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THE SPINE

THE DIFFERENTIAL DIAGNOSIS BETWEEN POTT'S DISEASE AND TUMOUR OF THE SPINE

Bernhard Paus (Sandvika, Norway)

Records and X-rays of 50 patients with tumour of the spine verified by histological examination were compared with records and X-rays of 50 patients with Pott's disease proven by the finding of Bacillus Koch.

In Norway an age under 15 years represents a slight indication for tumour, as does history before admission of less than 6 months; a history of more than 12 months indicates Pott's disease. A hemoglobin below 80 per cent and particularly below 70 per cent heavily indicates tumour as does an ESR of 50 mm or more. In uncomplicated cases of Pott's disease ESR is seldom that high. Indeed, in clinically doubtful cases without complications or additional disease besides the spinal disease, an ESR of 50 mm or more practically always means tumour if unspecific spondylitis can be excluded.

Only one vertebra affected indicates tumour as do changes in vertebral arch or processes. Paravertebral soft tissue swelling ("abscess shadow") was seen in 23 of 50 patients with tumour and reduced disc space in 40. This last observation is in contrast to the usual assertion that the disc space stays unchanged in case of tumour.

The author concludes that biopsy is indicated for obtaining or verifying the diagnosis, as well as for establishing the nature of the possible tumour.

FLUOROSIS WITH NEUROLOGICAL COMPLICATIONS

Kjell Harbo (Oslo, Norway)

A 56-year-old industrial worker noticed during the last 3 or 4 years progressive muscle wasting, loss of strength and pain in his left upper extremity. Besides, clinical examination showed sensory loss of the left upper extremity and exaggerated tendon reflexes in the lower extremities.

X-ray of the cervical column revealed extensive changes, most pronounced from C_3 to C_6. The vertebral bodies were osteosclerotic, irregular in shape with beak-like lipping, osteophyte formation and calcification of the ligaments.

Myelography showed almost complete block at C_6-C_7.

The patient had had an ankle arthrodesis 2½ years earlier. Roentgenograms taken

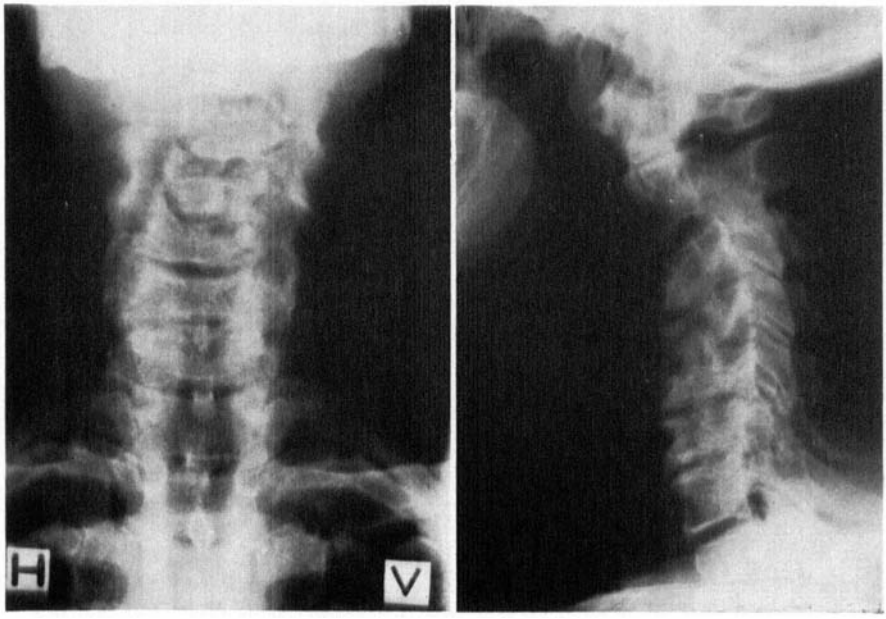


Figure 1.

during the healing period revealed an unusual degree and form of calcification in the soft tissues.

This man had been working in a Norwegian aluminium factory for 16 years and was among the workers most exposed to fluoride compounds liberated through the production process.

A decompressive operation of the cervical column a.m. Cloward was performed. The bone structure was unusually hard all through the vertebral body with nearly no signs of normal spongiosa. Biopsies were taken for fluorine analysis. The highest value was 2700 p.p.m. bone ash. This is much higher than the average values in individuals who have not been exposed to fluoride compounds, but at the same time among the lowest values given in the literature for cases with fluorosis.

RESULTS OF OPERATIVE TREATMENT OF HERNIATED INTERVERTEBRAL DISC

P. Salenius & L. E. Laurent (Helsinki, Finland)

During a six-year period, 1960–1965, 886 patients suffering from sciatica were operated on for a protruded disc at the Invalid Foundation Hospital. In 1971 a questionnaire was sent to the patients. 695 patients answered the questionnaire (78.5 per cent). The material was dealt with by a computer. 66 per cent were men and 34 per cent women. The frequency of sciatica was greatest in the age group 30–49 years (71 per cent). 122 of the patients had had a previous operation for a

protruded disc. A fusion operation was performed in 43 cases. 33 patients were later operated for relapse of disc protrusion. There were thus 173 patients who had been operated twice (20 per cent).

Later results indicated that 56 per cent of cases were improved, 36 per cent were unchanged, and 8 per cent were worse. 66 per cent of the cases had nevertheless returned to their previous work, 8 per cent had changed their work to a lighter one, 7 per cent did not work, and 17 per cent were on pension, mainly because of advanced age.

RESULTS OF LUMBAR INTERVERTEBRAL DISC OPERATION IN CORRELATION WITH PREOPERATIVE AND OPERATIVE FINDINGS

Antti Alho & Erkki Karaharju (Helsinki, Finland)

During 1961–1965, a total of 725 sciatica patients were operated on. Myelography was performed on 95 per cent of the patients. For 84 per cent the finding was considered adequate in the first operated interspace; in 30 per cent of the cases another interspace was opened with a positive finding revealed in one-half of the patients. A prolapsed disc was found significantly more frequently on the left (61 per cent). The level distribution was: prolapse between L5 and S1–35 per cent; between L4 and L5–62 per cent; and between L3 and L4–5 per cent.

The straight leg raising test was negative in 7 per cent of the patients with a positive operative finding. In the level diagnostics, the knee and ankle jerk tests were rather unreliable. On the other hand, weakness of the extensor hallucis longus muscle and pain radiating to the great toe bore a significant correlation with the prolapsed L4–L5 discs. The myelogram was negative in only 5 per cent of the cases with verified prolapsed discs. The patients with a negative or questionable operative finding had a longer average history than the patients with an adequate finding. The results were best among patients with sciatica of two to six months' duration.

Twenty-one per cent of the patients had distinctive radiating pain two to five months after the operation. The most satisfactory results were achieved in patients with an adequate operative finding. In a follow-up study conducted five to ten years later, no correlation was found between the prevailing condition and the factors which were important for the immediate postoperative result.

ANTERO-LATERAL DECOMPRESSION AS A TREATMENT OF FRESH PARAPLEGIA FOLLOWING VERTEBRAL FRACTURE

Erik B. Riska (Helsinki, Finland)

Six patients with paraplegia following vertebral fracture have been treated with antero-lateral decompression operation. Three were men and three women, age 17, 21, 28, 43, 54 and 71 years, respectively. The level of the spinal lesion was in two cases Th IV and V, and in four cases Th XII–L I. In four cases the paraplegia was complete, in two cases incomplete with slight unilateral motor function. Two patients had no other traumata, one patient a hemipelvic and a radius fracture, one patient a pelvic fracture, thoracic injury with flail chest and a fracture of the femoral shaft and calcaneus, one patient a rupture of the left lung with flail chest and a pelvic fracture, one patient a fracture of the humerus. Two

Figure 1. Oxygen myelography of a 43-year-old man with paraplegia following a fracture of the first lumbar vertebra. Before operation to the left, after antero-lateral decompression operation to the right.

patients were operated on 5 days after the injury, one 11 days, one 13 days, one 38 days, and one 6 months after the accident.

The exact detection of the compression of the spinal cord is decisive for the decompression procedure. A careful examination of the patient should be completed with x-ray of the spinal column, tomography of the broken vertebra, and if necessary with oxygen myelography (Figure 1).

In thoracic spine the operation was done according to the technique of Alexander described by Griffiths, Seddon & Roaf. In the region of Th XII and L I the incision was made along the XIth rib, which was partly resected. Psoas muscle was dissected transversely and artery lumbales ligated. The broken vertebra was localized with roentgen television during the operation. Compressing bone tissue from the vertebra, loose fragments and compressing discus were removed. Finally the left-over thin bony roof between the cavity and the spinal cord was broken down and removed. Interbody fusion was carried out using resected rib fragments as grafts.

Two patients made a complete recovery, one a good recovery. These three patients are back to their former work. One patient walks with crutches without help and the rehabilitation is still going on. The follow-up time is too short for the two last patients (Table 1).

In a case of traumatic paraplegia one must of course not give too much hope for the patient as a result of operative treatment, but if the paraplegia develops gradually within the first hour, first day or first week after the trauma, a

Table 1.

Patient number	Result of treatment of paraplegia: Degree of motor paralysis	Motor function began to return	Result of operation
1	Complete loss	26 days after operation	Complete recovery
2	Incomplete loss	4 days after operation	Complete recovery
3	Incomplete loss	4 days after operation	Good recovery
4	Complete loss	21 days after operation	Moderate recovery
5	Complete loss	21 days after operation	Follow-up 30 days
6	Complete loss	–	Follow-up 7 days

decompression operation should be undertaken. In these cases the compression of the spinal cord is usually from the front and the laminae are in general unbroken. If not, a posterior fusion might be indicated before mobilizing the patient. The results of these six operated cases indicate a more active treatment of traumatic paraplegia following vertebral fracture instead of the usual conservative treatment.

OSTEOSYNTHESIS OF SPONDYLOLYSIS

Klas Buring & Nis Fredensborg (Malmö, Sweden)

The method of direct repair of the defect in spondylolisthesis described by J. E. Buck has been performed on 12 patients—9 men and 3 women. The mean age was 32 years (18–49); the postoperative observation period was 12–19 months. The location: 9 cases L V, 3 cases L IV. The indication has been severe irretractable lumbar pain. Standing in an upright position had been limited in time and had often hindered the patient in his work. Conservative treatment in these cases had been tried at least one year.

Results: Nine of our cases are free from pain and have returned to work, several having labour work. One girl disabled by lumbar pain became pregnant shortly after the operation; however, the pregnancy and delivery proceeded uneventfully and she has since resumed her work, now free from previous pain. Three cases have failed to unite. In two of these cases the reason for failure may be due to the fact that the slip was too great, as they belonged to Meyerding's group II. Here we later carried out an anterior fusion.

Conclusion: The method of Buck offers a logical alternative to the earlier arsenal of fusions for spondylolisthesis. It should, however, be reserved for cases where the forward displacement of the body does not exceed 4 mm.

DISCUSSION:

K. Harry Sörensen (Odense, Denmark)

As pain in cases of spondylolysis and spondylolisthesis is as a rule due to the accompanying disc degeneration, fixation of a screw should only be used if the disc is still normal, which is verified by taking a lateral X-ray of the disc in question with the patient in a standing posture.

In all other cases anterior intercorporal fusion should be performed, which will give far safer fixation. At the same time the disc degeneration is treated effectively.

THE TECHNIQUE IN CASE OF ANTERIOR LUMBAR INTERCORPORAL FUSION

K. Harry Sörensen (Odense, Denmark)

The technique is described and illustrated by colour film, and a short summary of 84 performed operations is given.

BONE PATHOLOGY

LOCAL RESECTION OF BONE TUMOURS

E. V. S. Koskinen (Helsinki, Finland)

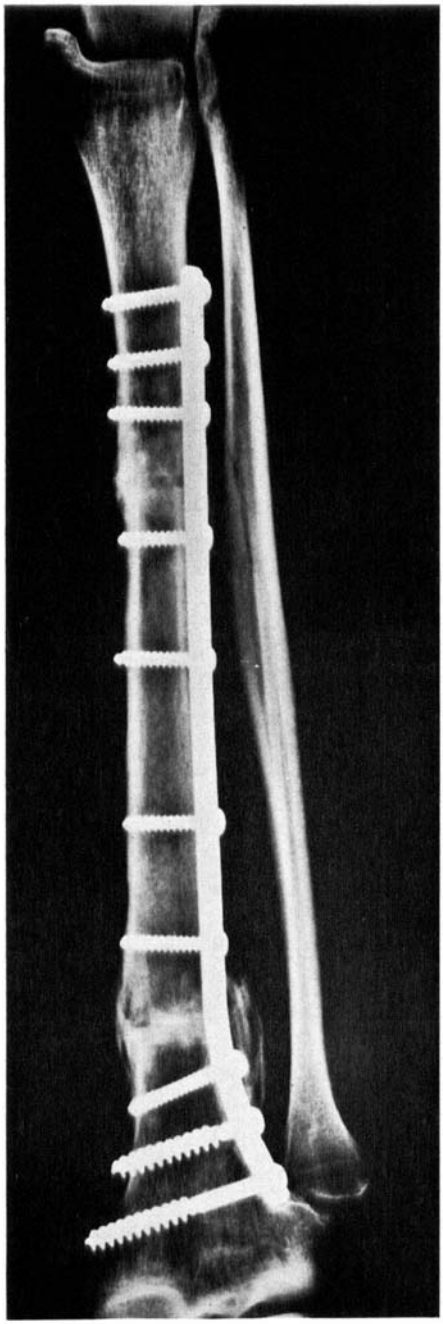
The study describes the local removal of benign, semi-malignant or malignant bone tumours in 171 cases, of which 101 were resections (Figure 1). The follow-up results are presented.

