

PROCEEDINGS OF
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34th ASSEMBLY IN NORWAY
JUNE 1968

The meeting of the Scandinavian Orthopaedic Association was held in Sandefjord under the Presidency of Henrich Nissen-Lie

TRAUMATIC LESIONS OF THE SPINE AND PELVIS

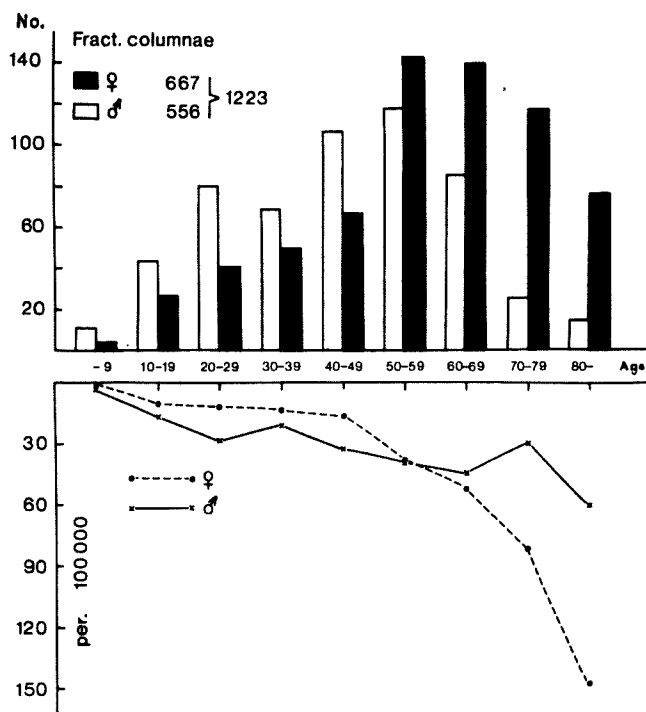
Chairman: Arnt Jakobsen (Oslo, Norway)

FRACTURE OF THE SPINE

Hans Rostad, Kaare Solheim, Per Siewers & Mons Lie (Oslo, Norway)

In the 10-year period 1952-61 inclusive, 1223 patients (556 men and 667 women) with fracture of the spine were admitted to the Surgical and Neurosurgical Depart-

Figure 1. Fracture of the spine, Oslo 1952-61. Upper part: age and sex distribution. Lower part: number of patients with fracture of the spine per 100,000 inhabitants in the different age groups (calculated on an estimated average population in Oslo as of 1 January 1956).



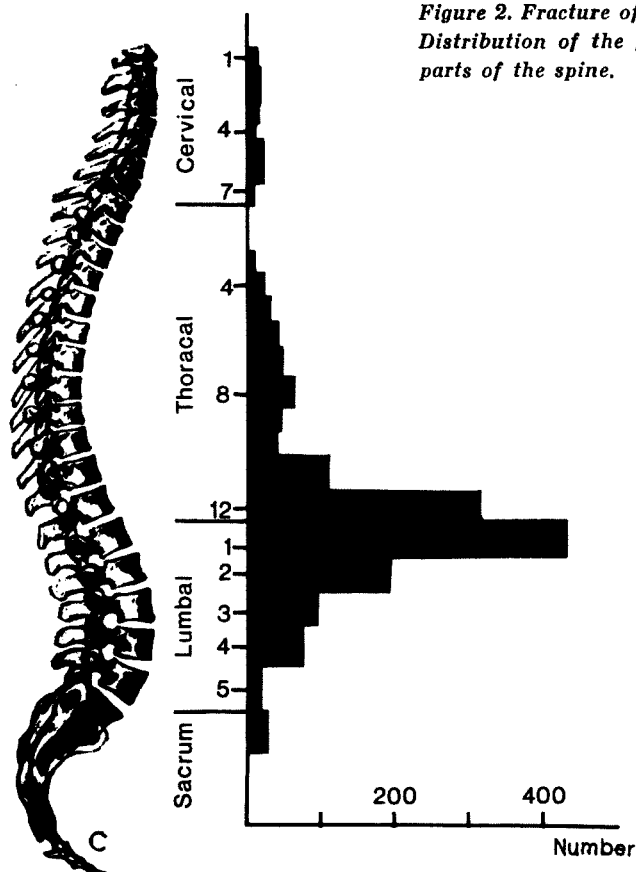


Figure 2. Fracture of the spine, Oslo 1952-61. Distribution of the fracture in the different parts of the spine.

ments, Aker and Ullevål Hospitals, Oslo. This is the majority of such patients in Oslo in this period. The majority of the patients were 50-70 years of age. There was an increase in incidence after the age of 70.

In Th_{12} - L_3 there were 1355 fractures, i.e. 64 per cent of the altogether 2075 fractures of the spine.

Falls in- and out-of-doors were the causes of injury in 55 per cent of the cases.

In 1119 patients treatment was bed rest and exercises, reposition and plaster of paris were used in 34 patients, and 53 were operated upon.

The 57 patients with nerve lesions (4.5 per cent) were followed up clinically and roentgenologically after an observation time of 7-16 years. Of these, 23 had complete lesion of the spinal cord and 34 partial lesion. Nine patients with complete lesion of the cervical and thoracal spinal cord were dead, 7 of whom died in connection with the accident or shortly after. Of 14 patients with complete lesion in the lumbar spinal cord 11 were alive, 6 of whom were fully employed.

Of the 34 patients with partial lesions, 16 were without symptoms, 7 had slight paresis and were fully employed, 5 were more or less crippled.

FRACTURES OF THE SPINE WITH CORD LESIONS

G. Blikra & R. Ringkjøb (Oslo, Norway)

In a series of 100 patients with fracture of the spine with cord lesion (55 cervical, 24 dorsal, and 21 lumbar), traffic accident was the most frequent cause in cervical injuries.

Lack of free airways immediately after the accident or during transportation led to several complications and some early deaths.

Eleven patients died before admission to hospital, another 15 within the first weeks. In the rest, early laminectomy was performed in 31 patients: Of 18 patients with complete paraplegia or quadriplegia, improvement was demonstrated in only 2, both with conus-cauda lesions. Of 13 patients with incomplete transverse lesions, 5 were improved. Three of these were operated upon because of increasing neurological signs and 1 because spontaneous improvement had ceased.

Laminectomy or early operative spinal fusion did not influence the frequency of early complications from the respiratory or the urinary tract, or of decubital ulcers.

Adequate first aid at the scene of the accident, including provisions for open airways, and careful lifting and transportation, may improve the prognosis of traumatic paraplegia. Skull traction should be applied as early as possible in cervical lesions. Laminectomy is indicated mainly in patients with increasing neurological deficit. Avoidance of complications depends on special nursing.

**FRACTURE OF THE SPINE TREATED BY INDIVIDUAL EARLY MOBILIZATION.
AN EIGHT-YEAR FOLLOW-UP STUDY**

P. Thestrup Andersen (Gentofte, Denmark)

The authors conclude that early mobilization is an effective and safe procedure in dorso-lumbar corporal fractures when spinal cord lesions or instability are absent. The treatment should be followed up by intensive physical re-training.

To be published in Acta Orthopaedica Scandinavica.

