.6–90 percent. In a previous study, we have shown that naproxen given three times daily for 4 weeks after THR can reduce heterotopic ossification.

The present study was performed to examine the effect of a short-term treatment with naproxen on the occurrence of HO.

Patients and methods: Thirty consecutive patients with coxarthrosis were operated on with a cemented Müller total hip prosthesis. They were all given 500 mg naproxen twice daily for 8 days. The medication was started along with premedication on the day of operation.

Radiographic and clinical examinations were performed after 6 and 13 weeks. HO was evaluated according to DeLee. Seven patients could not complete the study.

All the radiographs were blinded and randomly mixed with the radiographs of 27 patients from a placebo group from our previous study.

Results:

Table

	6 weeks				13 weeks			
DeLee (degrees)	0	1	2	3	0	1	2	3
Placebo (numbers)	15	8	4	0	14	7	6	0
Naproxen	20	3	0	0	19	3	1	0

$P < 0.05$ (Fisher's exact test)

Conclusion: We found that 8 days of treatment with 500 daily after total hip replacement can reduce the heterotopic ossification significantly.

Low molecular weight heparin (Enoxaparin) versus Dextran 70 in the prevention of postoperative deep vein thrombosis after total hip replacement: A Danish multicenter study

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We present a randomized open study comparing the thromboprophylactic efficacy and safety of Enoxaparin (40 mg s.c. o.d.; LMWH) with a standard regimen of Dextran 70 (Macrodex 60 mg/mL) in patients undergoing elective total hip replacement. Deep vein thrombosis (DVT) was diagnosed by bilateral ascending phlebography 7–11 days after the operation, and all the venograms were assessed by 3 independent radiologists. Totally, 246 consecutive patients were included, and 27 were excluded; thus, 219 patients were eligible for analysis. DVT was diagnosed in 7 of 108 (6 percent) patients in the LMWH group and in 24 of 111 (21 percent) patients in the dextran group ($P = 0.0021$). Distribution of proximal and distal DVT did not differ between the groups. Three patients in the dextran group developed symptomatic DVT after discharge from the hospital. Blood loss in drains on the first postoperative day was significantly higher in the dextran group compared with that in the LMWH group ($P < 0.01$). Bleeding and adverse events did not differ in the groups. No deaths occurred during the study. One patient in the LMWH group died within 1 month after the operation.

Mobilization—a disregarded factor! Influence on postoperative thromboembolism

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Seventy-eight patients (total hip replacement surgery) were studied in order to assess the preventive influence of early mobilization on postoperative thromboembolic complications. Patients were admitted to two orthopedic wards: A and B. Ward A used mobilization on the 4th day after operation throughout the study, whereas Ward B had mobilization on the 9th day during the first part of the study (February 12–July 14, 1988), Ward B_{LATE}, but changed to mobilization on the 4th day in the last part of the study (July 15–December 12, 1988), Ward B_{EARLY}. All the patients had thromboprophylaxis with thigh-length compression stockings (TED®, Kendall, U.S.A.) in combination with 50 anti-Xa units per kg of a low molecular weight heparin (Logiparin®, Novo Nordisk A/S, Denmark).

Deep vein thrombosis was diagnosed by bilateral phlebography in all the patients by examination between days 7 and 9 after the operation, and all the phlebograms were assessed by an independent radiologist. Eight patients were excluded for different reasons; thus, 70 patients were evaluated.

Results: See the table.

	Group	A	B_{EARLY}	B_{LATE}	Total
Thrombo-embolism	+	8	4	12	24
	−	27	15	4	46
	Total	35	19	16	70

A vs B_{EARLY}. $P = 1.00$; A vs B_{LATE}. $P = 0.0012$; B_{EARLY} vs B_{LATE}. $P = 0.0038$

Conclusions: Early mobilization is important to decrease the number of postoperative complications in patients undergoing hip arthroplasty. If mobilization is delayed, the full benefit of thromboprophylaxis may be lost.

Knee

Knee arthroscopy after sports trauma

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To evaluate the pattern of injuries and the diagnostic importance of knee arthroscopy after acute sports-related trauma, the results of 100 consecutive arthroscopies were registered. The indications for acute arthroscopy were swelling, instability, or locked knee.

Patients: The patients were on an average 25 years of age, and there were 60 males and 40 females. All the arthroscopies were performed under general or epidural analgesia.

Results: Most injuries occurred in football (31 percent, followed by skiing (29 percent) and handball (10 percent). The structure most frequently injured was the anterior cruciate ligament (48 percent), followed by meniscus lesions (36 percent) and collateral ligament lesions (34 percent). Totally, 61 percent of the meniscus lesions were medial, and 39 percent were lateral. Of the collateral ligament injuries, 91 percent were medial. Fifteen patients had chondral lesions.

Twenty-two of the 29 patients injured while skiing had an ACL rupture. Forty-four patients had surgery, but 12 patients with ACL an rupture were treated conservatively. In 57 percent, the preoperative and the arthroscopic diagnoses were similar.

Conclusions: We found surprisingly many serious injuries after downhill skiing, and hope for better prophylactic measures. The clinical diagnosis is difficult, and arthroscopic investigations should be made on wide indications.

Knee arthroscopy under local anesthesia

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In our department, 147 patients with knee problems were examined arthroscopically under local anesthesia. In 117 cases, an intraarticular explanation was found; and in 84 of these, arthroscopic surgery was performed. Seventy-three were meniscectomies. Forty-two women and 105 men between 15 and 70 years of age (mean 32 years) were selected among a total of 400 arthroscopies performed during the period from January 1989 to February 1990. Another 2 patients were preoperatively selected for local anesthesia, but were peroperatively supplemented with general anesthesia.

Before the operation, all the patients were examined in the outpatient clinic, and those suited for local anesthesia were selected. Information about the anesthetic and operative procedure was given to the patient in the outpatient clinic, as well as during the surgery, which we find is of great importance in order to obtain full cooperation from the patient.

A standard solution of lidocaine 1 percent with 10 micrograms of norepinephrine per mL was used. Ten milliliters was infiltrated s.c. in the area of the portals, and another 10 mL was injected into the joint. No further medication was given. A 5-mm arthroscope was used with a video camera and an intermittent flow of an isotonic sodium chloride solution.