The majority of the tumours were localized close to a joint, which circumstance introduces grave problems in the planning of treatment in view of saving the joint. Part of the tumours recurred, or the tumour was initially malignant or underwent malignant transformation.

The following surgical procedures were applied: (1) removal of tumour and bone grafting; (2) resection of upper end of humerus or ulna or lower end of radius, with replacement by fibular graft; (3) resection of diaphysis of humerus, with replacement by fibular and tibial graft, and metallic implant; (4) resection of tibial condyle, with full thickness iliac bone graft; (5) resection of tibial condyle, with bone grafting and arthrodesis; (6) resection of lower end of femur,

Figure 1. Local removal of bone tumours in 171 cases.

Tumour	Resection	Curettage
Chondroma	16	7
Chondroblastoma	2	3
Osteochondroma	21	
Osteoid osteoma	17	2
Hemangioma	1	
Aneurysmal bone cyst	5	5
Fibrous dysplasia	9	23
Fibroma		5
Solitary bone cyst		7
Giant cell tumour	15	18
Chondrosarcoma	7	
Fibrosarcoma	5	
Osteosarcoma	2	
Parosteal sarcoma	1	
Total	101	70



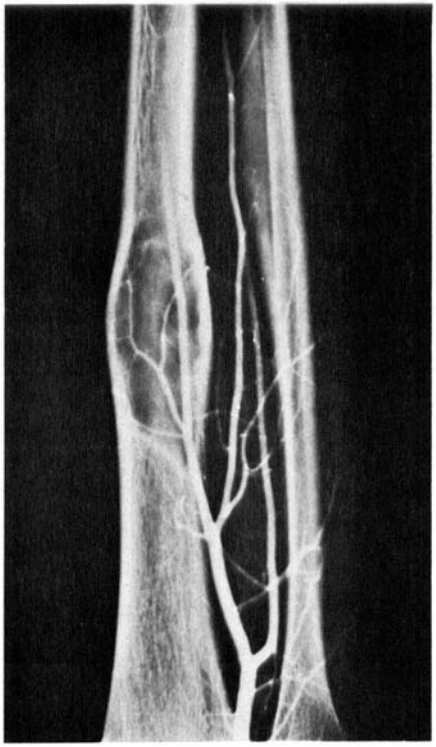


Figure 2. Medullary fibrosarcoma in tibia of woman aged 20; angiograph showing pathological vascularization. Good functional result after segmental resection with massive homograft and assisting autogenic bone replacement and A-O plate fixing. No recurrence within 2 years.

with replacement by homograft; (7) resection of lower end of femur, with replacement by hemicylindrical tibial autograft; (8) resection of upper part of femur, with replacement by endoprosthesis.

The therapeutic principle aimed at resection with wide margin, in order to preclude recurrence. Massive replacement bone grafting, autogenous or homogenous (hemi-joint replacement), endoprosthesis or arthrodesis is practiced if the operation would not be radical enough otherwise. In the case of small, sharply confined benign tumours, evacuation and autogenous bone grafting are justified.

RESULTS OF TREATMENT OF FIBROUS DYSPLASIA OF BONE

T. Sam Lindholm & E. V. S. Koskinen (Helsinki, Finland)

Thirty-two cases of fibrous dysplasia of bone are demonstrated. The surgical treatment was performed in the years 1951–1968 in the Department of Orthopaedics and Traumatology, University of Helsinki. 22 cases were monostotic and 8 of polyostotic type. One case was classified as typical for the syndrome of Albright. Initial symptoms of the disease were noted at the mean age of 16.9 and consisted of tenderness, pain or pathological fracture. The most typical bone localisations of monostotic lesions were humerus, tibia and femur, in the order mentioned. In polyostotic cases 72 lesions were noted at all sites in the skeleton.

Active surgical treatment of lesions of fibrous dysplasia is recommended. The results of treatment of monostotic lesions are usually successful. Evacuation and bone transplantation may also be performed to prevent pathological fractures. In polyostotic cases surgical intervention is not always advantageous, but fractures and deformities should be treated (Figure 1).

Follow-up examination, on an average 5 years later, showed that regression of the lesions and ultimate cure is usual after surgery of monostotic lesions. Progression of polyostotic lesions is usual during the period of growth and sometimes also afterwards. No malignant features were observed in this material (Figure 2).

Figure 1. Results of treatment in 24 monostotic and 8 polyostotic cases of fibrous dysplasia.

Treatment	Results					
	Good		Fair		Poor	
Evacuation	6			1	1	
Evacuation & bone grafting	9		1			
Evacuation & osteosynthesis				1		1
Resection & bone graft	5		1			
Osteotomy		1				
Laminectomy					1	1
Conservative		2				1
Total monostotic	20		2		2	
Total polyostotic		3		2		3
Per cent	84%	37%	8%	26%	8%	37%

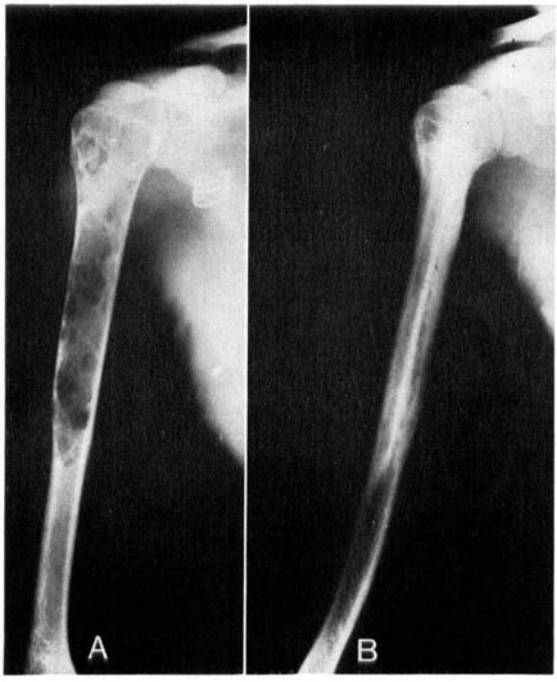


Figure 2. A 21-year-old woman with monostotic fibrous dysplasia in the proximal humerus, with high pathological fracture (A). After evacuation and grafting with fibular and spongeous bone the lesion was cured (B). The functional result was good.

SYMPOSIUM ON SCOLIOSIS

INTREVITAL WIRELESS TELEMETRY OF AXIAL FORCES IN HARRINGTON DISTRACTION RODS IN PATIENTS WITH IDIOPATHIC SCOLIOSIS

A. Nachemson & G. Elfström (Gothenburg, Sweden)

The axial forces in a Harrington distraction rod used for internal correction of scoliosis have been measured with wireless telemetry. The heat sterilizable system, which was constructed specifically for this purpose, contains a force-gauging Pressductor, an internal power-transfer coil and an internal transmitter. The electrical energy for the transmitter and Pressductor is provided by means of electromagnetic induction between an external power-transfer coil and the implanted one. The implanted units were covered with epoxy resin and silicon rubber and the wires were Teflon-coated.

The modified Harrington rods were inserted in 12 girls, aged 12–20 years, who had idiopathic scoliosis of varying severity (55°–12°). The measuring rod was exchanged for an ordinary one at a second operation, routinely performed after 2–3 weeks in these patients in this department. In none of the patients were there any signs of harmful effects from the implanted devices, neither clinically nor macro- or microscopically.

Distraction forces during operation ranging from 20 to 40 kp resulted in corrections of around 50 per cent except in the most severe curve of 120° where it reached only 25 per cent. The other curves were not particularly rigid. The force declined with time, rapidly in the beginning, slower after three days. After about 12 days the force recorded stabilized at about one-third of the maximal force used during operation. Recordings also demonstrated the necessity of great care in handling the patients immediately after operation, in order to avoid upper laminar fractures. In four patients the compression rod on the convex side of the curve was also used. In three patients this resulted in an increase in axial force of as much as 5 kp, while in one young patient with a less rigid curve of 55° a decrease of the same amount was noted.

The axial forces during deep breathing, bicycling in bed and similar exercises were relatively low. Log-rolling caused only a slight increase, less when lying on the side of the concavity than on the opposite side.

With regard to the axial force the Milwaukee brace, compared with no external support, in standing exerted a distractive force of 4 to 6 kp in the three patients tested.

In the supine position, compared with no external support, there was a reduction in axial force of 2 to 4 kp when wearing the brace.

Evaluation, in standing, of the different parts of a Milwaukee brace demonstrated the importance of a well-fitted pelvic cage, of either chin or occiput pads and especially of two side-supporting pads.

Mechanically these last-mentioned results should be valid also for non-operated patients with moderate curves of idiopathic origin for whom this brace is commonly used.

CORRECTION OF IDIOPATHIC SCOLIOSIS USING MILWAUKEE BRACE AND THE HARRINGTON METHOD

A. Langenskiöld & O. Snellman (Helsinki, Finland)

During the period 1969–72, the Orthopaedic Hospital of Invalid Foundation surgically treated 106 cases of idiopathic scoliosis using the Milwaukee brace, Harrington instrumentations, tibial grafts and ambulation 6 months postoperatively. The average correction age in the adolescent scoliosis has been about 14 years and determination of 71 of these cases between 12–16 years. The author presents a two stage operation treatment using a manual correction just before the rod is installed. The distraction rod has been used in 94 cases and the compressive rod in 7 cases and both in 2 cases. Using this technique, the average primary correction was 55 per cent. To date the complications include 1 deep infection, 1 hook release, 4 rods broken (only in cases where the rod was bent at time of surgery) and no pseudarthroses.

THE CORRECTION OF IDIOPATHIC SCOLIOSIS USING THE RISSER CAST AND HARRINGTON ROD

C. L. Nash (England)

During the period of 1969–1971 the University Hospitals of Cleveland, Ohio, conducted a study of early ambulation following scoliosis spine fusion. Forty-six

patients with uncomplicated idiopathic adolescent scoliosis were treated with a program of fusion of the major curve using a Harrington distractor rod and iliac graft and ambulation at two weeks in a Risser cast maintained for 5 months.

At an average follow-up of 17 months, there was an average correction of 50 per cent of the average preoperative curve of 59°. The immediate postoperative correction averaged 56° compared to 53° standing in the Risser cast at two weeks. The only significant complications were two cases of early hook failure causing 5°–10° loss.

A MODIFICATION OF THE HARRINGTON HOOK-HOLDER

Olai Snellman (Helsinki, Finland)

The author presents a modification of the standard Harrington hook-holder which grips the hook more firmly between the tips of the holder. The surface area of the tip of the holder has been increased in order to stabilise the hook better when rotational forces are applied during insertion of the hook.

OPERATIVE TREATMENT OF IDIOPATHIC SCOLIOSIS

J. A. Sevastikoglow, A. Hallén & U. Lindgren (Umeå, Sweden)

This is a preliminary report of 10 patients with idiopathic scoliosis operated on by combined rib-resection and spine fusion. The cases were selected among a total load of 148 consecutive cases of idiopathic scoliosis largely according to the same indications suggested by Von Lockum (1948). Three were male and 7 were female patients; their mean age at operation was 17.5 (range 13–22) years. Before surgery the thoracic deformity was evaluated by transversal tomografi of the chest and the patients were stretched in bed according to Cotrell & D'Amore (1968) for about 3 weeks. During operation 1 to 3 cm from the ribs mainly responsible for the deformity, usually 5 to 7, were resected at the most prominent point on the convexity of scoliosis. The medial fragment of the rib was mobilized to the costo-transversal joint and the fragments were then approximated and kept together with a suture (mersilene). The resected rib fragments were prepared to some mm thick bone sticks, which were transplanted on the previously decorticated concave side of the laminae of the scoliotic curve. The patients were stretched in a plaster spicca another 6 weeks post-surgery and they were then mobilized with a Milwaukee brace for about 6 months. No severe complications were encountered in this material. The cosmetic results were very good. The degree of correction of the spine deformity was comparable to that reported by Risser & Nordquist (1958), but somewhat inferior to that reported by Goldstein (1969) and Moe & Valuska (1970), where the Harrington instrumentation method was used. The effect on the VC and MBC was about the same as reported by Westgate & Moe (1969).

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A FOLLOW-UP STUDY OF PATIENTS WITH IDIOPATHIC SCOLIOSIS

Vagn Kolind-Sørensen (Århus, Denmark)

A follow-up study of 203 patients with severe idiopathic scoliosis, treated at the Orthopaedic Hospital in Århus from 1936–56 is presented. Only patients with scoliosis of more than 40° have been included.

The death rate was normal among patients with scoliosis of 40–100°, and approximately one-tenth had minor heart trouble. Among patients with scoliosis of over 100° the death rate was more than twice as high and half of the patients had heart trouble.