**A MODIFIED, SO-CALLED HALO SPLINT FOR THE EARLY MOBILIZATION OF
PATIENTS WITH CERVICAL SPINE LESIONS**

Håkan Brattström, Mark Blomberg & Urban Pontén (Lund, Sweden)

The so-called halo splint, designed in and described from the Rancho Los Amigos Hospital, Los Angeles, has come into wide use in the Anglo-Saxon countries for traction and fixation in traumatic lesions of the cervical spine.

This apparatus has great advantages, primarily that of allowing an almost immediate mobilization of the patient. Drawbacks: It is difficult to apply, does not permit detailed X-rays, no myelography or tomography; moreover, it is not possible to grade the force of traction. The authors reported on a modified apparatus in which these drawbacks have been largely eliminated. This apparatus will be described in detail elsewhere.

FOLLOW-UP ON A GROUP OF PATIENTS WITH PARA- AND QUADRIPLÉGIA

Bodil Eskesen (Hornbæk, Denmark)

During the period 1954–1967 a total of 410 patients with acquired para- or quadriplegia have been treated in the Physical Therapy and Rehabilitation Hospital, Hornbæk, Denmark. Most of the cases were of traumatic origin, and no progressing diseases are included. The majority of the patients were admitted 1–3 months after the injury was sustained, transferred from neurosurgical and orthopaedic departments on Zealand and Funen (population 2.6 millions).

The follow-up study was carried out in 1967 and comprised patients with complete transverse lesion of the cord—45 with paraplegia (traumatic in 44 cases) with a minimum follow-up period of 2 years and 100 with paraplegia (traumatic in 78 cases) with a minimum follow-up period of 1 year.

75 per cent of the patients were in the hospital for less than 12 months, 25 per cent for 12–24 months, the rehabilitation being delayed particularly by decubitus ulcers or by urinary complications.

Decubitus ulcers were present in 66 out of 145 at first admission, but the incidence has been decreasing during recent years. After their final discharge, about 50 per cent of the patients developed decubitus.

Complications from the urinary tract: Bladder stones in some 50 per cent, nephrolithiasis in 5, and urethral fistula in 8 out of the 145 patients. All cases of urolithiasis were treated by operation as soon as possible.

83 patients with paraplegia and 22 with quadriplegia were discharged primarily to their own homes, and later 5 paraplegics and 6 quadriplegics could be discharged from nursing homes to their own homes.

Medical rehabilitation to independence in the activities of daily living was obtained in 76 patients with paraplegia, whereas 5 children, 7 elderly patients, and 5 patients with complications are in need of help (7 have died, 6 of cutaneous or urinary complications).

Out of 32 patients with quadriplegia, 8 have acquired independence in the activities of daily living—all under 32 years of age. This group includes one patient with a complete transverse lesion distally to the 6th cervical segment. 7 need some assistance, and 17 are completely dependent (13 have died, 7 of cutaneous and urinary complications).

Vocational rehabilitation: Out of 93 surviving paraplegics 56 are employed or being trained for work. Ten have given up working because of complications, 27 have not been working, mainly because of advanced age.

Out of 32 quadriplegics 16 are employed or being trained for work, although not all of them are independent in the activities of daily living. The remaining 16 have no work.

This follow-up study supports the view that this category of patients should be collected and treated together in a few departments where the entire staff—doctors, nurses, and other personnel as well as medical advisers can work as a team and can gather experience of the paraplegics' problems.

DISCUSSION:

Erik Moberg (Gothenburg, Sweden)

So far, little has been mentioned concerning the stability in so-called fractures of the vertebral bodies. It must be borne in mind that although the skeletal damage certainly predominates radiologically, the injuries not infrequently affect mainly the intervertebral disc and ligaments, in particular the interspinous ligament and the strong anterior longitudinal ligament. This has been pointed out by, *inter alios*, Nicoll. In such cases the fracture merely indicates the level of the injury.

Clinically the lesion is often easily palpable. There may be considerable tenderness between the spinous processes of the vertebrae where the ligament has ruptured. If the patient is placed prone on a pillow and the injury is at the dorso-lumbar junction, direct pressure by the thumbs over the spinous processes may reveal abnormal mobility and pain due to the instability. In such cases I primarily perform short bone graft fusion, and the results have been good. This diagnostic technique is often omitted, and frequently the radiologist does not visualize the spinous processes and thus cannot demonstrate the increased distance.

A. Nachemson (Gothenburg, Sweden)

Due to increasing compression of a vertebral body the mobilization of some paraplegics will bring about disturbing gibbosity. The spinous processes may sometimes cause erosion of the skin, and instability and pain may also follow. These problem patients are presented to the orthopaedic surgeons by the rehabilitation people.

The Harrington distraction rods for correction of scoliotic spines may also be used for the correction of increasing kyphosis. One patient (a 50-year-old male) is presented in which increasing angulation of the spine at the Th 12 level was reduced from 45° to 20° by the use of one Harrington distraction rod on each side of the spinous processes, anchored with hooks to the laminae of Th 10 and L 2, respectively. Bilateral lateral fusion was performed in the same stage, and the patient was allowed to get up and start exercises two months after surgery. No plaster bed was used. After 4 months the spine appeared to be stable, and walking exercises were started.

This procedure offers a relatively simple solution for patients with unstable kyphotic spines after fractures of vertebral bodies. With these rods, correction can be achieved; and at the same time, the fixation is stable enough to allow adequate skin-care, turning in bed, etc., which is of importance for paraplegics.

FRACTURE OF THE PELVIS

Kaare Solheim, Hans Rostad, Per Siewers & Mons Lie (Oslo, Norway)

In 1952-61 inclusive, 524 patients with fracture of the pelvis were treated at the Surgical Departments of Ullevål and Aker Hospitals. This figure constitutes the majority of patients with this type of injury in Oslo (450,000 inhabitants) during that period. There were 276 women and 248 men in the series. Women outnumbered men in the age groups over 70 years and the incidence rose sharply in the older age groups. Falls indoors and outdoors were the commonest cause (about 50

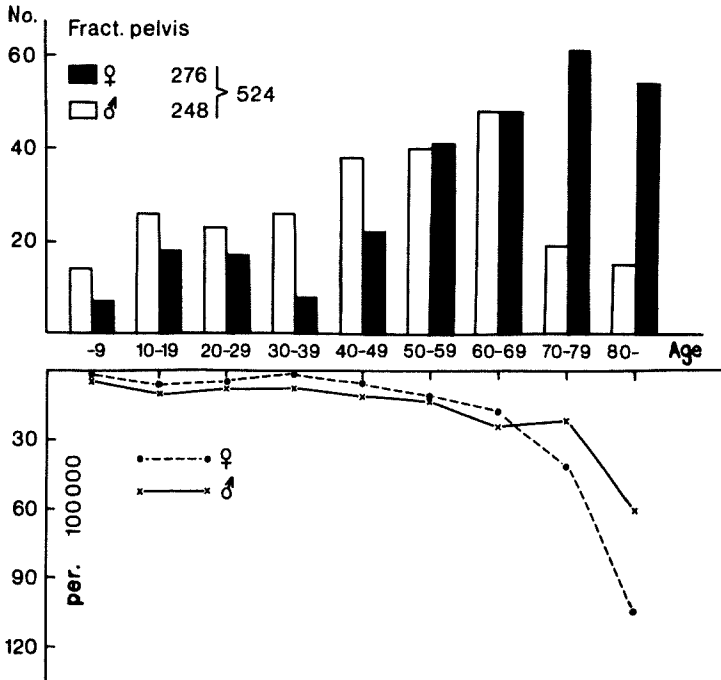


Figure 1. Fracture of the pelvis, Oslo 1952-61. Upper part: Age and sex distribution. Lower part: Number of patients with pelvic fractures per 100,000 inhabitants in the different age groups (calculated on an estimated average population in Oslo as of 1 January 1956).

per cent), and traffic accidents were the cause in one-third of the patients, with a marked increase in the later years. Multiple injuries were therefore common, and were registered in one-third of the patients.