The intraarticular derangements were primarily meniscal tears, arthrosis, ruptures of the ACL, and chondromalacia.

Sixty-three randomly selected patients were interviewed postoperatively. Ninety-four percent would prefer local anesthesia in case of another arthroscopy.

We find that local anesthesia is suitable for arthroscopic examination and surgery in a selected group of patients.

Epidemiology of surgically treated meniscal lesions in the knee

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In a suburban area of Copenhagen with approximately 620,000 inhabitants, all the surgically treated meniscal lesions of the knee joint were recorded during the years 1982–84. All the operations in this study were open. The 3 years selected have been carefully chosen, because arthroscopic surgery performed in private clinics, preventing reli-

able epidemiologic analysis, was introduced the following years.

The overall incidence of meniscal lesions per 10,000 inhabitants per year was 9.0 in men and 4.2 in women. The highest incidences were seen in the 3rd, 4th, and 5th decades of life. A higher frequency of trauma related to onset of symptoms was seen among men (77 percent) than among women (64 percent; $P < 0.001$). The bucket-handle lesion was the most frequent type of meniscal lesion in men (35 percent), whereas peripheral detachment was the most frequent type in women (41 percent).

A varying frequency of trauma inducing the lesions in men and women did not explain the sex differences in type of lesion ($P < 0.01$). Nineteen percent of the 1,215 patients in this study were treated with partial meniscectomy, while 0.7 percent had meniscal repair performed. These figures will increase with time and possibly reduce the frequency of arthrosis following meniscus surgery.

Long-term results after arthroscopic meniscectomy of bucket-handle tears

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After total meniscectomy the risk of developing arthrosis and poor knee function is very high. Short-term results of partial meniscectomy show good functional results. The aim of this study was to describe the long-term results after arthroscopic meniscectomy of severe meniscus tears.

Material and methods: During 1978–82, 52 partial meniscectomies were performed. The knees underwent no other primary treatment. The average age of the patients at operation was 32 years, and the time of observation was 8 years. By reexamination the function was evaluated clinically, by Lysholm's score, and Tegner's activity scale. Standing radiographs were taken of both knees.

Results: During the follow-up period, 5 patients had further meniscectomy after a new injury. A Lysholm score exceeding 90 was found in 46/52 cases and Tegner's level was a mean of 5.2 before surgery and fell to 4.7 at follow-up. According to Ahlbäck's evaluation the radiographic examination showed that 21 patients had narrowing of the articular space, in most cases of degree one. Five patients had the same changes in the unoperated on knee joint. Fairbanks' changes were found in 29 knees.

Conclusion: More than 8 years after arthroscopic meniscectomy of bucket-handle tears, the knee function was good, but arthrosis had developed in half of the patients.

Breakdown of metal-backed patellar components in total knee prostheses

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From February 1987 to September 1988, 79 metal-backed patellar components were used with the Biomet ACG 2000 total knee prosthesis.

This procedure was discontinued in the summer of 1988 because we began to see disintegration of the polyethylene part and wear of the metal back, with severe metallosis in the synovium and loud noises from the knee. We now use the all-polyethylene patellar component.

Four patients were reoperated on because of symptoms, whereas the other 75 knees were reviewed, but no additional failures of the patellar component were seen.

Based on our own experience and reports in recent literature, we recommend that the use of metal-backed patellar components be discontinued.

Failure of metal-backed patellar component after total condylar knee arthroplasty

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During the period June 1987 to July 1989, 111 total condylar knee prostheses using a metal-backed patellar component were inserted. The mean time from primary knee replacement to failure was 15 (7–22) months.

All the patients experienced a sudden grinding sensation in the knee after an otherwise uncomplicated postoperative course. Four patients had some degree of pain and 1 experienced knee locking. In all the cases, radiographs revealed direct patellar-femoral metal-on-metal contact expressing absence of the polyethylene, and in 3 cases this was visible as a silhouette elsewhere in the knee joint.

On reoperation a characteristic black synovitis was found. The cemented patellar titanium components were solidly anchored in the patella. In all the cases the polyethylene was fractured and had separated from the metal backing, which showed considerable wear.

Total synovectomy was performed, and the patellar components were replaced. No tibial or femoral components were renewed. Following reoperation, 7 patients had an uncomplicated postoperative course, whereas 1 patient with rheumatoid arthritis, treated with steroids, developed a pyarthrosis. From January 1984 to May 1987 by comparison, 151 knee arthroplasties were performed using the same type of knee prostheses, but with an all-polyethylene patellar component, and with no complications.

On the basis of the foregoing and the literature, metal-backed patellar components cannot be recommended.

Disintegration of metal-backed patellar prosthesis

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From January 1988 through March 1989, 47 cases of total knee alloplasty using metal-backed patellar buttons (Biomet Inc. R) were used for treatment of gonarthrosis. The patients were followed clinically and radiographically at regular intervals. Within the first 1.5 postoperative years, 4 patients were admitted on account of acute knee pain. The phenomenon was associated with loud squeaking during knee motion. Radiographically, metal-against-metal contact was demonstrated in the femoropatellar junction. These knees were all revised within the shortest possible time by removal of the patellar button, synovectomy, and insertion of a UHMWPE patellar component. The symptoms disappeared following this treatment. The findings during knee surgery were black synovial lining, disintegration of UHMWPE from the metal, the latter being firmly seated in cement and bone. The UHMWPE components were either cracked or grooved. Pathoanatomically, a metallic synovitis with giant-cell granulomas was demonstrated. Material analysis showed no material fatigue, and the only explanation given for the component separation was the use of an old design with metal backing. Comparative radiographic analysis of the four failures and the rest of the knees could not demonstrate any difference according to anatomic placement, axis of the knee joint, or techniques of cementation. A frequency of 8.5 percent (95 percent confidence limits: 2.4–20.4) of material failure during the first postoperative years is unacceptable.

Foot and ankle

Conservatively treated rupture of the Achilles tendon

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The treatment of the acutely ruptured Achilles tendon is predominantly operative. This is a consequence of an unacceptably high frequency of reruptures following conservative treatment.