Thus, heart complications and high death rate were only of importance among the severest cases of scoliosis.

One-third af the patients had lumbar pains, rather independent of the degree of scoliosis.

Only about one-fifth received disablement pension and there was little difference among patients with more and less than 100° scoliosis.

A distribution of occupations showed that patients who had received suitable training while young managed well in society, even with severe scoliosis.

The marriage rate was lower than in the normal population; in the group of over 100° only one-half were married.

The number of scolioses of more than 100° dropped considerably when surgical treatment was introduced.

TREATMENT OF SCOLIOSIS WITH THE MILWAUKEE BRACE

A. Nachemson & Nordwall (Gothenburg, Sweden)

Since 1967 a total of 160 patients have been treated with the Milwaukee brace for more than one year in a program in which constant brace-wearing, good contact with the patient, and regular controls in a special scoliosis unit are of the main principles. Indications and the treatment program are presented. Of the 160 patients 89 per cent were idiopathic, 4 per cent congenital, and 4 per cent had polio. 30 per cent were double-primary curves. A total of 208 curves were evaluated.

The average curve at the onset of brace treatment was 39° in the thoracic area, 35° in the lumbar area. The rotation of the apical vertebra was on the average

25°, measured according to Moe et al. (*J. Bone Jt Surg.* **51**-A, 223, 1969). The brace had an immediate correcting effect on the curve of 23 per cent (9°) while the derotation was 16 per cent (4°). Those curves that were small and had a small rotation showed the best correction. The complications were few. 89 per cent of the patients adhered strictly to the treatment program. 2.5 per cent demonstrated some changes in the teeth or facial configuration; 7.5 per cent had skin problems. Provided the initial contact is well established and the fitting of the brace is made on an inpatient basis, it is possible to treat scoliosis patients in a Milwaukee brace for years without complications and with very few dropouts. The brace has an immediate straightening as well as derotating effect on the spine.

CONSERVATIVE TREATMENT OF IDIOPATHIC SCOLIOSIS WITH THE MILWAUKEE BRACE

J. A. Sevastikoglou & P. Karlman (Umeå, Sweden)

148 patients with idiopathic scoliosis have been seen in the Department of Orthopaedic Surgery, Umeå, during the last 5 years. 57, or 38.4 per cent were considered in need of treatment with a Milwaukee brace. 9 were male and 48 female patients. The mean age for the onset of the spine deformity was 13.4 for the total material, 12.4 for the treated patients. Treatment with a Milwaukee brace was introduced at a mean age of 15.4 (range 9–23) years. The mean duration of the treatment up to this time is 29 (range 4–56) months. The degree of the primary scoliotic curve at the beginning of the treatment as determined by the Ferguson method was $\leqq 20°$ in 4 cases, 21°–40° in 33, 41°–60° in 18 and $> 60°$ in 2 cases. The indications for treatment with a Milwaukee brace and its principles were largely the same as suggested by Blount et al. (*J. Bone Jt Surg.* **40**-A, 511, 1958). In 13 patients the treatment has been completed; 9 of these have been operated; 6 patients have interrupted the treatment themselves.

The results of the treatment obtained until now in this series of patients are summarized below:

	Comparison between radiographic and clinical evaluation of the results	
	Radiographic evaluation	Clinical evaluation
Improved	4 %	25 %
Unaffected	60 %	33 %
Deteriorated	36 %	42 %

These preliminary observations suggest that treatment with the Milwaukee brace:

(a) has as the main target the prevention of progress of the scoliotic deformity;

(b) often leads to improved body configuration without always improving the scoliotic curve;

(c) that it does not seem to solve the problem of the conservative treatment of the patient with idiopathic scoliosis, at least in our hands.

DENTOFACIAL REACTIONS DURING AND AFTER TREATMENT WITH A MILWAUKEE BRACE

E. Dahl (Copenhagen, Denmark)

Dentofacial reactions during and after treatment of scoliosis with a Milwaukee brace were demonstrated by X-ray cephalometric technique. In the evaluated patients tantalum implants were placed in the maxilla and the mandible according to the technique of *Björk* in order to interpret more accurately the cephalometric findings.

It was concluded that dentofacial development should be examined routinely during treatment with a Milwaukee brace. A hard processed acrylic splint worn during the orthopaedic treatment will prevent or minimize the undesirable changes in the dental occlusion. It was recommended that patients be supplied with such an appliance at the beginning of the treatment with a Milwaukee brace. The intraoral stabilizing appliance will not completely prevent facial changes. It would appear from the reported cases, however, that a definite tendency for recovery can be expected after brace removal. One of the cases showed that reversal of the changes can take place even if the brace is removed in a period without marked growth activity. Some morphologic changes in the mandible may remain, and radiographic changes in the temporomandibular joint were demonstrated.

A STUDY OF THE GROWTH PATTERN IN IDIOPATHIC STRUCTURAL SCOLIOSIS

S. Willner (Malmö, Sweden)

Most of the etiological factors causing idiopathic structural scoliosis are still unknown. However, one factor that is generally accepted is growth. Growth pattern was studied in a material consisting of 320 girls with idiopathic scoliosis and compared to age-matched controls without scoliosis. The controls proved to be identical with other age-matched Scandinavian measurements of height. The loss in height due to the curves was considered and added to the measured standing height. In a cross-sectional study it was observed that girls with scoliosis having late onset (after 10 years of age) were significantly taller than the controls. Even in some age groups the uncorrected height exceeded that of the controls. In contrast, those with early onset did not differ in height from the control group.

When the scoliosis was divided into three groups of severities ($< 20°$, 20–40°, $> 40°$) no differences in height were observed. Furthermore, a study of height velocity did not reveal any significant differences between girls with and without scoliosis after the age of 10, i.e. girls with scoliosis had to grow faster earlier in life. In conclusion, there seems to be a difference in growth pattern between adolescent scoliosis and children without this deformity.

SCOLIOTIC DEFORMITIES AND POWER TRANSMISSION OF THE SPINE—A SERIES OF UNIVERSAL JOINTS

F. Tideström (Linköping, Sweden)

The intervertebral disc may be considered as a universal joint and the whole spine as a series of such. This point of wiev makes it easier to understand not only the construction of the normal vertebra but also of scoliotic deformitics.

A model of universal joints indicates the locations of the wedged and of the twisted vertebrae. It demonstrates too the laws of clinotorsion as a result of combined bendings in the sagittal and the frontal planes. In the kyfotic thoracic curve the clinotwist exaggerates the effect of the lateral twist of the yellow ligament. This suggests to be the cause of the worst prognoses of the thoracic curves. The transversal processes of the thoracic curve are located in a relatively homogenous field of rotation and are of about equal length on each side. In the lumbar curve, on the contrary, the transversal process of the convex side is in a field of tension both in longitudinal and transversal direction and will be hypertrophic. On the concave side the situation is the opposite. The concave lumbar transversal process will be extremely small by inactivity.

MECHANICAL PROPERTIES OF COLLAGENOUS STRUCTURES IN PATIENTS WITH SCOLIOSIS

Anders Nordwall (Gothenburg, Sweden)

Several authors have proposed that an important factor in the etiology of idiopathic scoliosis is a change of metabolism of the body which may cause changes in the biomechanical functions, especially of the connective tissue. In this study the mechanical properties of the interspinous ligaments and the tendon of the erector spinae muscle were tested for elastic stiffness and breaking strength. The samples were obtained from 35 patients with idiopathic scoliosis and 15 patients with other types of scoliosis undergoing surgical correction according to the Harrington technique.

No significant difference in elastic stiffness could be found in interspinous ligaments from different levels of the spine, and the distance from the apex of the scoliosis was not of any importance. No difference existed between patients from the two scoliosis groups, nor was there any significant difference between the two scoliosis groups when strips of the muscle tendon were tested for elastic stiffness and breaking strength.

This study excludes mechanical changes in the connective tissue as the cause for idiopathic scoliosis.

DISCUSSION:

A. Nordwall (Gothenburg, Sweden)

Variation of biology and method do not permit study of small changes of the mechanical properties with this method. We therefore do further studies of the connective tissue from these patients with histological and biochemical analyses, and we also study the heat denaturation properties of the collagen. These properties are dependent on the biological age of the tissue on a molecular level, and are linked with its general mechanical properties.

GROWTH DISTURBANCE OF MUSCLE—A POSSIBLE FACTOR IN THE PATHOGENESIS OF SCOLIOSIS. EXPERIMENTAL STUDY

S. Hakkarainen (Helsinki, Finland)

Most methods used to induce experimental scoliosis are either operative or else produce scar tissue, which is also known to provoke scoliosis.

Table 1.

	Results	
	No.	Parameter of scoliosis
No scoliosis	38	0
Scoliosis, straightened	58	1
Constant scoliosis	52	2
Progressive scoliosis	80	3
Indistinct scoliosis	25	4
Total	253	

In 1902 Wullstein provoked scoliosis in two dogs by keeping them in a scoliosis position for several months by leather strips. On the other hand, it is known that if a muscle is kept immobilized for a long time in a position shorter than that at rest, it results in a myostatic contracture (Moll 1886, Davenport & Ranson 1929).

The present material consists of experiments made on 253 rabbits of 2–5 weeks. They were immobilized by a plaster cast in a scoliotic position for 2–5 weeks, the plaster being changed once a week. The development of scoliosis was recorded radiologically. The results are presented in Table 1. Scoliosis developed in 183 rabbits or 72 per cent. Scoliosis is more apt to develop the younger the animal is at the time of plastering and the longer the time spent in plaster.

The lengths of the intercostal muscles on the concave side were measured on preparations of part of the rabbits, and they were found to have shortened.

Seventy scoliotic rabbits were operated on by cutting the costotransversal ligaments and by removing the dorsal part of the intercostal muscles in 2–4 intercostal spaces on the concave side. Fat tissue was transplanted in the operated intercostal spaces to prevent cicatrization. Table 2 shows the distribution of the operated cases into different classifications of scoliosis and the effect of the operation.

Table 2.

		Parameter of scoliosis						
		0	1	2	3	4	Frequency	Per cent
		No. of experiments						
Parameter of operation	0			4	12		16	23
	1				8		8	11
	2				21		21	30
	3		3	9	2		14	20
	4			6	4	1	11	16
Frequency			3	19	47	1	70	
Per cent			5	27	67	1		100

(Parameter of operation: 0 = no effect, 1 = slight effect, 2 = cessation in progress of scoliosis, 3 = regression, 4 = indistinct effect). The result of the operation was positive in 61 per cent.

It is evident that in these experiments there is a muscle contracture on the concave side, and it seems natural that the same phenomenon would also be found in man in idiopathic scoliosis.

SPINAL FUSION AND THE CORRECTION OF THE EXPERIMENTAL SCOLIOSIS IN GROWING RABBITS WITH FREE PERIOSTEAL GRAFTS

V. Ritsilä, S. Alhopuro, O. Snellman & S. Hakkarainen (Helsinki, Finland)

Experimental attempts to produce solid fusion of the growing spine have generally been unsuccessful. Therefore, spine fusion experiments have failed to throw much light on the clinical problems of early spine fusion. In rabbits spinal fusion has been attempted but not achieved. Continued growth in length of the spines of young animals routinely occurs after spine arthrodesis, in which gross pseudarthroses have developed at each interspace.

In an earlier article by Veijo Ritsilä and Sakari Alhopuro, a bony fusion was achieved in different regions of the thoracic and lumbar spine with free periosteal transplants. In unilateral fusions this caused a progressive scoliosis.

In the present study this new model of spinal growth disturbance is used in attempts to correct experimental scoliosis provoked with other methods. When a progressive scoliosis has developed, free periosteal graft from the tibia of the same animal is transplanted to the convex side of the spine between the spinous and articular processes overlying the vertebral facets.

With this method we could achieve spinal fusion and stop the progression of experimental scoliosis. It is possible that in early fusion gradual straightening of slight or moderate scoliosis will take place.

DISCUSSION:

J. A. Sevastikoglou (Umeå, Sweden)

From the scoliosis symposium of this meeting it seems justified to draw the following conclusions as to the trends in the care of scoliotic patients in Scandinavia, the concentration of which in some few centers is under development. The use of the Milwaukee brace as the method of choice for the conservative treatment of the condition is spreading. Harrington's method is, on the other hand, used in several places, but other methods have also been tried for the operative treatment of scoliosis. The active attitude is thus adopted increasingly but the problem of scoliosis is yet not solved. There is, therefore, no place for dogmatism for our acting. Further research regarding the etiology and pathophysiology of scoliosis and the development of new principles and methods of treatment are necessary, and in this respect the activities of the institution headed by Dr. Langenskiöld are the only example to follow.