The majority of the patients were treated conservatively. Operation and traction treatment were carried out in only 20 and 32 patients, respectively. The period of bed rest was reduced in the course of time, one-fourth of the patients being confined to bed for less than a week.

Complications from the pelvic fracture were uncommon (rupture of urethra or urinary bladder in 20 patients, nerve injury (ischadicus) in 6 patients, and severe hemorrhage in 26 patients (patients needing 2 pints of blood or more to stabilize their vital signs)).

28 patients died. Of these, 10 died from multiple injuries, two from hemorrhage, five from fat embolism, and seven from bronchopneumonia.

Follow-up was carried out on patients with ruptured symphysis (17 patients) and fractures involving the acetabulum (79 patients). Except for central luxation fractures, the clinical and X-ray results were found to be good in the majority of the patients. Patients with severe displacement of the acetabulum had bad clinical results and severe arthrosis. Operative treatment is recommended as the treatment of choice in these patients.

FRACTURA PELVIS AND FRACTURA ACETABULI

Olaf Holter (Tønsberg, Norway)

During the years 1955–1964, 88 patients (40 women, 48 men) with pelvic injuries were admitted to the Surgical Department, Vestfold Sentralsykehus. The injuries were classified as fractura pelvis in 67 patients and fractura acetabuli in 21. Fifty per cent of all the fractures arose from traffic injuries. Approximately 35 per cent of the patients had multiple lesions; of these, *ca.* 85 per cent were caused by traffic injuries. Most of the accompanying injuries were to the head or extremities—in 4 cases there were injuries to the urinary bladder and/or urethra.

In a follow-up study in which 48 of the 67 patients with fractura pelvis replied to a questionnaire, 40 reported complete recovery, and 8 complained of back pain, especially while walking. Two women had required sectio cesarea.

Of the 21 cases of fractura acetabuli, 6 showed fissures—the 5 patients with fissure who replied to the questionnaire claimed complete recovery.

Seven of the patients with central acetabular fracture were followed-up with a clinical and roentgenological examination, as were 2 patients with dorsal dislocation. These 9 patients had pain and restricted movement of the hip, as well as back pain. Three of these 9 were operated upon, one according to the method of Smith Pettersen (cup arthroplasty), one by arthrodesis (primary), and one by repositioning the luxation and fixing the posterior fragment by a screw. The remaining patients were treated by traction. This treatment did not have any effect on the position of the fragments.

In addition to restricted movement of the hip joint, painful movements, and back pain, the patients with fractura acetabuli also complained of pain especially in the sacroiliac and sacrospinal muscles. Four showed scoliosis and one necrosis of the femoral caput. All these patients had shortening of the limb varying from 1.5 to 3.5 cm, and in 5 cases a Trendelenburg positive deformation.

The chief aims of treatment in cases of central acetabular fracture must be to achieve a stable joint, to avoid deformity of the pelvis, and to avoid shortening of the limb. The joint must, therefore, be reconstructed.

DISCUSSION:

Mac Felländer (Stockholm, Sweden)

As regards fractures of the pelvis, an exact classification is important. Different types of fracture, for instance double vertical fractures and central dislocation fractures, present special problems.

A series of cases of pelvic fractures from the Stockholm region has been presented by Lars Räf, my former co-worker (*Acta chir. scand.* 131, 298, 1966). It comprises 101 patients over the period 1952–1963. His observations agree on the whole with those reported here by Slätis and Huittinen. The mortality rate was 12 per cent; as shock due to blood-loss was the cause of death in half the cases, increased attention should be given to this complication. Follow-up examination of 65 patients showed a high incidence of considerable back trouble in the cases in which the fracture ran through the sacrum or into the sacroiliac joint. In the treatment of such fractures of the pelvic girdle with cranial dislocation, we propose

reduction with femoral traction and subsequent fusion in the sacroiliac joint. A case of such treatment was demonstrated.

A series of 50 patients with central dislocation of the hip from the Stockholm region over the period 1954–1963 has also been analysed (to be published by Göthlin & Hindmarsh). The prognosis depends upon the fracture involvement. If the fracture involves the inner wall, the prognosis is favourable. If it involves the upper dome the prognosis is poorer and depends upon the degree of reduction that can be achieved by traction treatment and upon the condition of the acetabular roof. One-third of the total number of patients were more or less disabled. Four patients with severe injuries of the upper dome were treated by cup arthroplasty, since the prognosis was judged as very poor. In three of these cases the results were very good; in the fourth, in which the operation was made about a year and a half after the injury, the result was less satisfactory. The ideal time for this operation would be about six weeks after the injury, when the fractures in the pelvic floor begin to unite. This reconstructive operation is an alternative to the technically difficult method of open reduction and osteosynthesis, which has been described by Judet and his co-workers and, at this Congress, by Olerud.

Erik Moberg (Gothenburg, Sweden)

Symphysiolysis, with or without other damage to the pelvis, may be successfully treated surgically. The simplest and safest way is to pull the symphysis together by a wire loop through the obturator foramina. It is not advisable to use a wire through a drill hole or plate and screws, as the skeletal structure is not suited for such osteosyntheses which are apt to fail. The cortex in the obturator foramina is sufficiently resistant. The procedure is simple, and the patients may be mobilized in a week or two. The common swelling of the legs, due to accumulation of fluid around the pelvic lesions, soon disappears.

HAEMATOGENOUS OSTEOMYELITIS—PATHOLOGY

Eivind Myhre (Oslo, Norway)

Most cases of osteomyelitis arise in the metaphysis due to the vascular arrangement in bone. From the age of one year the epiphysial cartilage forms a vascular barrier which is one of the reasons why osteomyelitis behaves differently in various age groups. Some characteristics in the development of untreated acute osteomyelitis are shown in Table 1.

Chronic osteomyelitis of the secondary type develops either from an acute osteomyelitis or is due to trauma. The primary type manifests itself as a Brodie abscess, sometimes as plasma cell osteomyelitis, or very rarely as Garré's sclerosing osteomyelitis.

The histological features of acute infection are characterized by hyperaemia, oedema, and leukocytic infiltration. The suppurative reaction with the formation of pus reveals a tendency to expand in both directions in the bone marrow. Ischaemia occurs because of thrombotic processes in the neighbouring vessels and because oedema and pus expands through the cortex to the periosteum which is raised from the cortex, thus disrupting the vascular connections. Ischaemia leads to necrosis which again leads to the formation of sequestra.

Table 1. Acute haematogenous osteomyelitis at different ages.

	Infants (under 1 yr)	Children	Adults (over 16 yr)
Localization	Meta- and epiphysis	Metaphysis	Diaphysis
Multiple foci	Rather frequent	Rare	—
Spread	Subperiosteal, epiphysis and joint	Diaphysis	Extraperiosteal, epiphysis and joint
Sequestrum	Rare	Frequent	Rare
Fistula	Rare	Rather frequent	Frequent
Involucrum formation	Strong	Moderate	Weak

The histological changes of chronic osteomyelitis are characterized by a zonal arrangement.