At our department, we have used a restrictive conservative treatment consisting of a total immobilization period of 12 weeks: 3 weeks with high femur casting with the foot in the relaxed equinus position and the following 9 weeks with a low cast with gradual reduction to neutral plantar flexion and allowing full weight bearing.

We present the long-term functional results below.

In the period October 1982–December 1986, 66 acutely ruptured Achilles tendons were treated. Fifty-seven patients were reexamined with a median follow-up of 6 (3–7) years. Four patients had sustained a rerupture that healed secondarily during conservative treatment. One patient developed a deep thrombosis of the leg. Functionally, the patients were evaluated using the Tegner functional score. The score was a median 5.3 before rupture and 5.0 at follow-up.

Eleven patients experienced slight discomfort during sports activities, and 2 were moderately disabled during daily activities. One patient was severely disabled, with a Tegner activity score of 1 (the patient with the thrombosis).

Conclusions: Restrictive conservative treatment gives a fully acceptable functional end result. The overall complication rate in this study was 5/57 including 4 reruptures, and we find that restrictive conservative treatment is a good alternative to operative treatment of the acute rupture of the Achilles tendon.

Single leg postural equilibrium test

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The purpose of the study was to quantify the single leg postural equilibrium test and to relate the results of the test to the state of the lateral ligaments of the ankle in patients with functional instability of the ankle, as well as comparing the results with those of the contralateral leg and of a control group.

Patients and methods: The clinical group consisted of 29 patients with functional instability of the ankle joint. Prior to operative exploration of the lateral ligaments of the ankle joint, the ability to balance on one leg was tested. At operation the condition of the anterior talofibular and calcaneofibular ligaments was registered. The control group comprised 41 patients. None suffered from functional instability of the ankle joints or had a history of injury to the lower extremities.

Results: Patients with ruptured calcaneofibular ligament had a significantly inferior result compared with patients with an uninjured calcaneofibular ligament. The test result was also inferior to that of the unaffected leg, and to that of the control group.

Conclusion: The single leg postural equilibrium test is a simple clinical test that is easily employed in the objective evaluation of functional instability of the ankle.

Increased peroneal reaction time in functional ankle instability

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The reaction of 15 functionally ankle-stable and 15 functionally ankle-unstable athletes to sudden ankle inversion was described by registering EMG of lower extremity muscles, motion of lower extremity joints, and displacement of the body center of pressure. Both groups reacted to inversion by 1) a contraction of the peroneal muscle group, and 2) a flexion of hip and knee, and a dorsiflexion of the ankle resulting in a diminished vertical force on the inverting foot and an eversion of 5°. The reaction of the peronei (1) was considered to be the result of a spinal reflex, and the reaction time was increased in the unstable group (84 (70–90) msec compared with the stable group 69 (60–80) msec; $P < 0.01$). The flexion pattern reaction (2) was considered to be the result of a centrally mediated strategy, and no difference in central reaction time was found between groups. These result support the theory of a proprioceptive deficit being a pathogenetic factor in functional instability.

A strong correlation was found between peroneal reaction time and postural sway when standing one legged on a force plate (Spearman's *rho* = 0.92).

In 10 unstable subjects tested with and without tape, a reflex enhancing effect through stimulation of cutaneous receptors could not be verified.

Observer variation in the classification of ankle fractures

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The interobserver and intraobserver variations in the classification of ankle fractures into the systems of Lauge Hansen (LH) and Weber (W) were assessed. Radiographs of 94 patients were classified independently by 4 observers. One was a specialist in orthopedics, 2 had training in orthopedics, and 1 was a specialist in radiology. The radiographs (frontal, lateral, and oblique projections) were classified according to both systems. Three months later, the radiographs were reviewed by the same observers.

The observer variations were analyzed by kappa statistics. It adjusts the observed agreement for the agreement reached solely by chance. According to Svanholm et al. (1989), we define kappa values < 0.5 as poor and values > 0.75 as excellent agreement.

In the first reading the overall kappa values reached in the LH and the W system were 0.49 and 0.58. In the second reading the values were 0.60 and 0.56. The intraobserver agreement for both systems varied between 0.60 and 0.76. The kappa values for the pronation-abduction fractures in the LH system (0.12 and 0.35) were significantly poorer than the values reached in the other categories. Regarding staging of supination-adduction (SA) and supination-eversion fractures according to the LH system, the kappa values were poor (0.13 and 0.35). For the staging of SA fractures the observed agreement was not higher than the expected agreement by chance.

We found moderate reliability in the classification of both systems, but a poor precision of staging within the categories of the LH system. We suggest that future classification systems should be tested for reliability before being accepted.

Staple fixation in Mitchell's osteotomy for hallux valgus

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Since September 1988, staple fixation of Mitchell's osteotomies has been used at our department to avoid postoperative plaster immobilization. An evaluation after the first year is presented.

Material and methods: Sixty-one feet of 60 patients, median age 38 (14–65) years, were operated on by 16 different surgeons. Median hospitalization was 2 (1–4) days. The patients were seen in the outpatient clinic after 2 and 12 weeks. The median sick leave was 14 (2–109) days.

The osteotomy was fixated with two staples (13–16 × 10 mm) inserted dorsally and medially to the osteotomy using a powered stapler, the 3M Staplizer. Postoperatively, the patients were mobilized with heel shoes for 2 weeks, after which they were allowed full weight bearing.

Results: After 2 weeks, 27 patients were able to stand freely on the operated on foot while another 29 patients had slight discomfort, but no pain. At 12 weeks, normal gait was seen in 50 patients while 7 indicated a slight discomfort, but no pain.

No dislocations were seen, and 60 out of 61 osteotomies healed. Five patients were seen after the third month, 3 of

these were reoperated on: 1 patient developed a pseudarthrosis, 1 had his staples removed because of metatarsalgia, and 1 patient developed a neuroma. Two patients needed physiotherapy.

Conclusion: Fixation of the Mitchell osteotomy with staples reduces external immobilization and enables early weight bearing.