THE HIP

VARUS-ROTATION OSTEOTOMY IN THE TREATMENT OF PERTHES' DISEASE. A PRELIMINARY REPORT

L. E. Laurent (Helsinki, Finland)

In patients with Perthes' disease in which X-rays indicate "a head at risk" (Catterall 1971), conservative treatment gives bad results. The results of treatment

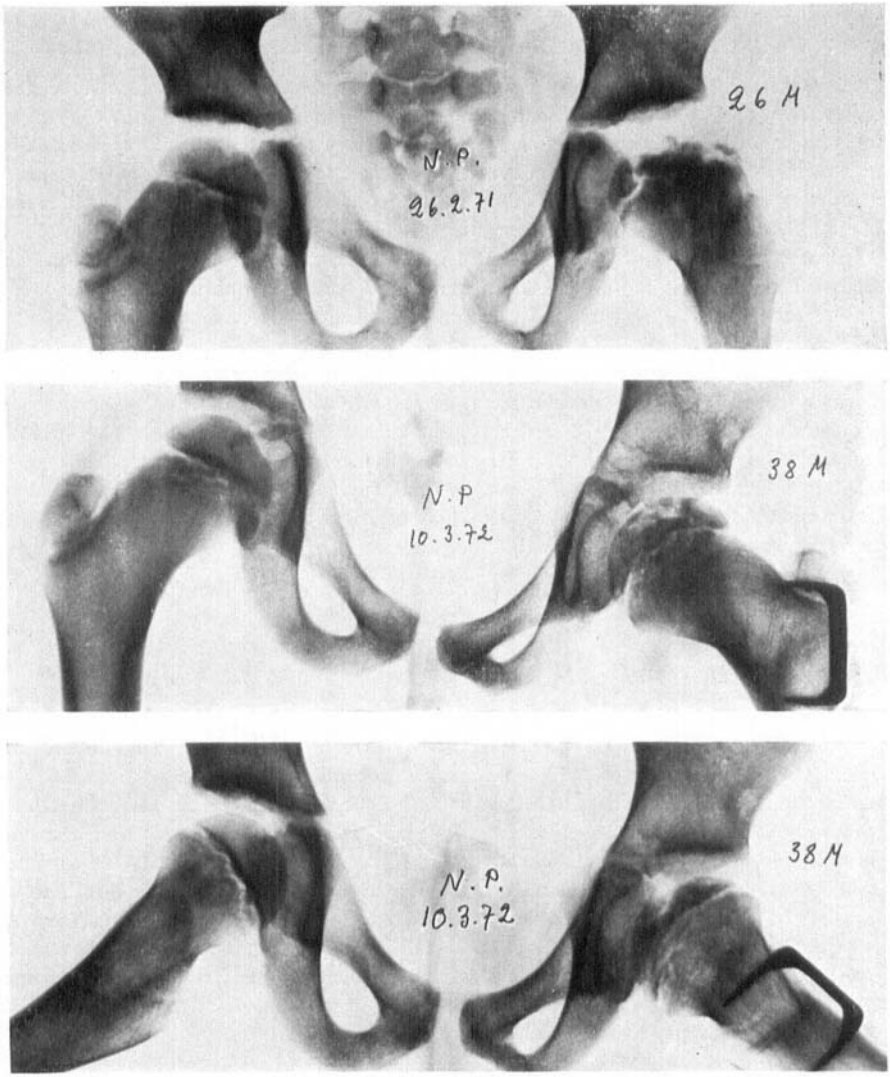

Figure 1.

with a Thomas splint at the Invalid Foundation Hospital were good in only about 50 per cent of the 165 cases followed up (Edgren 1965). Varus-rotation osteotomy with centering of the head into the acetabulum performed in good time seems to improve the results (Axer 1965, Somerville 1971). In my opinion, subluxation of the head is an absolute indication for osteotomy. The preliminary results of twenty hips with an observation time of one to two years after operation indicate that good results can be achieved if the osteotomy is performed before irreparable changes occurred. However, an osteotomy performed too early seems to be unable to prevent progression of the disease with recurrence of the subluxation. Even in cases where irreversible changes have already occurred, it is worth correcting the subluxation with an osteotomy because better congruence between the joint surfaces can still be achieved. In cases where the damage of the capital epiphysis has led to premature closure of the growth plate with a progressive coxa vara deformity, an epiphyseodesis of the greater trochanter should be performed (Langenskiöld & Salenius 1967).

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DEROTATION VARIZATION OSTEOTOMY IN THE TREATMENT OF PERTHES' DISEASE

S. Haraldsson (Reykjavik, Iceland)

At the Orthopaedic Clinic, Härnösand, Sweden, 27 subtrochanteric derotation varization osteotomies of the femur in 26 patients were performed between Sept. 1966 and Sept. 1971 for Perthes' disease. Osteosynthesis with metal plate. After 8 weeks in plaster cast full mobilisation with return to normal unrestricted life. Mean age 5.1 years in 20 boys and 6 girls. At the operation 14 hips showed the initial stage of Waldenström; 13 showed the fragmentation stage.

Review of 26 hips. Mean observation time 2.6 years. All patients were free from pain and lived a normal life without physical restraint. The osteochondrotic process at the review was healed in the first 10 hips, and in hips nos. 12 and 21. Thus, of these 12 hips in the growing period of Waldenström (healed but not full-grown), 9 had been in the initial stage and 3 in the fragmentation stage when operated upon.

Roentgenographic criteria at review (Table 1): (1) epiphyseal quotient of Sjöwall

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Figure 1. A boy, 6½ years old at diagnosis. Treated with a Thomas splint 26 months preoperatively. The preoperative radiograph shows significant subluxation and fragmentation. The preliminary result 12 months later is good.

Table 1. Derotation varization osteotomy in treatment of Perthes' disease. 12 cases healed at review.

Case no.[1]	Age at operation	Sex	Stage at operation (Waldenström)	Interval onset → 1st healed radiograph	Total involvement of nucleus	Duration of observation op → review	Anatomical result. Measurements from radiogr. at review			
							Epiphysial quotient %	Method of Mose	C–E angle	Classification
1	3 yr 8 mo.	female	initial	3 yr 9 mo.	yes	4 yr 10 mo.	87	20/20[2]	30/35[3]	good
2	6 yr 7 mo.	male	initial	4 yr 3 mo.		4 yr 6 mo.	83	24/26	15/25	fair
3	7 yr 6 mo.	female	initial	3 yr		4 yr 7 mo.	65	26/28	35/50	fair
4	3 yr 8 mo.	male	fragmentation	4 yr 6 mo.	yes	4 yr 6 mo.	80	22/22	25/30	good
5	5 yr	female	initial	3 yr 2 mo.	yes	4 yr	98	20/20	25/25	good
6	4 yr 2 mo.	male	initial	3 yr 10 mo.	yes	3 yr 7 mo.	90	20/20	25/25	good
7	2 yr 8 mo.	male	initial	1 yr 8 mo.	yes	3 yr 5 mo.	92	16/16	25/25	good
8	7 yr 1 mo.	male	initial	2 yr 7 mo.	yes	3 yr 4 mo.	92	20/20	30/30	good
9	5 yr 4 mo.	male	initial	2 yr 5 mo.	yes	3 yr 1 mo.	72	20/20	20/25	fair
10	4 yr 8 mo.	female	initial	1 yr 9 mo.	yes	3 yr 1 mo.	93	16/16	25/30	good
12	6 yr	male	fragmentation	3 yr 1 mo.		2 yr 8 mo.	84	16/16	20/25	good
21	3 yr 3 mo.	female	fragmentation	1 yr 7 mo.	yes	1 yr 9 mo.	78	12/12	25/25	good

[1] Of 27 hips operated upon 12 showed growing period of Waldenström at review (healed but not full-grown).

[2] The two figures are frontal view/lateral view.

[3] The operated hip is given first.

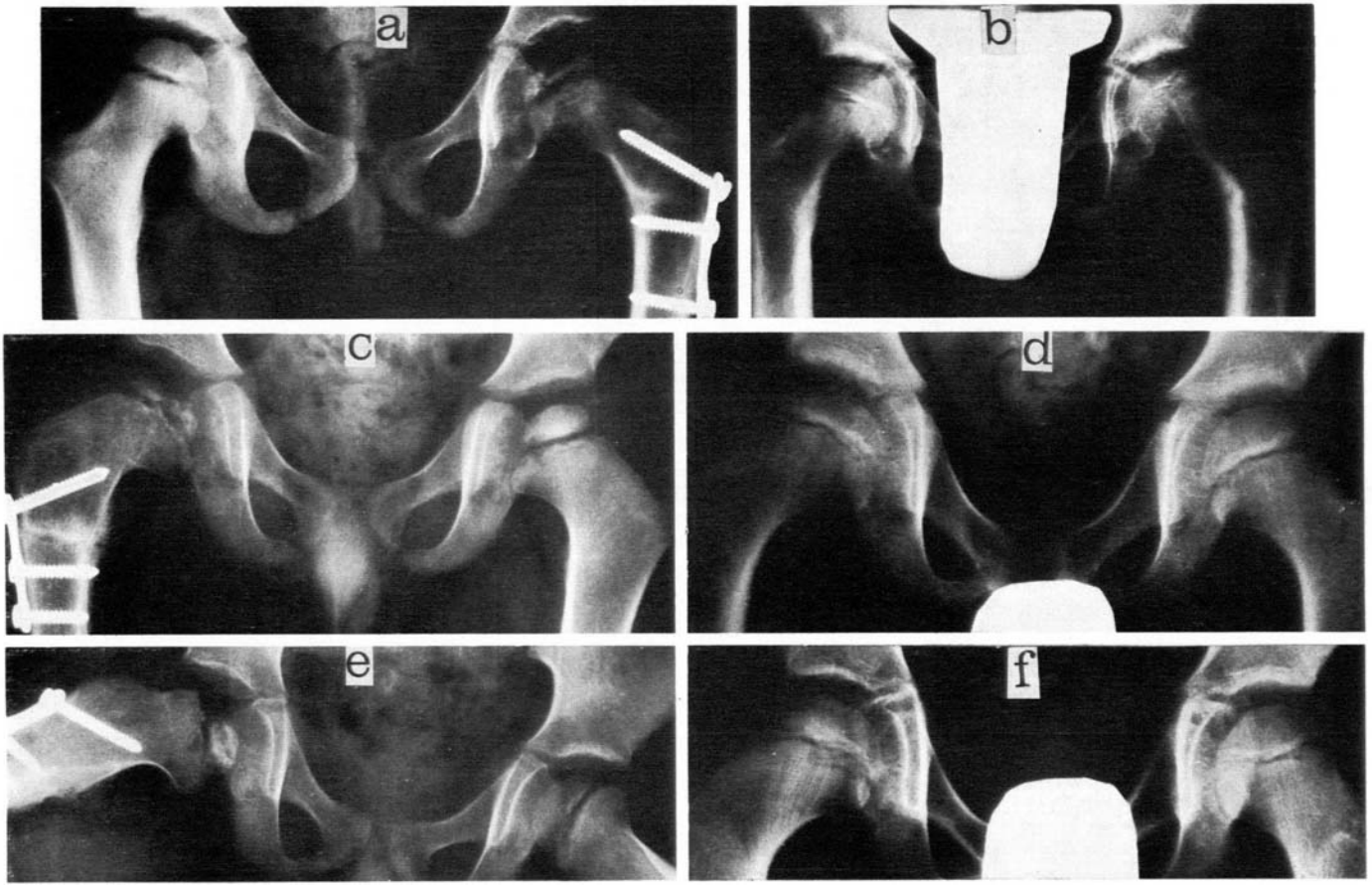


Figure 1. Results after osteotomy. A *Hip 1. Fragmentation stage.* B *Hip 1. Healed. E.Q. 87 %.* C *Hip 4. Healing period.* D *Hip 4. Healed. E.Q. 80 %.* E *Hip 6. Fragmentation stage.* F *Hip 6. Healed. E.Q. 90 %.*

(assessment of flattening); (2) concentric circle template method of Mose (spherical shape); (3) C-E angle of Wiberg (spatial relation head/acetabulum).

According to these criteria the anatomical results were classified as good in 9 and fair in 3 of the 12 hips healed at review (Table 1).

Compared with the results after prolonged conservative treatment, these preliminary results after a therapeutic measure lasting 2–3 months are considered sufficiently favourable for continuation on the described therapeutic line.

HIGH FEMORAL OSTEOTOMY AS TREATMENT FOR OSTEOARTHRITIS OF THE HIP JOINT

H. Appel & S. Friberg (Umeå, Sweden)

During the period of 1959–69, 161 high femur osteotomies were made in 147 patients at the Department of Orthopaedic Surgery in Umeå, Sweden. Three different methods of osteotomy were used. These three methods were performed during different periods of time and no selection of cases to a specific method were made.

Method 1. Varisation or valgisation osteotomies with internal fixation.

Method 2. Transverse osteotomy *without dislocation* after internal fixation with nail and plate (Nissen).

Method 3. Subtrochanteric Z or L osteotomy *without dislocation* and internal fixation with screws.

Results of follow-up examination:

	No. of hips	Obs. time	Total relief of pain at rest	Total relief of pain on motion	Patients' assessment improved
Method 1.	36	6:6	66 %	30 %	69 %
Method 2.	27	9:4	62 %	22 %	70 %
Method 3.	49	6:4	65 %	24 %	78 %

The results clearly show that the high femoral osteotomy has a good and lasting effect on pain at rest and that the long-term effect on weight-bearing pain is less prominent. No statistical differences exist between the three different operative methods.

These results cannot be explained by the purely "mechanical" theories of effect of an osteotomy (Pauwels, Blount). On the contrary, they support the theories of an effect of the osteotomy on the vascular supply to or drainage from caput femoris (Helal, Nissen, Phillip, Arnoldi et al.).