Antibiotic treatment has greatly changed the course of the disease and thereby also the pathological-anatomical picture.

RADIOLOGICAL FINDINGS IN OSTEOMYELITIS

Sigurd Eek (Oslo, Norway)

For therapeutic reason the diagnosis of *acute* osteomyelitis should be made by the clinician *before* radiological changes have appeared in the soft tissues and bones. It is thus the primary task of the radiologist to support or weaken the clinical suspicion of osteomyelitis. This cannot be done until swelling of the soft tissues has appeared, with increased outlines of the lymphatics and obliteration of the muscle contour against the subcutaneous fat. A *definite* radiological diagnosis cannot be made until 1–3 weeks have elapsed and the osseous changes have become manifest. At this stage sufficient treatment should have been instituted long previously.

The task of the radiologist in *chronic* osteomyelitis is well-known, and no major technical or diagnostic methods have been added in recent years. Therefore, now as in the past, the radiologist must be familiar with the diagnostic, differential diagnostic, and developmental problems of the disease, and he must still be extremely reserved in making prognostic statements on the basis of the X-ray findings in chronic osteomyelitis.

ACUTE HAEMATOGENOUS OSTEOMYELITIS IN A 5-YEAR MATERIAL

Henrik Hagelsteen (Oslo, Norway)

During the period 1963–1967, 24 children with acute haematogenous osteomyelitis (0.24 per cent of all admitted patients) were treated: 12 boys and 12 girls, age range 0–14 years. 9 were under 1 year of age.

The most common site of the disease was in the metaphyses of the long bones. In 5 cases the spine was affected; all 5 patients were 2-5 years.

The temperature on admission was below 37.5° C in half the cases.

A highly increased ESR was a constant and characteristic early sign.

Leukocytosis was inconstant and uncharacteristic.

A positive blood culture was found in only 2 cases (*Staphylococcus aureus*), but a number of the patients had received chemotherapy prior to admission.

The therapeutic principle was early institution of intensive chemotherapy, continued for 6 weeks after the acute symptoms have subsided. In many cases the affected limb was fixed or a plaster cast used in cases of spondylitis.

Children who fix a limb or the back because of pain and have highly increased ESR and possibly elevated temperature should be treated as cases of acute haematogenous osteomyelitis until another diagnosis has been made. In that case, the prognosis is favourable.

OSTEOMYELITIS IN A SURGICAL DEPARTMENT

Rolf Hagen (Oslo, Norway)

During the years 1957-66, 21 acute and 28 chronic cases of osteomyelitis were treated in Department III, Ullevål hospital.

Positive roentgenograms and bacteriological findings were demonstrated in, respectively, 18 and 8 patients with acute osteomyelitis. Penicillin-resistant staphylococci were cultured in 7 of these 8 cases. Eleven conservatively treated patients disclosed symptoms of less than 5 days' duration whereas 7 operated presented a longer history. On follow-up examination 4 patients with osteomyelitis of the femur showed lengthening up to 2.5 cm.

The chronic infections originated from acute osteomyelitis in 11, postoperative infections in 9, and non-operated compound fracture in 8 cases. Among 129 conservatively treated compound fractures of tibia and femur were found 6 osteomyelitic infections, but none after osteosynthesis of 40 corresponding compound fractures. After osteosynthesis of 790 closed femoral fractures were found 4 cases

Table 1. Frequency of osteomyelitis after compound fractures and osteosyntheses, Department III, Ullevål Hospital 1957-66.

	%
Compound fractures without osteosynthesis	4,5
Compound fractures with osteosynthesis	0
Osteosynthesis of closed fractures	0,5

Table 2. Follow-up study of chronic osteomyelitis, Department III, Ullevål Hospital.

	No. of patients
Healed	11
Defect-healed	10
Active fistulating	2
Dead (of other causes)	5

with osteomyelitis (Table 1). Sequestrectomy was performed as radically as possible with primary closure. Table 2 shows the results of the follow-up.

Acute cases are given lincocin immediately after the blood cultures are carried out. The majority of cases are treated effectively with antibiotics, provided the symptoms have endured less than 5 days.

Radical excision of devitalized tissue and rigid osteosynthesis of compound fractures are important prophylactic measures against osteomyelitis.

NON-SPECIFIC, BACTERIAL INFECTIONS OF BONE

Helge Fjermers (Kristiansand S, Norway)

During the period 1955-1967, 154 patients with non-specific, bacterial infections of bone were admitted to Martina Hansens Hospital.

Except for 60 cases of non-specific spondylitis, the localization was the usual, mostly of long bones. Secondary osteomyelitis following operations was found in 34 patients. In 31 others there was a history of initial sepsis. *Staphylococcus aureus* was cultured in 89 out of 110 cases. Operation was performed in 83 patients, chiefly excochleation and/or sequestrectomy; in 11 cases these operations were combined with bone transplants. Different antibiotics have been used, according to the bacterial resistance.

From hospital records it was found that 48 patients had no relapse after 1-10 years, whereas 49 had residual infection. Fifty-seven had not been observed more than one year after discharge.

It may be concluded from this presentation that infection of bone is still a problem in surgery that is not easily solved. Antibiotic treatment alone as well as combined with surgery fails in a great number of cases.

THE TREATMENT OF OSTEOMYELITIS

Bernhard Paus (Sandvika, Norway)

Prevention is better than cure and so also in the case of osteomyelitis. Thus, in the neonatal period, any infection should be regarded as a potential source for spread of infection and be treated accordingly. Open fractures might sometimes best be treated following the principles in war surgery with thorough debridement and delayed primary suture. In selective bone surgery aseptic technique is essential.

Treatment of acute as well as chronic osteomyelitis should be a combination of both systemic and local. The first should aim at improving the patient's general condition, if necessary with blood transfusions, i.v. infusions, vitamin C, protein, etc. It also includes chemotherapy which in acute cases should start early and therefore cannot wait for the result of bacteriological examination of pus or blood culture. Large doses should be used and the treatment should continue after all clinical symptoms of osteomyelitis have disappeared, but we do not know how long this period should last.

The local treatment in acute osteomyelitis includes immobilization, incision of subperiosteal abscesses, and possibly drilling or trepanation of bone. In chronic cases the problem is as much the treatment of ischaemia as of infection. The ischaemic tissues have to be removed. A large variety of methods have been advocated, which proves the difficulty of treatment and might indicate that the treatment of these patients, to a certain degree, should be centralized.

Martina Hansens Hospital has tried lincocin for a little more than a year in the treatment of 20 cases of chronic osteomyelitis. This observation time is too short for a final evaluation; but out of 16 patients with lincocin-sensitive microbes, 7 should, so far, be listed as cured and 6 as improved. We thus feel there is a reason for continued use of lincocin in patients with chronic osteomyelitis due to lincocin-sensitive microbes.

Our experience is that the treatment should continue at least 5 weeks after the sinus has closed, and possibly for a much longer period. In 5 patients who stopped within 4 weeks after the sinus closed, there were 4 recurrences, whereas in 7 patients who continued for 5 weeks or longer the infection has not recurred during a 6-10 months' observation period.