Shoulder

Recurrent anterior dislocation of the shoulder treated operatively a. m. Boitchew

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The most optimal operative treatment of recurrent anterior dislocation of the shoulder is still discussed. In the method of Boitchew, the processus coracoideus with attachments of m. bicipitis and m. coracobrachialis is chiselled off and guided under m. subscapularis in front of the joint capsule, and then refixated in situ by using a screw. During 5 years, 24 patients (22 men and 2 women) were operated on unilaterally a. m. Boitchew, and the results of the treatment were evaluated clinically. Stability, movement, and function of the shoulder were evaluated; and the patients gave a subjective estimation of the result. The average age was 26 (16–40) years, and the average time of observation was 2.5 (1–5) years. In 19 patients a satisfying objective result was reached, and 20 patients regarded the result as satisfactory. The average reduction of the external rotation was found to be 10° (0°–20°). Redislocation occurred in 3 patients. One was reoperated on a.m. Putti-Platt, while the 2 others in spite of this event regarded the result as satisfactory.

In the treatment of recurrent anterior dislocation of the shoulder, the Boitchew method seems very suitable, as far as this relatively simple operative technique only gives little reduction in the external rotation, and the frequency of recurrence is found to be acceptable.

Shoulder arthroplasty

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The results after hemiarthroplasty and total shoulder joint replacements were evaluated a median of 58 (10–107) months postoperatively. From 1978 to 1988, 31 shoulders were inserted in 25 patients. Only 17 shoulders in 12 patients were reviewed because 10 patients were dead, 2 patients did not want to participate, and 1 arthroplasty had been removed. The Neer-II hemiarthroplasty in 2 shoulders, 12 total shoulder replacements a. m. Neer-II, and 3 total shoulder replacements a.m. St. George were used.

The indication for operation was chronic severe pain. The preoperative diagnoses were rheumatoid arthritis in 12 shoulders, arthrosis in 3, and a previous fracture of the humeral head in 2 shoulders. The median age was 67 (48–77) years.

At follow-up, three fifths had no significant pain.

Functional level was evaluated from the patients' ability to perform 14 activities of daily living, graduated from 0–56 points. The median function score was 31 (12–54). An inverse relationship between pain and functional level was observed (Spearman's test $P < 0.017$). The survival curve a.m. Kaplan Meier showed that one third had loosening of the glenoid component after 5 years.

Conclusion: With a median follow-up period of 58 months, three fifths of the shoulders were without significant pain. Two thirds of the shoulders had acceptable functional level, and the survival rate of the glenoid component was two thirds after 5 years.

Hand surgery

Long-term follow-up of the cemented Caffinière prosthesis for trapeziometacarpal arthroplasty

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Since the introduction of the Caffinière cemented prosthesis for arthroplasty of the trapeziometacarpal (TMC) joint, Caffinière has published the only long-term follow-up of 22 operations with encouraging results. We report the long-term results obtained at our hospital, where the operation has been performed since 1978.

Twenty patients with 22 Caffinière prostheses were evaluated a median of 9 years after implantation. Indication for the operation was pain from the TMC joint that could not be conservatively treated combined with radiographic degenerative changes of the joint, but without pantrapezial destruction. Twenty had arthrosis and 2 rheumatoid arthritis. Eighteen patients with 20 prostheses had low stress demands of their hands, and 2 had hand stressing work. Three hands had been reoperated on because of of early to intermediate aseptic loosening with replacement of two cups and one total prosthesis.

We found radiographic loosening in one of the revised prostheses, whereas all the other prostheses were without signs of loosening. Of the 21 thumbs that could be evaluat-

ed for pain, 19 were painless or only had slight pain; one had moderate pain, and the patient with the loose prosthesis had severe disabling pain. This patient and 1 patient with severe rheumatoid arthritis excluded, mobility, and strength was found satisfactory.

We conclude that function does not deteriorate with time that late loosening does not seem to be a problem with this prosthesis, and that it is possible to obtain good results with component replacement in the case of aseptic loosening.

Syndroma caput ulnae treated by Lauenstein's operation

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Controversies concerning the treatment of posttraumatic syndroma caput ulnae are still evident.

Since January 1989, our treatment has been arthrodesis ad modum Lauenstein of the distal articulation between the radius and ulna, combined with resection of the ulnar neck. This preliminary study incudes 8 patients (6 women and 2 men), median age 39 (22–77) years of whom 7 have had a distal fracture healed with shortening of the radius or with subluxation of the ulnar head. Preoperative morbidity was 24 (3–48) months. The median postoperative observation time was 6 (4–17) months.

All the patients preoperatively claimed persistent, medial wrist pain and restricted pronation-supination.

Results: After Lauenstein's operation, 7 patients were asymptomatic, and only 1 had slight intermittent pain from the site of the resection. There was 60° improvement of pronation-supination.

Spine

Intraoperative autologous transfusion (cell saving) during spinal surgery

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Because of the risk of transmitting diseases, such as hepatitis A and B, hepatitis non-A, non-B, and HIV virus, by homologous blood transfusion, techniques of intraoperative reinfusion of the red blood cells (cell saving) have been developed.

Material: Thirteen patients undergoing major spinal surgery in the period March 1989 to February 1990 received intraoperative autologous transfusion by use of a Haemonetic Cell Saver 3 Plus. There were 9 girls and 4 boys. The average age was 15 (12–18) years. Ten patients had idiopathic scoliosis, 2 had muscular dystrophy, and 1 had a kyphotic deformity. Cell saving was used peroperatively only.

Results: The total loss of blood was on an average 2,980 (1,430–5,775) mL, whereas the loss of blood peroperatively was, on an average, 2,040 (300–4,000) mL. From this, 1,100 (200–2,300) mL was cell saved, that is, about 54 percent of regained blood, with a hematocrit of 60. Postoperatively, the hematocrit, on an average, fell from 41 to 32. Peroperatively, 8 patients had no further transfusion, 3 required one unit of blood, and 2 required two units. Postoperatively, 3 patients had no transfusion, 1 had one unit of blood, 2 had two units, and 7 had three units. During peroperative use of the cell saver, the estimated blood salvage is 3.6 blood transfusions per patient. Complications related to use of the cell-saving technique have not been recognized.

Conclusion: The technique is recommended in the absence of tumor or infection for all orthopedic procedures in which homologous blood may be needed. In the present work, the cell-saving technique is only used peroperatively, but it should also include the loss of blood in the postoperative period. Cell-saving programs are now available. An increased part of the loss of blood may be regained when the cell-saving technique becomes routine. The technique is generally accepted by Jehovah's Witnesses.