DISCUSSION:

Hans N. Gregersen (Ålborg, Denmark)

Question to Helge Appel & Sven Friberg.

From your figures we saw no difference in the results of treatment whatever type of osteotomy you used.

Do you think you would obtain the same results if you used a simple myelotomy?

S. Friberg (Umeå, Sweden)

About 10 myelotomies were performed in Umeå during the period of 1959–61. The immediate results were good, but rapid reappearance of the preoperative symptoms in one to two years were found. However, in theory a myelotomy should be just as good as an osteotomy, and further investigation of the effect of a myelotomy on the patients' symptoms and on the intramedullary hypertension are now undertaken in Umeå.

EXPERIENCES WITH A HUNDRED SUBTROCHANTERIC VALGUS-OSTEOTOMIES

Knud Jørring & Rasmus Movin (Copenhagen, Denmark)

During the period 1961–1971, 102 patients had subtrochanteric valgus-osteotomy performed at the Surgical Department A, Frederiksberg Hospital, Copenhagen.

The operation was carried out by a method earlier published by Movin in the Danish Society of Surgeons.

The procedure was performed on 79 patients with sequelae after fracture of the neck of the femur, and on 23 patients with osteoarthritis of the hip.

Eighty-three of the patients underwent a postoperative clinical and radiological examination with an observation time of at least one year.

All osteotomies healed. In one case re-operation was necessary 7 months after the primary operation to achieve healing.

The procedure had a satisfactory effect on the often disabling pains of the patients, but the mobility of the joint and the walking capacity was not influenced accordingly.

The incidence of deep infection in this series was high (6 per cent). In all 6 patients it caused removal of the osteosynthetic material. The osteotomies healed but the results had considerably deteriorated.

In consequence of this complication our operating room conditions have been revised.

THE FIRST HUNDRED INTERTROCHANTERIC DISPLACEMENT OSTEOTOMIES WITH THE NEW COMPRESSION PLATE

P. Salenius (Helsinki, Finland)

Despite recent developments in the treatment of painful osteoarthritis of the hip joint, particularly by means of artificial joints, intertrochanteric displacement osteotomy still has its place, especially in the treatment of young patients. Stable internal fixation is an absolute necessity for complete and rapid recovery after intertrochanteric displacement osteotomy.

Three years ago, at a meeting of the Finnish Surgical Association, I introduced a compression plate which I had used for several years and which I had published in the *Journal of Bone and Joint Surgery* in 1970. The plate is of stainless steel in one size only, and is manufactured by Zimmer in England.

The fitting of the plate is usually very simple. The hook at its upper end is fitted over the greater trochanter and pulled downwards with a forceps. The plate is fixed with two AO-screws to the proximal fragment of the osteotomy. After fixation of the proximal fragment an AO-type compression device is fitted to the distal end of the plate, and the fragments are pressed together. It is now important

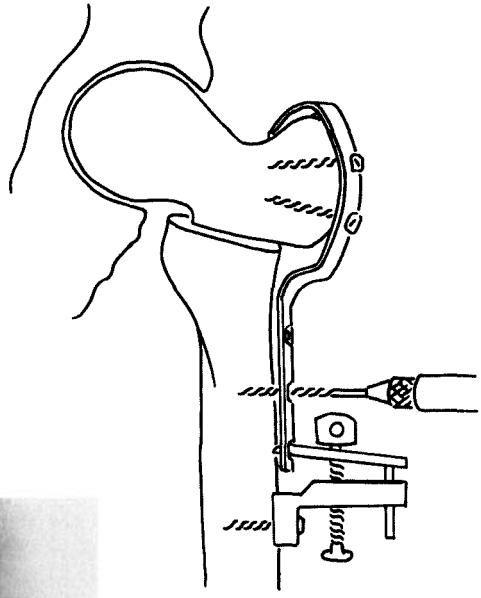


Figure 1: The fragments of the osteotomy are compressed together with an AO-compression device. The hook of the plate must rest on the trochanter. A very good compression and stable fixation is usually obtained.

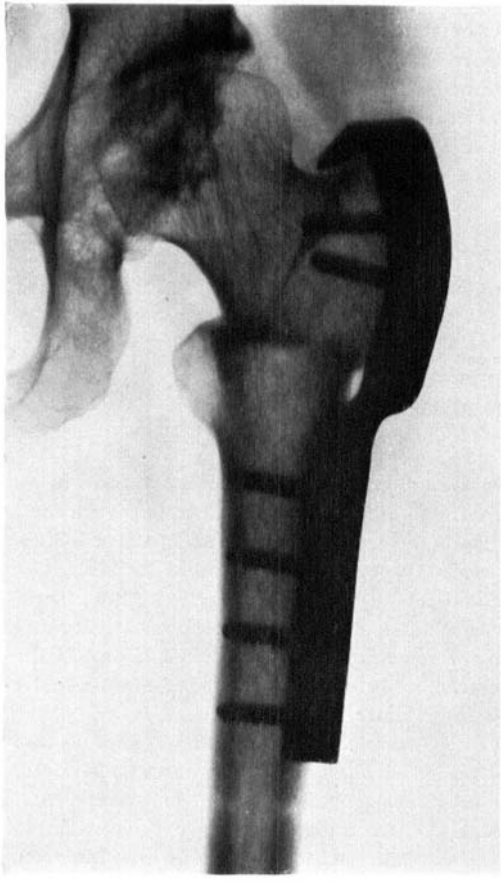


Figure 2: About 40 % of the osteotomies consolidated in 6 weeks as did this case, and the majority in less than three months. Only one non-union occurred in the series of the first 105 osteotomies (0.95 %).

that the hook at the upper end is immediately over the trochanter so that the compression force rests on the trochanter and not on the two upper screws (Figure 1). The fragments are then compressed together and the distal fragment is fixed to the plate with AO-screws.

Until now, about 300 osteotomies have been performed with this plate, beginning in 1968. The first 105 osteotomies are analysed here. There was only one non-union, a patient who refused weight-bearing and who had used cortisone for her rheumatoid arthritis. One-third of the patients left the hospital in less than two weeks. Full weight-bearing was started 6–8 weeks after the operation. At this stage about 40 per cent of osteotomies were considered consolidated (Figure 2). The majority, about 65 per cent, were considered consolidated in less than three months.

On the basis of this follow-up examination of the first hundred intertrochanteric osteotomies, the new compression plate may be recommended for internal fixation of the intertrochanteric displacement osteotomy of the femur.

LOCAL AMLOID DEPOSITS IN THE FIBROUS CAPSULE IN CASES OF OSTEOARTHRITIS OF THE HIP

K. Harry Sörensen & H. E. Christensen (Odense, Denmark)

At the Department of Orthopaedic Surgery and the Institute of Pathology, Odense Hospital, Denmark, 60 biopsies from the hip joint capsule removed after total hip replacement (Charnley) were examined from November 1970 to May 1972.

In 19 biopsies amyloid was histologically demonstrated in the fibrous capsule after staining with alcaline Congo red and demonstration of green dicroism with polarized light. In cases of primary idiopathic osteoarthritis, amyloid was found 3 times more frequently in men than in women. By rectal biopsy, examination of the bone marrow, serological tests for rheumatoid arthritis, and serum-protein examination and clinical examination for rheumatoid arthritis and myelomatosis were excluded, for which reason it was a question of quite local occurrence of amyloid.

There was no correlation between age, duration or the degree of severity of the osteoarthritis (Merle d'Aubigne's scale) and the occurrence of amyloid or the quantity of this, and there was no correlation between amyloid and possible simultaneous occurrence of hyalinization or inflammation or previous injection of hydrocortisone.

DISLOCATION OR SUBLUXATION OF THE HIP FOLLOWING IMMOBILIZATION OF THE KNEE IN EXTENSION IN YOUNG RABBITS

J.-E. Michelsson & A. Langenskiöld (Helsinki, Finland)

The effect of immobilization of a leg on the hip in growing rabbits was investigated. In 85 one- to eight-week old rabbits, one or both hind limbs were immobilized with the knee in extension and the hip free and movable. In almost all of the rabbits a dislocation or subluxation gradually developed. The development of the changes in the hip was dependent on the age of the animal and the duration of the immobilization. The younger the animal and the longer the duration of the immobilization, the more marked were the changes in the hip. After a short period of immobilization a partial or complete regression of the changes in the

hip developed. The extension of the knee led to increased tension in the hamstring muscles. If these muscles were cut and an immediate subsequent immobilization was performed, no or only slight changes in the hip of the immobilized limb developed. The present investigation shows that in young rabbits simple immobilization of the knee in an extended position leads to changes resembling congenital dislocation of the hip in man. These facts contribute to clarify the unclear pathogenesis of human congenital dislocation of the hip.

INTRAVITAL OXYTETRACYCLINE LABELLING OF THE HUMAN FEMORAL HEAD

P. Rokkanen & P. Slätis (Vasa, Finland)

The viability of the femoral head after subcapital fracture of the neck has previously been evaluated by arteriography, venography, bone-seeking isotopes and various intravital staining techniques. None of these has been routinely used, and the condition of the femoral head is still usually evaluated from plain radiographs.

Intravital labelling of the femoral head by parenteral administration of oxytetracycline prior to surgery was done in 69 patients with subcapital fractures of the femoral neck. The femoral head and an appropriate part of the femoral neck was replaced in all cases by a metallic endoprothesis.

In fresh fractures fluorescence microscopy of the removed and methyl-metacrylate-embedded specimens revealed an almost complete lack of oxytetracycline uptake indicating severely impaired nutrition of the cancellous bone. Two exceptions from this were noted: uniform fluorescence, obviously due to transchondral uptake from the synovial fluid, was observed subchondrally in a marrow zone beneath the hyaline cartilage. Secondly, fluorescence was observed in inveterate cases in areas of recent bone repair.

It is concluded that the viability of the femoral head after subcapital dislocated fracture of the neck is uniformly and seriously impaired.

INTRACAPSULAR FRACTURES OF THE FEMORAL NECK TREATED WITH CHRISTIANSEN'S HIP PROSTHESIS WITH TRUNNION-BEARING

J. Aamold & U. Slungaard (Oslo, Norway)

In the Orthopaedic Department, Aker Hospital, Oslo, 61 patients with dislocated fractures of the femoral neck were treated with primary replacement arthroplasty during the period April 1969 to January 1972 with insertion of the Tor Christiansen trunnion-bearing endoprosthesis. Most of the patients were more than 70 years of age. The operation was done through a posterior approach and early full weight-bearing was allowed. There were no technical complications and no deep infections. 5 patients died within 2 months after the operation and 6 other patients had died before the follow-up. The average length of follow-up was 11.2 months. All 50 living patients were examined. According to Love's criteria, 30 patients (60 per cent) were classified as excellent, 11 patients (22 per cent) as good and 9 patients (18 per cent) as fair. Some of the patients classified as "fair" were put in this group because of other factors than the results of the hip operation, e.g. hemiplegia.

We find the results encouraging and will continue to use the Christiansen hip prosthesis in cases where we find primary replacement arthroplasty indicated.

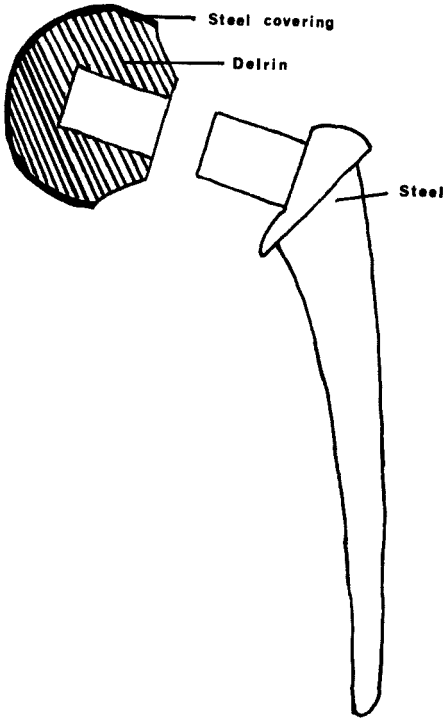


Figure 1.

TROCHANTERIC FRACTURES OF THE FEMUR TREATED WITH A KÜNTSCHER NAIL

E. B. Riska & M. Lyytikäinen (Helsinki, Finland)

Twenty-three patients with pertrochanteric fractures were treated with a Küntscher nail inserted through the medial femoral condyle after reduction of the fracture on the operating table under general anesthesia. Three were male and 20 female with an average age of 77 years. Four of the patients had a comminuted pertrochanteric fracture.

Mobilization of the patient was started on the day after the operation and full weight-bearing was allowed directly. 18 patients left the hospital within four weeks, 4 of them as dead. 5 of the patients were hospitalized between 5 and 8 weeks.

Good union of the fracture was verified in 12 cases within 2 months, in 3 cases within 3 months, and in 4 cases within 4 months after the operation. Good result of treatment was achieved in 19 cases (Table 1, Figure 1). Four patients died within 2 weeks, two of pulmonary thromboembolism, two of heart infarction. No infections were recognized.