EXPERIENCES WITH FUCIDIN IN THE TREATMENT OF OSTEOMYELITIS

Jan A. Pahle (Oslo, Norway)

A material of 30 patients, mean age 44.6 years, with chronic osteomyelitis was examined in order to assess the penetration and bacteriostatic effect of Fucidin in avascular sequestra, poorly vascularized bone and soft tissue, and in pus. All patients had long-standing processes with draining sinus, or deep abscess, several repeatedly operated upon. Duration of the disease 64 years to 2 months. *Staphylococcus aureus* verified in 29 patients. The importance of accurate bacteriology in material from the depths of the sinuses was confirmed. I.C. 50 was established in some cases. The sequestra and other tissue samples were taken in 7 cases with use of a tourniquet in order to avoid false increase of the concentration by admixture of blood. The sequestra were cut down so that the Fucidin concentration was measured in the central part. Serum concentration after a daily dosage of 3 or 2 g Fucidin after a minimum of 8 days' preoperative treatment varied between 15 and 210 $\mu\text{g/ml}$, the samples taken during the operation 10 hours after the last dosage. In poorly vascularized tissue a concentration of 21-59 $\mu\text{g/g}$ was found. In pus 6-61 $\mu\text{g/ml}$. In bone tissue with some preserved vascularization, values between 1.5 and 54 $\mu\text{g/g}$. In 3 histologically verified sequestra, values of 2.6, 41, and 56 $\mu\text{g/g}$ were found. The values were $>$ I.C. 50 in these 3 cases. In 2 groups of the material the penetration of semi-synthetic penicillins was examined simultaneously. Penicillin concentration was found to be only 20-50 per cent of that of Fucidin, with large daily variations. The morning concentration of semi-synthetic penicillins was $\rightarrow$ 0 against up to 117 μg Fucidin/g tissue. In poorly vascularized tissue a concentration of Fucidin 10 times higher than that of semi-synthetic penicillins was found, on an average. The observation time is too short (2 years) to permit conclusions about the lasting effect, although the immediate results were very satisfactory.

PYOGENIC (NON-SPECIFIC) BONE INFECTIONS. BACTERIOLOGICAL VIEWS

Arne Lystad (Oslo, Norway)

The commonest causal organism in osteomyelitis is *Staphylococcus aureus*. The increasing occurrence of staphylococci resistant to penicillin G and other antibiotics in common use is a problem.

The pathogenic capacity of staphylococci is the combined effect of their ability to produce extracellular substances such as enzymes and toxins together with the

invasive properties of the strains. In addition, staphylococci are common members of the normal flora and they are also found regularly in human environments.

Penicillin-resistant staphylococci from clinical infections always produce an inducible enzyme, penicillinase. Resistance to some other antibiotics can be transmitted among staphylococci by transducing bacteriophages.

Early diagnosis and use of the correct antibiotic are essential for the proper treatment of acute osteomyelitis. The drug of choice should be bactericidal and should have a good action against penicillinase-producing staphylococci.

Antibiotic treatment of chronic osteomyelitis must always be based on proper bacteriological investigations including sensitivity tests.

Chronic osteomyelitis can be prevented by early and correct treatment of acute osteomyelitis, and by proper care of surgical wounds and fractures. The incidence of infection is related to the initial care of the wound and therefore initial decontamination of the wound is vital. Prophylactic use of antibiotics is not indicated.

ORTHOPAEDIC INFECTIONS DURING A 5-YEAR PERIOD

Patient material. *Lars Lindberg* (Malmö, Sweden)

During 1963–1967 a prospective investigation was made of all infected orthopaedic patients at the Department of Orthopaedic Surgery in Malmö, 200 men and 178 women. Data concerning the course of the infections, including the sedimentation rate, ASTa, CRP, wound-healing, and bacteriology, were registered along with the therapy (operation, antibiotics, etc.).

The age distribution of the infected patients was found to be the same as that of the non-infected patients. 189 infections were postoperative, 88 traumatic, 47 haematogenous, 6 caused by joint injections. The origin of the remaining infections was doubtful. 27 per cent of all infections were localized to the hip region, 10 per cent to fractures (except fractures in the hip region), 11 per cent to joints, the remainder had varying localizations. The duration of high serological values, of fistulation, and of other signs of infection was tabulated, and the duration of treatment in hospital and of treatment with antibiotics was discussed.

Bacteriology. *Carl Ericson* (Malmö, Sweden)

Staphylococcus aureus was the dominating species, although it could not be isolated from a few patients.

Of more than 900 positive cultures, staphylococci were isolated in 39 per cent, coagulase-negative staphylococci and enterobacteria each in about 18 per cent, *Pseudomonas* in 9 per cent. Mixed cultures occurred in 33 per cent.

The possible aetiological significance of the bacteriological findings was discussed.

In 1933, 50 per cent of the *Staphylococcus aureus* strains belonged to endemic "hospital" types. In 1967, this number had been reduced to about 20 per cent. From the phage types, it was concluded that most of the staphylococcal infections were sporadic, and not due to epidemic outbreaks.

GENERAL AND LOCAL TREATMENT WITH CLOXACILLIN

Sven Åke Hedström (Lund, Sweden)

Chronic osteomyelitis due to *Staphylococcus aureus* was treated by high doses of antibiotics (cloxacillin 1 g 6 times daily) by mouth. Fistulae were treated locally by antibiotics in a dextran vehicle. The prognosis and treatment period (minimum of 6 months with oral treatment) were discussed and the results reported.

To be published in *Acta orthopaedica scandinavica*.

FUCIDIN TREATMENT OF CHRONIC STAPHYLOCOCCAL OSTEITIS AND OSTEOMYELITIS

Jørgen Ernst (Juelsminde, Denmark)

The results of Fucidin treatment of subacute and chronic staphylococcal osteitis and osteomyelitis are reviewed. The material is subdivided into two main groups: 32 cases in 31 patients exclusively treated with Fucidin in dosages of 750 mg four times daily and 41 cases in which Fucidin was employed in combination with other antibiotics, chiefly methicillin and novobiocin. The group includes eight patients from the pure Fucidin group and 25 new patients. In eight of these, two courses of treatment were employed at such long intervals that these are regarded as separate instances. In the combination group, Fucidin was employed in dosages of 1500 mg daily. In each of the main groups the patient material was subdivided into closed cases treated conservatively, chronic fistulous cases treated conservatively, and cases submitted to operative treatment. The results show that the closed, conservatively treated cases behave otherwise than the open cases, since among 13 closed, conservatively treated cases the results were good in 92 per cent. The remaining 60 cases were open. In the pure Fucidin group results were good in 37.5 per cent, whereas in the group with combined treatment 63.9 per cent showed good results. The difference, however, is not highly significant. Of the 60 open cases, 20 were conservatively and 40 operatively treated. Among the operatively treated cases 65 per cent had good results as contrasted with 30 per cent in the conservatively treated cases. The difference is 2.28 bigger than the mean error—which is significant.

Few complications were encountered; but it is emphasized that in four of the patients, raised values for liver-function tests were found. These were transient in three patients, but in the fourth resulted in a prolonged illness with ascites-like increase of the abdominal circumference.