Surgical treatment of thoracolumbar unstable fractures

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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 neurologic function was analyzed.

Patients and methods: Sixty-seven patients were surgically treated for unstable thoracolumbar fractures. Forty-three of the fractures were located in the thoracolumbar junction. Preoperatively, 20 of the patients were neurologically intact, 22 Frankel grade D, and 16 were total paraplegics. The rest had variable degrees of neurologic deficits. In 54 cases, fixation was obtained using Harrington's distraction rods with sublaminar wires two levels above and below the lesion. In another 8 cases, the AO internal fixator was used, and the rest were stabilized using the Luque technique or the Roy-Camille plates. Wide decompressive laminectomy was performed if the canal cross-sectional diameter was reduced.

Results: With an observation period from 6 months to 4 years, all the fractures healed without secondary deformity. The correction obtained was, on an average, 25 percent improvement in vertebral body height, and in cases with kyphosis, on an average, 15° correction was obtained. The only implant failure was 1 case of sublaminar wire breakage; no surgical complications or deterioration in neurologic status was seen. Nineteen patients with neurologic impairment improved on an average 1.5 levels on the Frankel grading scale, and 2 patients with total paraplegia improved 4 Frankel grades.

Conclusion: Surgical treatment of unstable thoracolumbar fractures corrects deformity without deterioration in neurologic functions or other complications. The neurologic outcome was favorable compared with nonoperative treatment.

Postoperative computed tomography 3 months after lumbar disc operation

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In a prospective single-blinded study, 56 patients operated on for lumbar disc herniation underwent clinical examination and computed tomography preoperatively and 3 months after the operation.

The degree of intraspinal scar tissue and recurrent or persistent disc herniation was described by a neuroradiologist without information of the clinical examination.

At follow-up of 54 patients, a median of 31 (21–37) months after the operation, 26 had an excellent outcome, 20 improved, and 8 patients had an unchanged or a worse outcome.

Dural or radicular scar tissue was present at the computed tomography in 44 of the patients, but the findings could not be correlated with the clinical outcome. Recurrent or persistent disc herniation was shown in 4 patients. Two of these patients had a poor outcome and were reoperated on, whereas 1 had an excellent outcome and an 1 improved outcome.

The clinical outcome of patients who had a normal computed tomography was better than in patients who had an abnormal CT, but this was not significant. Patients without facet joint degeneration had a significantly better clinical outcome than patients who had degeneration.

Computed tomography performed without contrast 3 months after the operation gave little information that could be correlated with the clinical outcome. Patients with excellent outcome had all degrees of intraspinal scar tissue.

Pediatric orthopedics

Proximal femoral focal deficiency (PFFD)

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Thirteen patients with PFFD (congenital shortening of the femur) were investigated clinically and radiographically after a median of 15 (4–37) years. The patients often had accompanying deformities (fibular aplasia, deformities of the upper extremities). The femoral shortening was classified according to Aitken (1959) and Fixsen and Lloyd–Roberts (1974) to evaluate the prognosis.

Eighteen extremities were affected, and in 13 attempts of achieving hip function had been performed. Analysis of the two classification systems showed that Aitken's system described the prognosis better considering hip function, but several operations (valgus osteotomies and bone grafting due to congenital pseudarthrosis) were often necessary.

All 8 unilateral cases and 2 of 5 bilateral cases were prosthetic users. In 3 patients, rotational plasty according to van Nes (leg turned 180° making the foot act as a knee) had been performed. At follow-up, only 1 patient received a disability pension, and 7 of the 13 patients were active in sports, often at a high level.

Conclusions: We recommend early classification, and in classes A and B repeated surgery to obtain hip function. Rotational osteotomy can be considered in unilateral cases and in bilateral cases with great leg-length discrepancy. Newer techniques for limb lengthening can possibly improve the cosmetic and functional result in these severely handicapped patients.

Domiciliary management of simple femoral fractures in children treated with skin traction

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Children 10 years of age or less with a femoral shaft fracture often require 4 to 6 weeks of hospitalization. Usually the treatment of the children is Russel's or Bryant's skin traction. Three orthopedic departments in Denmark manage these children at home after a few days of hospitalization.

Indication: Children 10 years old or less with a femoral shaft fracture treated with skin traction; the children must not have competitive injuries.

Material: From 1984 to 1989 the children from the county hospital in Næstved and from 1987 to 1989 the children from the county hospital in Hilleröd have been managed at home. During this period, 27 children were

treated with skin traction, 19 of whom were treated at home.

Results: A satisfactory outcome was observed with no fracture healing problems. All the parents were satisfied with the home treatment. The length of stay diminished from a median of 39 (22–53) days to a median of 5 (2–19) days. The number of ambulatory visits increased from a median of 1 (1–4) to a median of 3 (1–7).

Conclusions: We find that domiciliary gallows traction for femoral fractures in young children to be a good alternative to hospitalization, but requires that the parents are suitable and properly informed, that the fracture is suitable, and that the practical conditions of the home are in order.

Infections

Chronic synovitis of the knee—a lymphoscintigraphic study

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The present study is a supplement to former ones evaluating lymphoscintigraphy as a method to study synovial fluid resorption from the knee joint through the lymphatic system. The purpose was to investigate whether lymphoscintigraphy is a clinically useful method in the evaluation of patients suffering from chronic synovitis of the knee.

Patients and methods: The patients, 5 men and 5 women, with clinically assessed chronic knee synovitis, were examined. The median age was 44 (22–63) years, and the median duration of symptoms 1 (0.5–5) years. None of the patients had previous surgery around or in the examined knee or had radiographic signs of arthrosis. Lymphoscintigraphy was performed by intraarticular injection of 1 mL saline containing 60 MBq ^{99m}Technetium-labeled microcolloid particles. Scintigraphic visualization and calculations were performed by a Siemens gamma camera connected to a Siemens scintiview microcomputer.

Results: Radioactivity measurements, performed 1, 2, 4, and 22 hours after the injection, were very uniform. Half of the radioactivity disappeared from the knee joint within 22 hours. The radioactive uptake in the regional lymph nodes was very low: The highest measured uptake was only 2.4 percent of the activity in the knee joint.