The trochanteric Küntscher nail gives a good fixation of a pertrochanteric fracture, but the reduction of the fracture before nailing must be good and roentgen television is imperative for the procedure. Early mobilization of the patient is possible and full weight-bearing on the operated extremity is directly allowed. The results of treatment are good. Our small material confirms the good results

Figure 1. A woman of 70 years with a pertrochanteric fracture of the femur treated with a Küntscher nail inserted through the medial femoral condyle. To the left before operation, to the right two years after the operation. Good union of the fracture.

in 88 patients presented by Küntscher in 1969 and encourages us to continue with this method in the treatment of stable pertrochanteric fractures, but some instable or comminuted pertrochanteric fractures can also be treated with this method.

Table 1. Results and complications of the treatment of 23 patients

Result and complication	Number of patients
Union of the fracture within	
2 months	12
3 months	3
4 months	4
Good result of the treatment	19
Primary mortality	4
Infections	0
Tromboembolic disease	0 (2)

DISCUSSION:

L. Hult (Stockholm, Sweden)

I would like to mention briefly a similar method for trochanteric fractures where intramedullary inserted elastic condyl nails described by Josef Ender in Austria are used. The nails are 35–49 cm long and 4½ mm thick and are bent in a manner to be suitable for the purpose. After closed reduction of the fracture the first nail is inserted intramedullarly from the medial femorial condyle and under X-ray television brought up through the fracture area up into the femoral head. To get good stability another 1–3 nails are inserted. It is important that the nail length be exact, and it is very easy to change the first nail if it is too long or too short after the second nail has been inserted. The fixation is very stable and allows early weight-bearing. We have used this method on more than 100 cases during the last year in Södersjukhuset in Stockholm and are very satisfied because the intervention is easy and quick, gives very little bleeding and is not stressing for the patient. The healing seems to be quicker and safer than with the ordinary nail and plate. I also feel that these nails are easier to use than the Küntschner nail.

SUBCAPITAL FRACTURES OF THE FEMUR TREATED WITH TWO THIN SMITH-PETERSEN NAILS

E. B. Riska & M. Lyytikäinen (Helsinki, Finland)

Twenty-four patients with subcapital fractures of the femur were treated with two thin Smith-Petersen nails. 6 were male and 18 female with an average age of 42 (range 18 to 66) and 68 (range 40 to 89) years, respectively. 8 patients had a stable Pauwels I type fracture, 8 Pauwels II type fracture, and 8 an instable Pauwels III type fracture of the femur.

Sixteen patients were hospitalized less than two weeks, 8 between 3 and 4 weeks, and one patient 9 weeks. 10 patients were allowed full weight-bearing of the operated limb within one month, then within 2 months, and 4 after 5 months postoperatively. Because of short follow-up times only primary results could be presented, but in 14 cases the follow-up period was over 12 months.

In 23 cases good union of the fracture was recorded (Table 1, Figure 1). Thrombophlebitis was noticed in one case, and postoperative infection in one case, who

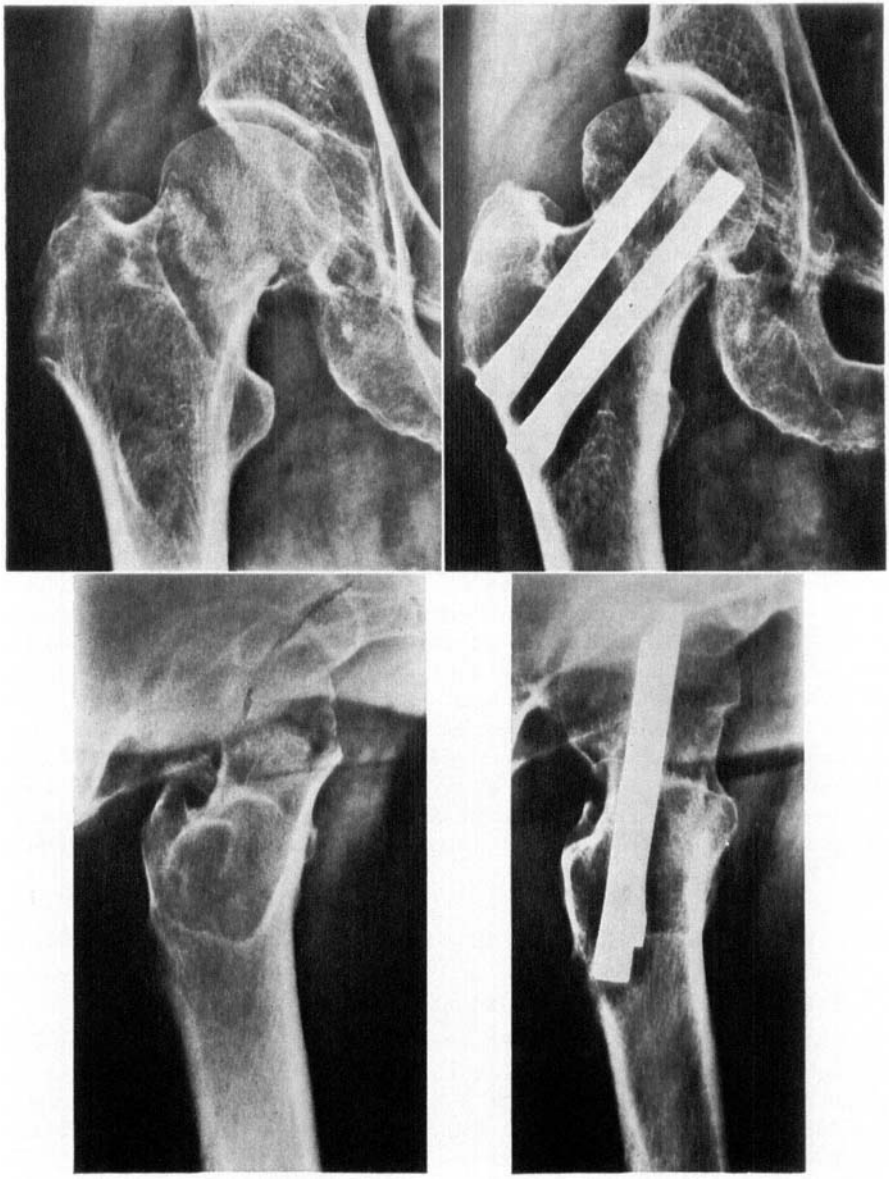


Figure 1. A woman of 45 years with a subcapitale Pauwels II type fracture treated with two thin Smith-Petersen nails. To the left before the operation, to the right one year after the operation.

Table 1. Primary results and complications of the treatment of 24 patients with two thin Smith-Petersen nails

Result and complication	Number of cases
Good union of the fracture	23
Died within five months	0
Thromboembolic disease	1
Infection	1
Pseudarthrosis	1

developed a pseudarthrosis of the femoral neck. In all other cases the movement on the hip joint was normal at the time of the last follow-up examination, and the patients walked without limp.

This method with two thin Smith-Petersen nails was presented because it is simple and easy to perform for every orthopaedic surgeon. Roentgen television is beneficial for the nailing procedure. A good reduction of the fracture before nailing is imperative. The method is suitable especially for younger cases, but also for older patients with subcapital fractures of the femur which are not treated with an endoprosthesis.

THE PELVIS

ARTERIAL INJURY IN FRACTURE OF THE PELVIS

V. M. Huittinen & P. Slätis (Helsinki, Finland)

Following Miller's suggestion (1963), several reports were presented on ligation of the hypogastric arteries to control severe haemorrhage within the fractured pelvis. There is no firm evidence, however, about the frequency or site of arterial injury associated with pelvic fractures, and indications for surgical intervention are in dispute.

In 27 medico-legal autopsies on accident victims with pelvic fractures, selective angiograms of the hypogastric arteries were done with a Micropaque gelatin solution. In 23 of these, injury to the arteries and extravasation of the radiopaque material could be demonstrated. The arterial injury was bilateral in 17 cases, unilateral in 6 cases and comprised three or more simultaneous lesions in 14 cases. The most frequent sites of leakage were in the immediate vicinity of the sacro-iliac joint and the sciatic notch (17 cases) and in the area of the urogenital diaphragm (6 cases). The major part of the haemorrhage occurred retroperitoneally, but in severe injuries the haematoma extended along the piriformis muscle through the sciatic foramen into the gluteal region.

The results of the present series show that ligation of the hypogastric artery should always be bilateral. Whether this procedure will arrest further bleeding is doubtful in cases with either multiple arterial injuries or extensive damage to the bone and adjacent structures. Reduction, with firm apposition of the profusely oozing bone fragments against each other, is obviously an important step in attempts to control bleeding. Routine procedures in these situations comprise adequate blood volume replacement, early reduction of the pelvic fracture

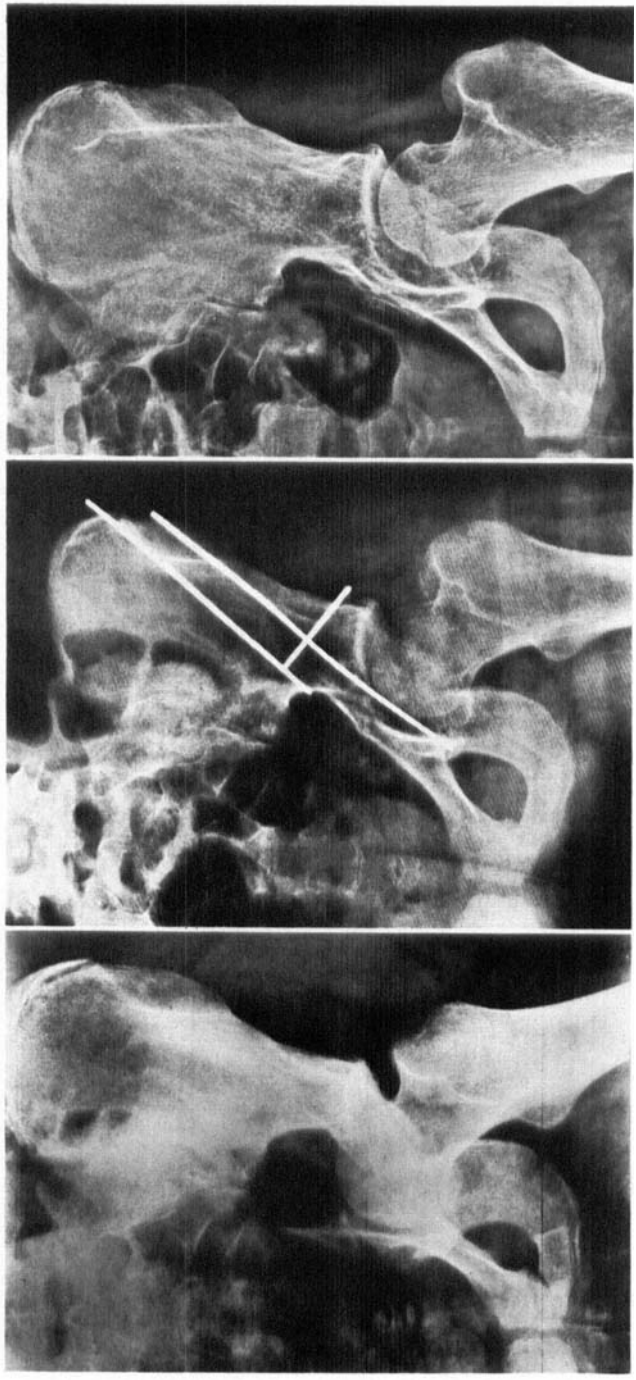


Figure 1. A woman of 22 years with an instable pelvic fracture treated operatively with pin fixation. The fracture and luxation of the femoral head to the left. Situation after pin fixation in the middle, and 19 months after the operation to the right.

and support of the girdle in a pelvic sling. If the bleeding still continues, bilateral ligation of the hypogastric arteries may be considered.

OPERATIVELY TREATED PELVIC FRACTURES IN 26 PATIENTS WITH MULTIPLE INJURIES

E. B. Riska & M. Lyytikäinen (Helsinki, Finland)

Instable pelvic fractures of 26 patients with multiple injuries were treated operatively between 1969 and 1971. 19 patients were male and 7 female with an average age of 38 years, 24 had a traffic accident, 2 fell from height. 12 patients had a comminuted fracture of the acetabulum, 12 comminuted fracture of the pelvis, one an instable hemipelvic fracture, and one a rupture of symphysis and the sacro-iliac joint. In 13 patients a cerebral concussion was recorded as an associated injury, 4 patients had in addition to the pelvic fracture hemopneumothorax, 11 patients rib or sternal fractures, 4 flail chest, 7 patients intra-abdominal injuries in need of urgent surgical treatment. 13 long bones and 9 short were broken. Rupture of ligaments in the knee joint was noted in 4 patients and a rupture of a big artery in 2 patients. In addition 20 patients had multiple lacerations and wounds, 2 ocular injury, and 5 got a thromboembolic disease. Because of multiple injuries most of the patients were treated during the first days in an intensive care unit.

In 21 patients the pelvic fracture was osteosynthetized with Vitallium or AO-screws, in three with AO-plates and screws, in one case with Supramid and in one case with Johansson pins (Figure 1). 13 patients were mobilized within 4 weeks, but 11 only within 7 weeks.

All 26 patients were followed up, 17 of them over 1½ years after the accident. 19 of 26 patients were back to their former work (Table 1); 14 patients had almost normal range of movement of their hip joints. No deaths were recorded. At the follow-up examination 7 patients were unable to work, but 2 of them were over 65 years of age. 10 patients had pains in their hip joint and limited range of movement. In 7 cases osteoarthritis of the hip joint was recorded in need of additional treatment later.