TREATMENT OF CHRONIC OSTEITIS WITH FUCIDIN AND PRO-STAPHLIN

Hans Bohr & E. Larsen (Copenhagen, Denmark)

The investigation includes 5 patients who have suffered from chronic fistulating osteitis for more than 2 years and who have undergone several operations on the bone with removal of sequestrae. Cultures from the wound before treatment in all cases grew *Staphylococcus aureus*, which was resistant to penicillin but sensitive to Fucidin (Leo) and Pro-Staphlin (Lundbeck). Fucidin and Pro-Staphlin were given daily in 4 doses of 1.5 and 2 g, respectively, as out-patient treatment. This was carried out for more than 3 months with cultures from the wound every

fortnight and control of the haemoglobin percentage, leukocytes, sedimentation rate, serum creatinine, serum electrophoresis, serum transaminasis, and G.O.T. The staphylococci disappeared little by little from the wounds during the treatment; but already 2 weeks after cessation of treatment, staphylococci were again demonstrated in 3 of the cases showing the same resistance pattern and phage types as before treatment. There were no signs of toxic effects from the medication administered but periodical dyspepsia and diarrhoea occurred despite Paragurth tablets given simultaneously. Though the material is small it seems to prove that even through prolonged treatment with these antibiotics complete asepsis of chronically infected bone foci cannot be obtained.

NON-SPECIFIC SPONDYLITIS

S. Ahlbäck, S. Collert & L. Lindberg (Stockholm and Malmö, Sweden)

Sixty-four cases of haematogenous spondylitis, 21 women and 43 men, treated 1950-1966 at the Departments of Orthopaedic Surgery, St. Göran's Hospital, Stockholm, and Malmö General Hospital have been investigated.

Seven were localized to the cervical region, 57 to the thoracal-lumbar region. The onset was simultaneous with an urinary infection in 16 cases, with a respiratory infection in 4 cases, and with a skin infection in 3 cases.

As half of the cases were sent to hospital as tuberculous spondylitis, we have tried to find differences between tuberculous and septic spondylitis in their early courses.

	Septic	Tbc
Onset	Acute or subacute	Chronic
Early fever	Common	Uncommon
Sed.rate	Often very high	Moderately high
ASTa	Often high	Often normal
Destruction	Over the whole endplate	One single cavity
Sequestrae	Occasional	Abundant
Gibbus	Uncommon	Common

The diagnosis was confirmed by operation in 16 cases and by needle biopsy in 12.

In the lesion *Staphylococcus aureus* was found in 13 cases, *S. albus* in 2, *B. coli* in 2, *B. proteus* in 2.

Antibiotics were given for more than 3 months.

The effect of this treatment is difficult to judge as the septic spondylitis seems to have a strong tendency to spontaneous healing in 10-12 months.

38 patients were followed-up after 2 years: 35 were found to have no back pain at all. In about half of the cases a spontaneous fusion was found on roentgenograms. All 38 cases were judged as roentgenologically healed.

THE DISTRIBUTION OF DIHYDROSTREPTOMYCIN AND TETRACYCLINE IN STAPHYCOCCAL ARTHRITIS, AN EXPERIMENTAL AND AUTORADIO- GRAPHIC STUDY

Lars Lindberg & Bo Lundberg (Malmö, Sweden)

The distribution of these two antibiotics in standardized experimental staphylococcal arthritis in golden hamsters and rabbits was studied with an autoradiographic technique which makes it possible to identify tritium-labelled, water-soluble substances on a cellular level in different tissues.

Intramuscularly given tetracyclin was found to be highly concentrated in bone tissue whereas the concentration in soft tissues, inclusive of pus and other kinds of infectious tissues, was comparatively low. No difference in concentration was found between the different soft tissues, the tetracyclin was evenly distributed among them all. Intramuscularly given dihydrostreptomycin was found to be highly concentrated in pus and in cartilage. Already 15 minutes after the injection the concentration in the abscesses was very high compared with the surrounding tissues and blood.

After intra-articular injection both antibiotics were found to be strictly located to the cavity and abscesses with open communication with the joint. No diffusion was found to closed recesses.

The conclusion of the results is that very high concentration of antibiotics can be attained by local injections of antibiotics in an infected joint, but that intramuscular injections must be given if all parts of the lesion shall be reached.

OPERATIVE TREATMENT OF OSTEOMYELITIS WITH PRIMARY WOUND CLOSURE

Knud Jansen (Copenhagen, Denmark)

Adequate blood supply is generally agreed to be essential in fracture healing and in fighting bone infections. Still we experience examples of neglect of this principle by destruction of both the endosteal and periosteal vessels by medullary nailing and secondary plating—and in infectious cases by packing the periosseous space with gauze while waiting a secondary healing of the bone and soft tissues.

Since 1951 I have applied the principle of primary closure to cases of pyogenic, hematogenous, or traumatic osteomyelitis.

The skin is incised and pre-existing retracted scars or fistulas excised. After probe-drilling the medullary cavity is opened. The periosteum, when present, is preserved. The bone cavity is reamed carefully, pus and visible necrotic bone being removed. The cavity is then filled with cancellous bank bone mixed with penicillin and some additional antibiotic. Periosteum, muscle, fascia, and skin are sutured and adequate general antibiotic treatment is commenced, with adjustment according to the growth analysis of the bacterial probes.

In cases with sufficient soft tissue cover, recovery has been achieved within two weeks. In cases of skin defects, in particular in tibial and ankle regions, a preliminary skin graft (cross leg flap) may be necessary. In cases of instability (pseudarthrosis, arthrodesis), immobilization is an essential additional measure.

The results have been satisfactory and in concordance with the patho-physiological principle applied.

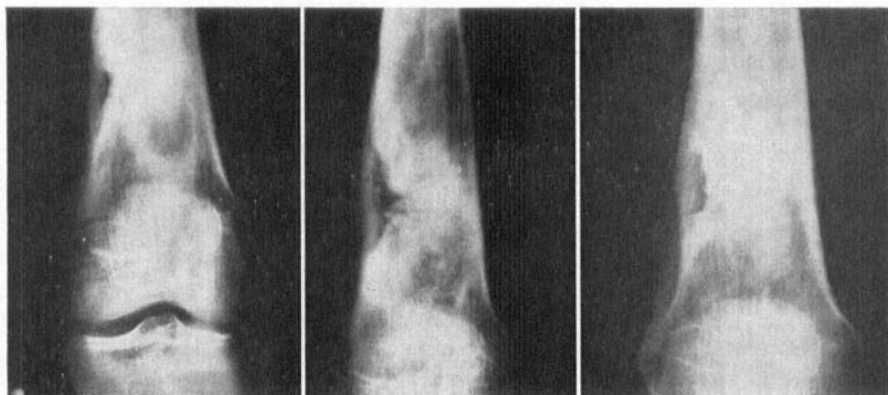


Figure 1a. Before surgery. Figure 1b. After surgery. Figure 1c. Four years later.

Figure 1. Acute in chronic osteomyelitis, distal end of femur (54-year-old male)
Healing within two weeks. No symptoms since.

STUDIES ON DICLOXACILLIN (DICLOCIL®)

P. Holstein & O. Hvid-Hansen (Hillerød, Denmark)

Dicloxacillin is a semi-synthetic penicillin (isoxazodyl penicillin) active against penicillinase-producing staphylococci. It is stable in acid and affords approximately the same serum level upon intramuscular and oral administration. The degree of absorption is independent of stomach contents. It is strongly bound to serum protein.