Discussion and conclusion: The decrease in radioactivity in the examined knees cannot be explained by a correspondingly high transportation through the lymphatic system. Lymphogenous resorption from those knees was very little. Further studies have shown that the synovial membrane has a significant phagocytotic activity, thus removing radioactive particles from the synovial fluid. Clinical application of intraarticular lymphoscintigraphy for the study of synovial fluid resorption, in patients with chronic synovitis, cannot be recommended.

Experimental septic arthritis treated with synovectomy

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The value of synovectomy in an experimental model of septic arthritis is evaluated.

Thirty-six rabbits inoculated with 10^3 *Staphylococcus aureus* in one knee joint were treated with cloxacillin 50 mg/kg × 2 i.m. and probenecid 250 mg p.o. × 1. On Day 3, 5, and 7, respectively, 30 knees were synovectomized. Six animals were treated only with antibiotics. Further, eight noninfected knees were synovectomized as controls. The animals were killed 3 and 7 weeks after the operation and the knees were examined according to prior experiments (1).

Postoperatively, all the bacterial cultures were negative. All the operated on knees had turbid joint fluid and a thickened synovial membrane. Microscopically, the uninfected knees and the knees synovectomized on Day 3 presented minor loss of cellularity and safranin staining ability of the cartilage. Further, minimal marginal erosion was seen in half of the primarily infected specimens. These findings were significantly fewer than following synovectomy later in the course of infection.

It is concluded that synovectomy in early cases of joint infection may stop the progressive destruction.

Reference

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Tumors

Radiation sarcomas of the shoulder girdle

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Radiation of healthy tissue can cause malignant transformation. In the present work, 6 cases will be presented and treatment and prognosis described.

Material: At the Sarcoma Center in Århus, 6 patients with radiation-induced sarcomas, localized to the shoulder girdle, have been treated in the period 1962 to 1989. There were 5 women and 1 man with an average age of 58 (37–74) years. Two patients had received radiation treatment because of periarthritis humeroscapularis, 1 because of lymphogranulomatosis malignum localized to the mediastinum, 1 because of axillary metastases from malignant melanoma, and 2 because of cancer mammae. On an average, 15 (7–26) years had passed since the radiation treatment had taken place until the sarcomas had developed. At the first referral to the Sarcoma Center, 3 patients were without previous biopsy or definitive treatment. Two had had an incisional biopsy and 1 had had an excisional biopsy. Two tumors were localized to the medial one third of the clavicle, two to the humeral diaphysis, one to the deltoid region, and one to the scapular region. Histogenetic types were three osteosarcomas, two extraosseous osteosarcomas, and one malignant fibrous histiocytoma. The grade of malignancy was in all the cases grade 3 (high grade of malignancy).

Surgical procedures: Three patients had wide local excision, 2 a four-quarter amputation, and 1 patient had only chemotherapy.

Results: All the patients were followed regularly for 10 years or until death. One patient had a local recurrence. Two patients had lung metastases. Three patients died of their tumor after an average of 11 (6–16) months, and of them, the 2 patients with metastasis. Two died of other causes, and 1 patient is still alive without tumor recurrence 2 years after the surgery.

Conclusions: It is well known that radiation can cause development of sarcomas in healthy tissues. In the present material, 6 cases with malignant transformation are described, all with grade 3 (high grade) malignancy. Radiotherapy should not be used for benign conditions. In the treatment of malignant tumors, the radiotherapy to bone should be reduced as much as possible.

Soft tissue sarcomas of the axillae

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Sarcomas of the axillae are rare and difficult to treat. The present work intends to evaluate treatment and prognosis.

Material: At the Sarcoma Center in Århus, 12 patients with sarcomas localized to the axillary region were treated in the period 1962 to 1989. There were 8 men and 4 women with an average age of 44 (15–91) years. Status at referral to the Sarcoma Center: only 3 patients had not had a biopsy or definitive surgery. Five patients had had an incisional biopsy and 2 an excisional biopsy. Histologically, there were 3 fibrosarcomas, 3 rhabdomyosarcomas, 1 extraosseous osteosarcoma, 1 malignant fibrous histiocytoma, 1 myxofibrous sarcoma, 1 liposarcoma, 1 malignant schwannoma, and 1 leiomyosarcoma. The malignancy was grade 1 (low grade) in 4 cases, grade 3 (high grade) in 6 cases, and not graded in 2 cases.

Surgical procedures: Ten patients had wide local excision, 9 without nerve resection, and 1 including a part of the brachial plexus. One patient had a four-quarter amputation, and 1 had only chemotherapy and radiation.

Results: All the patients were followed regularly for 10 years or until death. Four patients had a local recurrence. Six patients had metastases (5 to the lungs and 1 to the liver)—all of them had highly malignant tumors. Six patients died of their tumor illness. One died of another cause, and 5 patients are still alive: 4 of these had a low-grade malignant tumor and 1 had a not graded tumor on an average of 10 (2–20) years after the treatment.

Conclusions: The uncharacteristic initial symptoms and signs may often lead to an incorrect primary diagnosis of sarcoma of the axilla. Biopsy and surgery are therefore usually performed before referral to the Sarcoma Center. This and the extracompartmentally very difficult accessibility for radical surgical treatment lead to an extremely bad prognosis of highly malignant tumors of the axillae. In this series, 6 out of 6 patients died of their highly malignant tumor.

Epidemiology

Roller skate injuries

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During 1989, all the accidents with roller skates were prospectively registered in the casualty wards of our two hospitals. Cause and place of accident, defect(s) of the item, severity of the lesion according to the Abbreviated Injury Scale (AIS), use of prophylactic measurements, absence from school/work, and economic loss in the family due to the patient were registered. Sixty-eight patients (39 females and 29 males) with a mean age of 15 years (females 12, males 18) were treated in the casualty ward. Most accidents happened in the spring and summer between 6 and 8 p.m. Two were younger than aged 6 years, 26 were in the age group 6–10 years, 27 were between 11 and 15 years of age, 3 were between 16 and 20 years, and 10 were older than 20 years. Totally, 85 percent of the injuries happened by falling on uneven ground because of lack of routine or by maneuvering. In all, 58 of the accidents happened on public roads and paths, and one accident occurred on a special roller skate course. The surface was asphalt or pavement in 64 of the accidents, and in spite of that, only 7 of the injured used protective measures. In 42 of the accidents the AIS was < 3, in 22 the AIS was 3, and in 4 cases the AIS was 4. There were no fatal accidents. The inpatient time was only 6 days, and the accidents resulted in 285 days of sick leave for the patients and 17 days for the patients' families.