Considering the severe multiple injuries, the result of treatment, especially the operative treatment of the pelvic fracture, was good. The rigid osteosynthesis of

Table 1. Results and Complications of the Treatment of 26 Patients with Multiple Injuries and Operatively Treated Pelvic Fractures

Result and complication	Number of patients
Back to work	19
Almost normal hip joint	14
Mortality	0
Still unable to work	7
Pain in the hip joint and reduced mobility	10
Secondary osteoarthritis	7

the instable pelvic fracture allows early mobilization of the patient which is imperative for the good result of treatment of other injuries, e.g. fractures of long bones and chest injuries. The disability was slight in 19 patients, who were back to work, but after ten years the situation might be different.

SHOULDER SYMPOSIUM

EXPERIENCES IN OPERATIVE TREATMENT OF PERFORATING RUPTURES OF THE ROTATOR CUFF

G. Bakalim & M. Pasila (Helsinki, Finland)

The series consists of 55 patients with perforating rupture of the rotator cuff, operatively treated at the Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, in 1960–1970. The majority (45/55) were 40–59 years old. Three patients were under 40, 7 over 59. The indication for operation was painful weakness of the shoulder joint and nocturnal pain. In general, ruptures of the rotator cuff were conservatively treated. Of 193 patients treated at the Department of Physiotherapy in 1960–1965, only 24 were operated upon. Operative

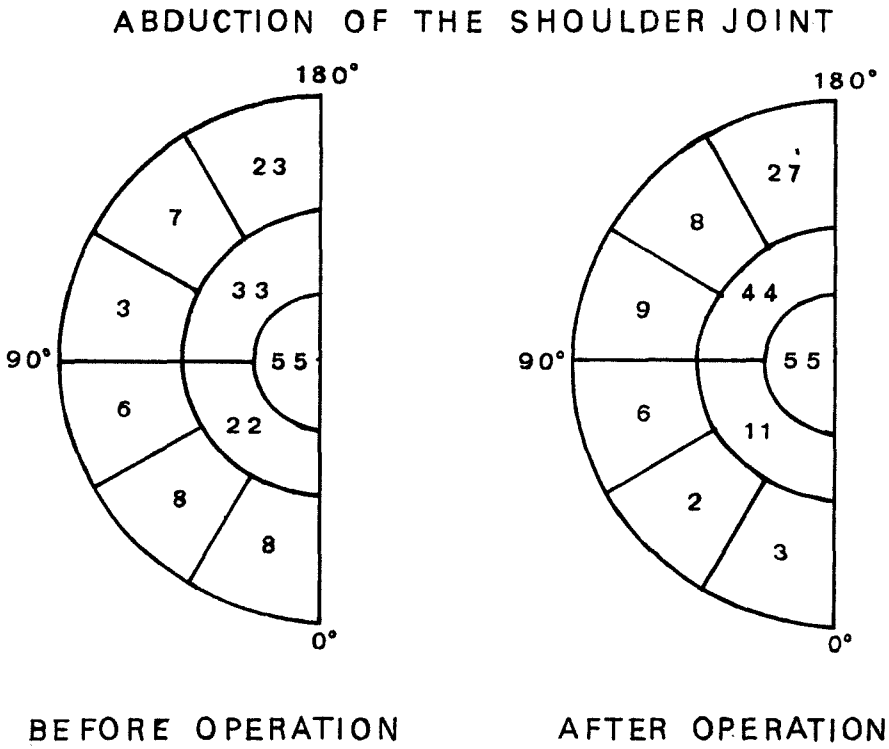


Figure 1.

repair was chiefly attempted in patients in heavy labour whose response to physiotherapy was unsatisfactory. It was a condition that passive abduction should be almost complete preoperatively.

Over half the patients (30/55) were operated on during the first 3 months, 43/55 during the first 6 months. Only 12/55 were operated on later. In 23/55 cases the rupture was large (over 3 cm). Acromion resection varying in extent was done alone 16 times, in conjunction with repair of the rotator cuff 20 times. Acromion resection alone was seldom (6/40) performed sooner than half a year after injury, more often (10/15) later. Repair of the rotator cuff was the only procedure in 19 cases.

Postoperative improvement of active abduction in the total series is shown in Figure 1. Abduction was impaired in some cases. Impairment was infrequent (1/19) in cases treated by repair of the rotator cuff alone, more frequent (8/36) when acromion resection was performed.

As regards the end results, particular attention was paid to return to heavy labour. 23/44 patients returned to heavy labour (Table 1). All of 4 patients operated on within a month, 13/32 operated on within 6 months, and 6/8 operated on later, returned to heavy labour.

Table 1. Unfitness for work and return to heavy work.

	Duration of unfitness for work			Total
	3 months	3–6	6–9	
Returned	11	10	2	23
Not returned				21
Total				44

OPERATIVE OR CONSERVATIVE TREATMENT OF TOTAL DISLOCATION OF THE ACROMIOCLAVICULAR JOINT

G. Bakalim & E. Wilppula (Helsinki, Finland)

A follow-up investigation was performed on 41 patients with total dislocation of the acromioclavicular joint, treated at the Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, in 1963–1969. The average follow-up time was 4.3 years. Nineteen patients were surgically treated, 22 conservatively. The procedures performed were repair of the coracoclavicular ligament and fixation of the acromioclavicular joint by a Kirschner wire. In the conservatively treated cases a dressing was applied to aid reduction of the acromioclavicular joint.

The shoulder was immobilized for an average of 5 weeks postoperatively, for 3 weeks in the conservatively treated cases. The operatively treated patients were unfit for work for an average of 12 weeks, the conservatively treated patients for 5 weeks.

The end results were evaluated on the basis of the patient's subjective symptoms (pain on effort, change of occupation) and objective findings at follow-up examination (instability of the acromioclavicular joint and related tenderness, range of motion of the shoulder joint, strength on abduction, radiological appearance). A

Table 1.
End results at complete acromioclavicular dislocation in the whole material.

Anatomical results	Functional end results Good	Poor	Total
Exact reduction	13	2	15
Partial dislocation	5	3	8
Complete dislocation	9	9	18
Total	27	14	41

Table 2. End results according to treatment in the whole material of complete acromioclavicular dislocations.

Treatment	Good	Poor	Total
Operative	14	5	19
Conservative	13	9	22
Total	27	14	41

good functional end result correlated with a good anatomical end result (Table 1). A good anatomical result was more frequent in the operatively treated group. Somewhat better results were achieved by operation than by conservative treatment (Table 2). Arthrosis of the acromioclavicular joint was in general slight and showed no correlation with the functional results.

DISLOCATIONS OF THE ACROMIOCLAVICULAR JOINT TREATED WITH CORACOCLAVICULAR CERCLAGE. A TEN-YEAR FOLLOW-UP STUDY

A. Ejeskär (Gothenburg, Sweden)

Sixty-five cases of dislocations of the acromioclavicular joint treated at the Department of Orthopedic Surgery I, Sahlgren Hospital, Gothenburg, Sweden, and uniformly operated with a coracoclavicular cerclage wire have been analysed. 8 patients were dead at the time of the follow-up. Of the remaining 57, 54 have been personally re-examined 6–12 years after the trauma (average 9.6 years). There were 11 subluxations and 43 luxations.

Pain, sense of weakness, deformity, limitation of mobility in elevation, abduction and rotation, together with reduction of muscle strength were factors used for classifying the results. The muscle strength was measured with Zadig's dynamometer. The patients were divided into four categories, excellent, good, acceptable and poor.

The conclusions of the study were as follows:

1. Results were acceptable or better in 90 per cent.
2. A tendency of reduced strength in abduction and elevation was noticed in the injured shoulder, although the figures were not statistically significant.
3. Arthrotomy makes the reposition easier but is probably also important for a good end result.

4. The cerclage wire should not be removed routinely.
5. No case of definite posttraumatic arthrosis was recorded.
6. After trauma the joint can be remodelled from a vertical type to a more horizontal one.

DISCUSSION:

Knud Jansen (Copenhagen, Denmark)

A recent follow-up study performed by Dr. Rosenørn on cases treated by primary operative treatment did not reveal similar excellent results as reported here.

In conservative management the problem is to offer effective and tolerable bandages.

In late cases I have had good results with the Dewar operation and with acromioclavicular fascial cerclage.

Recently, the plasty applying the coracoacromial ligament seems to offer promising results.

The angle of the joint is most interesting, in particular whether the sloping joint is a primary finding or a sequel to dislocation.

DISCUSSION:

H. G. Edeland (Gothenburg, Sweden)

In some instances of dislocations of the acromioclavicular joint, ligamentous structures carrying the nerves to the joint are ruptured, above all branches of the suprascapular and supraclavicular nerves. This probably explains why pain most often is not the dominant trouble with persistent joint dislocation.

A. Eieskär (Gothenburg, Sweden)

I recommend arthrotomy because in several patients where this was not done the joint was still dislocated at the end of the operation. Arthrotomy ought to prevent this.

X-ray examination under stress in order to diagnose a dislocation in the acromioclavicular joint is of limited value. If one is to use the method it must be a passive stretching in both arms. The patient should not actively carry weight.

FRACTURES OF THE SCAPULA WITH GREAT COMMUNITION AND DISPLACEMENT

V. Damholt & D. Zdravkovic (Odense, Denmark)

660 patients with fractures of the scapula were treated conservatively. Most of the patients had multiple lesions and had received severe injury. 40 patients had fracture at the upper lateral angle with serious dislocation and communition. These 40 patients were especially examined.

The results after conservative treatment were good. All the fractures were healed. No patients had limitation of strength and the mobility in the shoulder was only limited in few cases. Deformity was still seen in x-ray but only one had clinical deformity.

FRACTURA SCAPULAE

H. N. Gregersen (Ålborg, Denmark)

During a period of 11 years, 63 patients with fracture of the scapula were treated as inpatients at the surgical departments at Aalborg Sygehus Syd, Denmark. There were 50 males and 13 females. The frequency of the fractures was evenly distributed in age groups. 16 patients had the scapula fracture as the only lesion, 47 patients had other lesions in addition. Traffic accidents were the causing factor in 80 per cent of the cases.

The results were examined after an average observation time of 5½ years. One patient died during the observation time. The patients were questioned about pain in the shoulder and were examined for mobility.

It appeared that 38 patients were without pain, 17 patients had slight pain, and 7 patients had severe pain. 50 patients had free movement, 6 had slightly impaired function, and 6 had severely impaired function of the shoulder. The poor results regarding both pain and function were seen in patients with fractures through or close to the shoulder joint. Fractures of the clavicula, neck or shaft of the humerus did not influence the results. 4 patients (2 with paralysis agitans, 1 with cancer metastases to the scapula, and 1 with previously operated cervical disc herniation) showed poor results.

FOUR SEGMENT FRACTURES OF THE HUMERAL NECK

S. Pilgaard & A. Öster (Århus, Denmark)

A study of 21 four-segment proximal fractures from the County Hospital and Municipal Hospital in Århus, re-examined from 5 months to 15 years after the accident, is presented. Half the patients were more than 60 years of age at the fracture sustaining. Four were treated by closed treatment. 17 were operated upon (in three cases the humeral head was removed, four were Rush nailed, one was treated with cerclage only, three with Lane or AO plates and six received primarily the Neer prosthesis).

Closed reduction was found inadequate for active, healthy patients, in which case open reduction was preferred. In open reduction the best results were obtained in the patients treated with Rush nailing, plates or Neer prosthesis. Avascular necrosis of the detached head was uncontrollable.

The conclusion was that in four-fragment fractures of the proximal humeral neck, operative treatment is of value. According to our results, it seems that the methods with Rush nailing, plates and prosthesis have the same range of success. It is finally stressed that the four-segment classification mentioned in 1934 by Codman and later adopted by Charles S. Neer is important for the choice of treatment and the evaluation of the results.

PROXIMAL HUMERAL FRACTURES

Olof Ahlgren & Helge Appel (Umeå, Sweden)

Fifty proximal humeral fractures treated at University Hospital in Umeå, Sweden, were followed up. Observation time was more than one year. The fractures were classified in four groups according to the number of fragments and degree of

dislocation. On the one hand the results of treatment were evaluated owing to the patient's view of his own condition, on the other, by a numerical rating method of C. S. Neer.

It is surprising how often the patients had adapted to remaining symptoms. Most of the poor results were found among the fractures of type IV (dislocated four-part fractures). Concerning this type of fracture, one must consider a more extensive use of prosthetic reconstruction primarily. Fractures of type III (dislocated three-part fractures) gave somewhat better results. Closed reposition is however very difficult, which is why this type of fracture ought to be operated. Fractures of type II (dislocated two-part fractures) among old patients can give some problems, especially if the primary reposition will not succeed. Fractures of type I (all proximal humeral fractures without dislocation, regardless of the number of lines of cleavage) gave no greater problems concerning the treatment.