At the Frederiksborg Country Central Hospital, Hillerød, Denmark, this agent has been used for long-term oral treatment of osteitis. In this connection, we investigated whether the substance was excreted in the wound discharge after oral dose of 1 g. In one clean granulating wound, two sluggish granulating wounds, one necrotic wound without granulation tissue, and in one chronic osteomyelitis fistula a definite increase in the antibiotic concentration was found in the discharge about 6 hours after administration—and thus a definite antibiotic effect.

PRELIMINARY EXPERIENCE OF DICLOXACILLIN IN THE TREATMENT OF OSTEITIS

O. Hvid-Hansen & P. Holstein (Hillerød, Denmark)

Dicloxacillin was used as the only antibiotic on 9 patients, 5 of whom had chronic osteitis, previously treated with a large number of other antibiotics without any effect, and 4 had fresh osteitis. Adequate surgical treatment was given. *Staphylococcus aureus* was isolated from 6 patients and *Staphylococcus albus* from 2.

Healing was obtained in 7 patients, whereas in 2 the effect was questionable. Gastroenteritis occurred in one patient. We shall continue using this agent.

(One year after the treatment one patient has had a recurrence. Another patient, in whom the effect had been questionable, is cured.)

DISCITIS. CLOSED-SPACE INFECTION AFTER LUMBAR DISCUS PROLAPS OPERATION

Søren Pilgaard (Århus, Denmark)

The word "discitis" is used alternately with the term "closed-space infection". The symptoms of discitis are initially severe spasmodic pain in the back and the posterior part of the legs shortly after operation for protruded lumbar disc. There can be atypical abdominal pain (Sullivan). The disease can be without a rise in temperature (Lowmann). There is always a strongly elevated sedimentation rate and changes on the X-ray pictures.

At the Orthopedic Hospital in Århus 502 patients with lumbar discus prolaps have been operated on in the period from 1962-67. Of these patients, 15 developed discitis. The first 24 hours after operation the condition was normal.

1. In the period 2-28 days postoperatively all patients complained of severe back pain.

2. 3 patients had normal temperature, the rest had fever 2-30 days after the operation.

3. The most pronounced symptoms was the highly elevated SR (30-121 mm/h).

4. In all 15 patients the end-result on the X-ray pictures was a total bone-block between the two vertebrae on either side of the affected discus.

Only one patient had meningeal reaction.

The treatment was bedrest, leg traction, and sedatives. Nine patients received antibiotic treatment.

End result: 10 patients back at work 3-11 months after the operation, 2 received invalid pensions, 3 patients were not working after 12 months.

Conclusion: Discitis after prolaps operation is an occasional complication which can be alarming and always prolongs the postoperative phase. After our experience we can promise the patient with discitis a good and painless lower back.

SYNDACTYLIZATION IN THE MANAGEMENT OF CERTAIN TOE DEFORMITIES

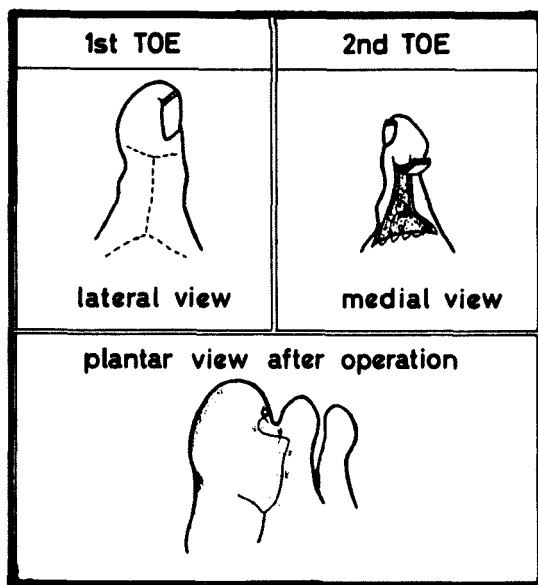
Erin Madsen (Sorø, Denmark)

Syndactylization was used for the treatment of overlying toes and of "lax toes" following resection for hallux valgus.

On the longer toe a flap of skin is freed on the dorsal as well as plantar aspect and laid on the shorter toe, where the edges of the flaps are outlined. The skin between the marks is removed, except for the distal 1 cm which instead is fashioned as a flap with distal attachment. This flap is applied to the longer toe. Thus, inverted skin edges are avoided. The toes are united by 2 or 3 thin catgut sutures in the soft tissues, taking care that the position of the shorter toe is adequate, so that its nail does not hurt the other toe. The skin flaps are trimmed and sutured. The toes are held together by gauze; no other dressing.

In the presence of contracture, tenotomy on the extensor tendons has been performed a few times; and in fixed hammer toe Slomann's operation has been used twice.

Out of 15 patients, 13 were seen 1-17 years after the operation—a total of 21 operated toes. In all cases the result was excellent, from the subjective as well as objective point of view.



A CLINICAL AND RADIOLOGICAL 20-YEAR FOLLOW-UP STUDY OF TRANSIENT SYNOVITIS OF THE HIP

Alf L. Nachemson & Sven Scheller (Gothenburg, Sweden)

To be published in Acta Orthopaedica Scandinavica.

OPERATIVE TREATMENT TO IMPROVE THE FUNCTION OF THE EXTREMITIES OF HEMIPLEGICS ESPECIALLY REGARDING GAIT FUNCTION

J. Kunov (Copenhagen, Denmark)

A 5-year material comprising 47 hemiplegic patients is reported: 34 female and 13 male patients, mostly under 70 years of age (23 right-sided, 24 left-sided).

The hemiplegia had most often been stationary throughout several years.

Prominent feature was gait disturbance because of area 6-paresis-type with spastic drop-foot and varus deformity.

Along with training and redressment, splinting and operative treatment were used alternatively or in combination.

The operations used were for stabilizing as well as counter-acting spasms and contractures. Types of operations used: transpositio tend. tib. post. + allongatio tend. calc. in 9, op. a. m. Silverskiöld in 6, transcisio tend. tib. post. in 6, subtaloarthrodesis in 3 cases, and in 20 cases various combined operations most frequently transctions and transpositions of tendons of tibialis posterior and anterior.

37 patients had a satisfactory result of the operation; 27 patients got an undoubtedly improved gait function; and 10 could do with a lesser bandage. 25 patients have been followed-up for more than 1 year, 16 for more than 2, and 6 for more than 5 years.

Operative treatment contributes essentially to improving the function of the extremities of these patients as well as other patients with diseases of the CNS.

BLOUNT'S DISEASE

Mohammed Zayer (Apelvikstrand, Sweden)

The author collected 124 cases suspected of having Blount's disease from 15 Swedish hospitals and presented 40 confirmed cases operated upon by Blount epiphyseodesis (14 cases) or osteotomy (24 cases). Two patients had both procedures. Of the patients, 23 were girls and 17 boys, 25 of the cases are considered infantile and 15 adolescent according to the classification of Langenskiöld and Blount.

From this material it seems permissible to conclude that Blount epiphyseodesis is suited for the younger group (2-13 years) and osteotomy for the older (over 14 years of age). The author suggested that it might be the characteristics of the disease which determine its course, irrespective of the surgical treatment, but hoped to be able to answer this question in the future.

SURGICAL TREATMENT OF KNEE JOINT INSTABILITY DUE TO BLOUNT'S DISEASE

H. Stören (Oslo, Norway)

To be published in Acta Orthopaedica Scandinavica.

WHY SYNOVECTOMY IN RHEUMATOID ARTHRITIS?