Rising incidence of hip fracture in Aalborg 1976–1988

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The aim of this study was to analyze the incidence of cervical and trochanteric hip fractures, and to estimate the future number in the municipality of Aalborg.

Patients and methods: In the period 1976–1988, a total of 3,099 hip fractures in persons aged 50 years or more were admitted. The population at risk during the observation period and an official population forecast to the year 2010 were registered. Linear regression analysis was performed to estimate the future incidence and number of fractures.

Results: The distribution was 60 percent cervical and 40 percent trochanteric fractures. The female:male ratio was 2.91. The number of hip fractures rose from 151 to 344, and the median age from 78 to 80 years. The population at risk was augmented by 5.4 percent to about 48,000 inhabitants, being 7.6 percent for women and 2.8 percent for men. The incidence rose from 3.7 per 1,000 in 1976 (women 5.2, men 1.9) to 7.2 in 1988 (women 10.1, men 3.5). Patients aged 80 years and above sustained 48 percent of the fractures. In this group, the incidence rose from 22.3 per 1,000 in 1976 (women 27.2, men 14.2) to 35.2 in 1988 (women 41.6, men 21.7). The population above 80 years rose 56 percent. The mean period of hospitalization was reduced from 37 days in 1976 to 25 days in 1988. The mean use of beds in the department rose from 15 in 1976 to 23 in 1988.

The incidence in the year 2010 was estimated to be 14.5 per 1,000 and the number of fractures 794.

Conclusions: During 1976–1988, the number of hip fractures in persons aged 50 years and above was increased more than twofold. A twofold increase can be expected within the next 17 years.

Basic science and pathology

Influence of cyclooxygenase inhibition on juxtaarticular hemodynamics in experimental arthritis

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NSAIDs are widely used in the treatment of synovial inflammation, although their effect on the progressive joint destruction still is unsettled. Arthritis is accompanied by intraosseous hemodynamic changes, which presumably contribute to the regional bone loss. We investigated the hemodynamic impact of cyclooxygenase inhibition in chronic arthritis. The material comprised 16 dogs, initially 3–4 months old, divided into two groups of 8 according to body weight, sex, and litter. Unilateral arthritis of the knee was induced by weekly intraarticular injections of carragheenan for 12 weeks. One group received oral naproxen (Naprosyn mixt.) 2 mg/kg/day. Regional blood flow (RBF) was measured by the microsphere method. Plasma volume was assessed by the distribution space of 125 I-fibrinogen. Both groups exhibited significant changes in juxtaarticular hemodynamics of arthritic knees compared with the contralateral noninflamed knees. These changes in blood flow and vascular volume were significantly less among naproxen treated animals. The table shows selected RBF data (mL/min/100 g):

	Naproxen		Controls	
	C	A/C	C	A/C
Synovialis	2.6	13.0*	2.9	23.6*
Capsule	1.1	3.4*	0.8	10.0*#
Patella	4.1	1.6*	3.3	3.5*#
Epiphysis, center	3.2	1.4*	2.2	3.8*#
Epiphysis, periphery	8.0	1.3*	6.2	3.3*#

C control, A/C: ratio arthritis/control, * $P < 0.05$ between limbs within each group, # $P < 0.05$ between groups.

The results indicate that hemodynamic changes in arthritis are amenable to long-term treatment with NSAIDs. Prostaglandins, which are potent vasodilators, seem to play a role in the vascular pathophysiology of arthritis.

Bone mineral content of tubular bone in relation to PMMA cementation—an animal model

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Measurements of bone mineral content (BMC) were made by dual-photon absorptiometry of the diaphyses of the tibiae in dogs. Eleven adult mongrel dogs were used. Two of the dogs were only intramedullarly reamed on one side. The tibiae were investigated after 4 weeks. Nine dogs were reamed on both sides, and the medullary cavity was filled with Palacos R cement on one side and bone wax on the other. Three of the dog tibiae were investigated after 4 weeks and six after 12 weeks.

Increased bone mineral content was found on the reamed side compared with the unreamed side. We found a

decrease in bone mineral content on the cemented side compared with bone wax, most pronounced after 4 weeks, but still significant after 12 weeks.

This could be due to a more complete remodeling with mineralization on the side with bone wax and/or inhibition of the remodeling on the side filled with acrylic bone cement.

Conclusions: 1) The shear strength of HA-coated implants was significantly less than that of porous-coated metal surfaces. 2) No biomechanical or histologic differences between HA-coated titanium and HA-coated chrome-cobalt implants could be recorded. 3) The failure of the HA-coated implants occurred at the interface between the HA-coating and the underlying metal. 4) This form of HA-coating might not be suitable for clinical purposes.

Histologic evaluation and shear strength of implants coated with hydroxyapatite and metallic beads: An animal study

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In the present study, the bone anchorage of HA-coated implants was compared with implants coated with sintered chrome-cobalt beads. In addition, the significance of coating HA onto a chrome-cobalt or a titanium alloy was evaluated.

Materials and methods: Twenty-two cylindric plugs (20 × 10 mm) were implanted in 16 adult dogs in the medial femoral condyle. Seven with HA-coating of 80–120 µm on chrome-cobalt (Corin) and six HA-coated on titanium (Corin). Nine were coated with sintered chrome-cobalt beads (250 µm De Puy and 400 µm PCA). All the coating was done on smooth surfaces by the manufactures. The implants were inserted in press fit.

The animals were killed after 4 weeks. The push-out test was performed on a 3-mm-thick section from cancellous bone on an Instron Testing Machine with a cross-head speed of 1 mm/min. Histologic sections, 50 µm thick, from adjacent bone were prepared and stained with 1) Stevenel's blue, van Gieson's picrofuchsin and 2) Basic fuchsin with light green. *Statistics:* The Mann-Whitney and Wilcoxon rank sum test.