Erik Moberg (Gothenburg, Sweden)

Figure 1 shows the conception of the problems to which I have come after about 12 years' experience of synovectomy. The number of operations has increased rapidly. In 1967 300 synovectomy operations were performed, many of them including several hand joints. The present discussion concerns the first third of the Figure, the period in which so-called preventive surgery is recommended.

From the swollen synovial tissue special leukocytes will go out into the joint fluid and give rise to lysosomes, active against the cartilage. One must remember that the bone and synovial tissue are linked together by a special vascular system, completely separate from the vessels, to the fibres, capsules, and the aponeuroses. It is now known that the synovial granulations appear at typical locations in the joint. The destruction to the bone also has typical locations to the region of the so-called nutrient foramina. A marked irregularity, however, characterizes the lesions to the cartilage. The picture is similar to the one in corrosion of a metal surface. Where destruction starts it will dig deep in some cases, in others there will be small superficial lesions over a large surface. In the joints all facts known indicate that a factor in the joint fluid is active here, presumably an enzyme.

The aim of synovectomy will therefore be to reduce the bone destruction by cutting the vascular connections between bone and synovial tissue and to stop or reduce the flow of destructive fluids into the joint. If a level low enough to be counteracted by the repairing forces in the cartilage can be obtained, the disease will stop locally. I have examples in which this has been possible for as long as

2

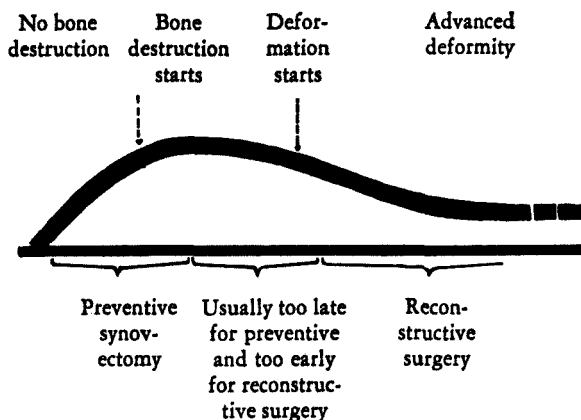


Figure 1. Local development in joints.

11 years after surgery, although the disease has advanced in other joints in the same hand. In a re-explored symptom-free joint 10 years after synovectomy the synovial tissue macroscopically was normal but microscopically showed only a thin fibrous lining and no real synovial tissue.

Mobility will in early cases usually remain intact after synovectomy. The pain will disappear. Of course, recurrences are not infrequent, but as a whole very much is gained with the synovectomy and for a considerable period of time. Table 1 shows some of the results obtained.

Table 1. Results of synovectomy (most cases from the hand) (our indications).

Follow-up time (yrs)	No recurrence	"Recurrences"
10-11	Some observations	
5	70 % free from pain, some with recurrence	30 %
3-10	40 %	

RESULTS OF EARLY WEIGHT-BEARING IN CASES OF OPERATED SUBCAPITAL FEMORAL NECK FRACTURES

Sven-Owe Häggquist (Malmö, Sweden)

A material of 388 patients with medial hip neck fractures was nailed according to Sven Johansson. Every second patient was allowed to carry full weight after 2 weeks and the other half of the group after 6 weeks.

The largest group was between 71 and 85 years, 48 per cent (Table 1). The post-operative mortality within 6 weeks was in both groups 4 per cent. Wound-healing was normal in 93 per cent of the women and in 96 per cent of the men. Totally there were 4 per cent wound infections and 5 per cent haematomas.

Table 1. Age groups. Weight-bearing after operation.

Age	2 weeks	6 weeks	2 weeks	6 weeks	%
	♀	♀	♂	♂	
<70	69	61	10	16	40
71-85	78	85	12	11	48
>85	28	12	4	2	12

Significant sliding of nails within 1 year occurred in the two groups in about the same frequency (30 per cent). The greatest occurrence was within the first 6 weeks (Table 2).

Table 2. Sliding of nail.

	2-week group (163 pat. followed-up)		6-week group (149 pat. followed-up)	
	No. of cases	%	No. of cases	%
< 6 weeks	21	13	22	15
6 weeks-6 months	19	12	16	11
6 months-1 year	6	4	6	4

Excellent primary result within the first year was defined as: no pain, no hindrance in movement, and no limp.

	2-week (%)	6-week (%)
Excellent results	23.4	18.8
Some persistent discomfort	36	45.1
Not possible to evaluate due to other illness	15.5	11.3
Dead within the first year	8.8	7.5
Not available for examination	16.6	15

The most favourable group is thus that with early weight-bearing.

Caput necroses can not be evaluated until more than 2 years have passed and not all patients have been followed-up this long. The comparison between the two groups does not reveal any difference. Men have so far shown an occurrence of caput necrosis twice as great as women.

We have thus found that primary results within 1 year postoperatively are not worsened if the patient is mobilized and allowed full weight-bearing already after 2 weeks rather than after 6 weeks.

OPEN REDUCTION OF FRACTURES OF THE DISTAL RADIUS

S. Edshage & G. Frykman (Gothenburg, Sweden)

In severely dislocated intra-articular fractures of the distal radius in which it has been impossible to keep the reduced fracture in position, we have tried open reduction and internal fixation. This method has been recommended in orthopaedic textbooks but only a few late results have been reported.

At the Clinic for Bone and Joint Surgery in Gothenburg we have been able to examine 27 out of 30 patients. The examination was performed at least two years after surgery (mean 4.7 years).

For the evaluation of the results we have used the same criteria as Frykman (*Acta Orthopaedica Scandinavica* Suppl. 108) but we used only two groups, good and poor. The former includes excellent and good and the latter fair and poor.

This classification shows the late results to be 8 good cases and 19 with a poor result. The percentage is the inverse of what has been reported of the closed reduction.

In the other series the poor results depend on weakness and decreased mobility in the joints. The series contained three cases of ruptured long extensor of the thumb and two cases of shoulder-hand syndrome. There was one case of infectious arthritis in the wrist joint. With exception of the arthritis these complications did not influence the evaluation of these cases.

One explanation for the extremely bad late results may be that the primary material was composed of extremely bad cases. To find out whether this was the case or not we tried to make a prognosis by the primary X-ray picture.

In a series where the end result was known after closed reduction, it was possible to make a prognosis for intra-articular fractures in the radio-carpal joint but not in cases where even the distal radio-ulnar joint was involved. When our series was divided according to these principles and a prognosis was made, we found that we should have had 75 per cent good results and 25 per cent poor results among the intra-articular fractures in the radio-carpal joint. Thus our series was not composed of extremely bad cases. The bad results must then depend on other factors. In those cases where the intra-articular fractures are in the distal radio-ulnar joint no prognosis can be made, and it is impossible to determine whether the primary material was an extremely bad one.

Thus our conclusion must be that open reduction of fractures of the distal radius is a surgical procedure that should be reserved for only very few cases. Instead, closed reduction in general anaesthesia or block anaesthesia must be tried and the possibilities for extension devices such as the one constructed by Grath must be tried. One must also remember that a less satisfactory position on the X-ray does not necessarily mean a less satisfactory clinical result.

SLIPPED UPPER FEMORAL EPIPHYSIS, CLINICAL EXAMINATIONS
CONCERNING THE AETIOLOGY

K. Harry Sørensen (Odense, Denmark)

To be published in Acta Orthopaedica Scandinavica.

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