Results: At the push-out test, a larger force was needed to press out implants with sintered beads as compared with the HA-coated implants ($P = 0.0002$). No difference was found whether the HA-coating was on chrome-cobalt or on titanium ($P = 0.7$). Failure of the HA-coated implants was caused by disruption between the metal surface and the HA-coating, which always remained fixed to the bone. Histologic sections showed direct bone approximation without membrane formation in the HA-coated implants, but also in some instances bone formation between the metal surface and HA-coating, which had disrupted at the insertion. In the implants with sintered Co-Cr beads, the macroscopic failure was located in the cancellous bone adjacent to the coating, which was histologically well infiltrated with bone through the outer layer of the beads. A thin fibrous membrane was, however, observed between the bone trabeculae, which were interdigitating with the beads. No difference was found in relation to the porosity of the coating.

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

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Blood perfusion in the tibial diaphysis following cementation with acrylic bone cement was investigated and compared with a control operation on the contralateral tibia with filling of the medullary canal with inert bone wax.

Method: Sixteen adult mongrel dogs were operated on, and followed for 1(2 dogs), 4 (6 dogs), and 12 (8 dogs) weeks. Blood perfusion was measured with the microsphere techniques and vital staining with disulfin blue. The dogs were killed and the tibiae were divided longitudinally, and alternately, the medial and lateral part of the bone was used for grading of disulfin staining and perfusion measurements.

Results: Blood perfusion was lowest on the cemented side in all but 1 case ($P = 0.03$, 4 weeks). On both sides, blood perfusion increased 3–4 times from 1 to 4 weeks of observation, and then decreased to the 1-week level after 12 weeks. Staining with disulfin blue was only seen subperiostally after 1 week. After 4 weeks, large subperiosteal apposition and some unstained areas near the endosteum were observed. After 12 weeks, no obvious unstained areas were seen. The subperiosteal apposition was smallest, and the unstained areas were largest in the cemented bones.

Discussion: The operative procedure, including filling of the medullary canal, was identical on the two sides. Consequently, the restrained blood perfusion and subperiosteal apposition on the cemented side must be attributed to the effects of bone cement, such as, curing heat and toxicity.

Effect of hyaluronic acid on cartilage in the immobilized rabbit knee

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In an experimental investigation of changes in articular cartilage after immobilization, one knee joint in 20 adult rabbits was immobilized with plaster of Paris. Ten of the knee joints were injected with 4 mg of high-molecular hyaluronic acid immediately prior to immobilization. The articular cartilage on the femoral condyles was studied by light microscopy, and the cartilage from the patella and the tibial plateau were studied biochemically 6 and 12 weeks after immobilization. Degenerative changes of the articular cartilage similar to those seen in arthrosis were observed after 6 weeks of immobilization. The glycosaminoglycans were separated by cellulose acetate electrophoresis, and the relative content of major glycosaminoglycans was measured by optic scanning. The total content of glycosaminoglycans was estimated by uronic acid analysis. A single intraarticular dose of high-molecular hyaluronic acid before joint immobilization did not prevent the occurrence of degenerative articular cartilage changes in previously normal knee joints. Further, in the cartilage from the hyaluronic acid treated group, the reparative changes were inhibited.

Changes in glycosaminoglycan content of rabbit tendon and muscle after immobilization

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Thirty adult rabbits, aged 9–10 months, were used in an experimental investigation of the effect of immobilization on tendon and muscles. The right hind limbs of 20 rabbits were immobilized in plaster of Paris (Scotcast) with 15° flexion of the knee and 10° dorsiflexion of the ankle joint. The Achilles tendon and its associated muscle were studied by light microscopy and by biochemical investigation 6 and 12 weeks after immobilization.

Samples for histologic study were stained with Hematoxylin-eosin, Azur B (pH 2 and 4), and Sirius red. Samples for the biochemical study were investigated for the content of glycosaminoglycans; they were separated by cellulose acetate electrophoresis, and the relative content of major glycosaminoglycans was measured by optical scanning. The total content of glycosaminoglycans was estimated by uronic acid analysis.

Morphologically, degenerative changes of the muscle were observed after 12 weeks of immobilization. The biochemical changes were seen after 6 weeks, and occurred in an increasing extent after 12 weeks, with a dramatic increase of the chondroitin sulfate content. In the tendon, only slight morphologic changes were ween after 12 weeks immobilization, but biochemically there was a twofold increase in the concentration of uronic acid and in the dermatan sulfate fraction, and loss of hyaluronic acid.

Quantitative metabolism in bone cells measured in vitro using mass spectrometry

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The metabolism of bone cells and thereby respiration regulates the transformation of the organic and inorganic compounds of osseous tissue controlling reconstruction and healing. Thirty years ago, it was shown that bone resorption takes place at a low pH. The low pH is obtained through excretion of organic acids from the bone cells. Alterations in the metabolism of the cells are therefore necessary to initiate the basic processes in remodeling. Therefore, determination of the basic metabolism of bone cells is of importance to elucidate the dynamic features of bone tissue. It has not been possible earlier to assess this metabolism directly; and recording of the influence of various substances on the cell metabolism has only been possible using indirect techniques. We have developed a technique for in vitro determination of human-cell metabolism using mass spectrometry.

With this technique, it has been possible to measure the oxygen consumption and carbon dioxide production directly and continuously in suspensions of human cells. In the experiments, we used human granulocytes, kidney tubule cells, and bone cells. The granulocytes were used directly after separation. Kidney cells and bone cells were used after cultivation in an incubator. All the recordings were done with the cells in suspension in a specially designed chamber.

The oxygen consumption in different suspensions of granulocytes varied from 2.4 to 340×10^{-11} moles/min, and carbon dioxide production varied from 5.0 to $2{,}640 \times 10^{-11}$. Oxygen consumption in bone cells varied from 1.4 to 6.4×10^{-11} moles/min, and carbon dioxide production varied from 2.2 to 11.0×10^{-11} moles/min.

By stimulating the granulocytes to phagocytosis, it was possible to increase the oxygen consumption by a factor 3 to 4.

On the basis of these preliminary experiments, we conclude that direct measurement of the metabolism in human bone cells is possible using mass spectrometry.