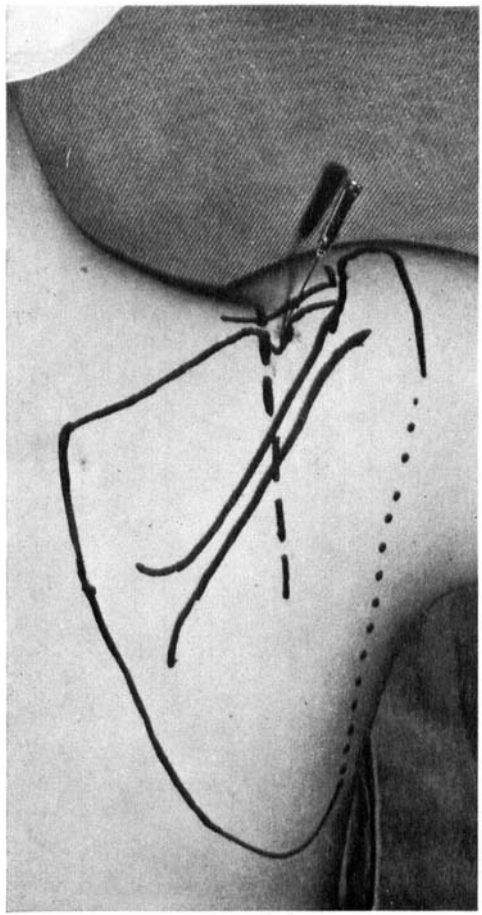


Figure 1. Anatomical landmarks for the identification of the scapular notch.

AN ALTERNATIVE ANAESTHESIA FOR USE IN ACUTE ANTERIOR SHOULDER DISLOCATIONS

H. G. Edeland & T. Stefánsson (Gothenburg, Sweden)

Block of the suprascapular nerve in the treatment of shoulder pain has been suggested by Rovenstine, Bonica, Moore, and others. Moore does not recommend this block in pain caused by shoulder dislocation.

The nerve supplies the two spinati muscles, parts of the shoulder joint capsule, and also parts of the acromioclavicular joint. The nerve passes the scapular notch. For anaesthesia 10–15 ml of 1 per cent mepivacaine (Carbocain®, Bofors) without adrenaline is slowly infiltrated into and through the notch, using an intradural needle (Figures 1 and 2).

The block has provided satisfactory pain relief in eight of ten consecutive patients with acute anterior shoulder dislocation. Effect has been obtained within a few minutes. A reduction technique, utilizing traction of the arm along the axis of the neck of the scapula with simultaneous manipulation of the head of the humerus in the axilla, was successful in all cases.

The suprascapular nerve block at the scapular notch is suggested as an alternative to general or supraclavicular plexus anaesthesia when anaesthesia is necessary at all, and when one of the other practices is unsuitable or contraindicated.

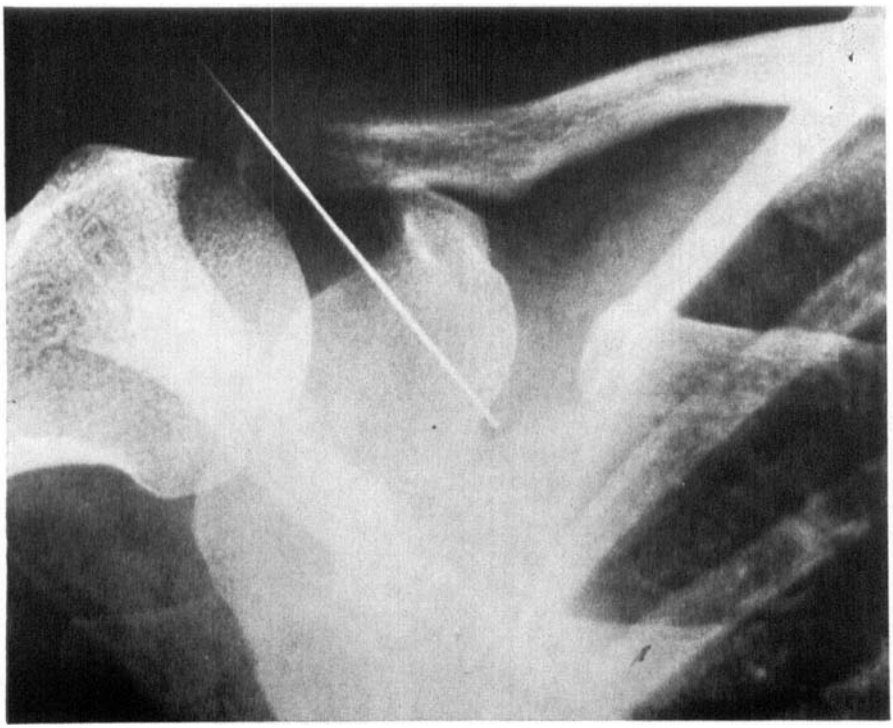


Figure 2. Radiograph of the cranial part of the scapula, with the tip of the intradural needle in the scapular notch.

LUXATIO HUMERI HABITUALIS

Cato Hellum & Arne Rugtveit (Oslo, Norway)

During the period 1957–70 the Bankart operation was performed on 67 shoulders in Kronprinsesse Märthas Institutt.

Material: Female 19, male 46 = 65 patients.

Right side 30, left side 33, bilateral 2 = 67 shoulders.

Half of the patients were between 15 and 20 years at their first dislocation.

In addition to the 2 with bilateral operations, 6 had dislocation of the non-operated shoulder and 9 had subluxation. This makes 17 patients with bilateral affection indicating a definite constitutional weakness of the shoulder joint.

65 had anterior dislocation and 2 posterior.

Results: One had redislocation 1½ years osteoperatively after adequate trauma. 2 had subluxations without trauma, one of them once and the other several times.

One had a feeling of unsecurity, but no actual recurrence.

49 had no pain whatsoever. 15 had very slight aching after strenuous work or of a "rheumatoid" type.

External rotation was limited to 37° in the operated shoulders (min. 5°, max. 80°) compared to 57° in the non-operated. All other movements were normal. None of the patients complained of restricted external rotation.

The usual straight incision gave ugly scars. S-shaped incisions ending in the axilla were considerably better.

KNEE, TIBIA and FOOT

DISTORSIO ARTICULATIONIS TALOCRURALIS RECIDIVANS TREATED OPERATIVELY

H. Glastrup (Stege, Denmark)

Twelve patients were treated 3 months to 11 years after accidents occurred.

The typical distortion of the ankle joint, developing complications later, causes an avulsion of the joint capsula along the anterior border of the lateral malleolus to the foreside of the tibia. These lesions are often combined with avulsion of adjoining ligaments.

The investigation material includes 3 cases of avulsion of the ligaments lateral between talus and calcaneus; there is uncertainity concerning a fourth case.

Simple reconstruction of the capsula and ligaments was made, using matresse-nylon sutures directly in periost or bone or between the torn fibres. Reconstruction of the ligaments between talus and calcaneus is technically difficult.

Mobility of the ankle joint is sought restricted. A cast is applied for 6 weeks, never longer, not even by avulsion of the syndesmosis.

Examination of 8 patients after treatment showed satisfactory results; only one had had 2 minor distorsions. All were fit and able to work. Objectively talus was found to be stable in the fork of the ankle joint; mobility was normal or only slightly impeded.

The observation period for the 3 cases of ligament lesions between talus and calcaneus and the suspect case has been too short. Examinations indicate, however, that these will be stable.

The investigation shows results of simple reconstruction of old lesions after ankle joint distortions to be good.

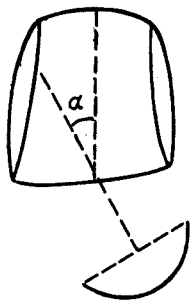
THE ANATOMY OF THE TALUS IN CLUBFEET. RESULTS OF AN ARTHROGRAPHIC STUDY

A. Hjelmstedt & B. Sahlstedt (Uppsala, Sweden)

In autopsy studies of congenital clubfeet most authors describe a pronounced deformity of the talus. The question then arises as to how often talus deformity occurs in clinical series and how it varies. The talus can be well delineated by arthrography of the talocrural and talonavicular joints. Arthrographic studies with standardized technique on 30 autopsy specimens of normal feet show a good correlation between the X-ray findings and the specimen itself.

A clinical study was performed on 24 congenital clubfeet in 18 patients and in 8 clubfeet in 5 patients with neurological disorders. Arthrography was repeated in 17 clubfeet. The median age at the first examination was 5 months and 3 years respectively.

In both groups the anatomy of the talus varied from within normal range to pronounced deformity of the same kind as reported from autopsy studies. The degree of medial deviation of the head is given in Figure 1. The plantar deviation of the head was not so pronounced. The curvation of the trochlea varied from normal to rather pronounced flattening in some cases of congenital clubfeet and further to extreme flattening in some of the neurological cases. The recesses of the talocrural joint were often partially or totally obliterated.



Normal angle of deviation
$\alpha = 15° \pm 6°$

Medial deviation of the head	Congenital	Secondary
5° — 24°	3	2
25° — 44°	9	1
45° — 64°	12	5
Total feet/patients	24/18	8/5

Figure 1.

DEVELOPMENT OF THE TIBIO-FEMORAL ANGLE DURING GROWTH

P. Salenius & E. Vankka (Helsinki, Finland)

The authors have investigated 1480 pairs of knees of children at different ages from newborns to 16 years with intervals of half a year. The results have been expressed as an angle between tibial and femoral longitudinal lines and given as degrees of varus or valgus correspondingly. The angles as degrees have then been analysed with the help of a computer. The aim of the investigation has been to find out the typical tibio-femoral angle for each age group. The result of the investigation is given in the figure, in which it can be seen that at birth there is a pronounced varus which at the age of about 1 year 8 months changes to valgus reaching its highest values at the age of three years. Sometimes the degree of valgus can be as high as 25° and be corrected by itself during growth. In the mean the valgus returns from about 10° at the age of three years to about 5–6° later, when it then stabilises. An operative correction is therefore very seldom indicated.

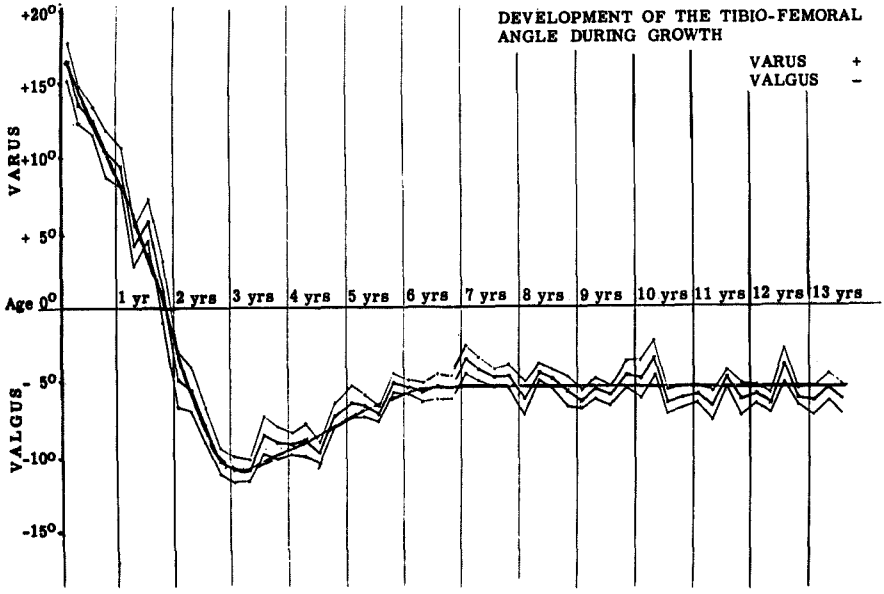


Figure 1. Development of the tibio-femoral angle during growth as estimated with the computer on the basis of 1480 investigated pairs of knees. The two lines represent the standard deviation between which the mean development is drawn freely.

RECONSTRUCTION OF CRUCIATE LIGAMENTS USING MENISCUS

Bengt O. V. Tillberg (Härnösand, Sweden)

Operation has more and more become the usual treatment in ligament injuries of the knee. In fresh injuries it is usually possible to perform a primary suture with good result, but the lesion is often overlooked. In such cases a reconstruction

has to be done. At the Orthopaedic Hospital in Härnösand the meniscus has been used as a substitute for the cruciate ligament since 1942. 48 patients have been operated upon. Two of these patients had a second operation because of a new trauma after several years. 33 patients were examined, another 9 interviewed and 5 are dead. One patient was excluded because of a new trauma and a new operation in another hospital.

With one exception, all the patients consider themselves much improved by the operation. They have all returned to their former occupation. A slight drawer sign was found in 11 patients and a moderate sign in one. However, 26 patients are still engaged in sport activities, even some with a feeling of instability.

At the follow-up examination the mean age of the patients was 49.3 years, ranging from 22 to 71 years. Mean value for observation time is 17.5 years.

Some arthrosis was found in 14 patients, mainly among the elderly.

A more detailed report will be given later.

POPLITEAL CYST. A FOLLOW-UP STUDY ON 42 OPERATIVELY TREATED PATIENTS

V. Vahvanen (Helsinki, Finland)

A total of 50 popliteal cysts in 42 patients were operatively treated. A diagnosis of rheumatoid arthritis (RA) was made in 28 patients. A dissecting popliteal giant cyst extending as far as the distal part of the calf was observed in 9 patients, in two patients bilaterally (altogether 11 giant cysts). All these cysts were rheumatoid in origin. In the majority of cases (46) the communication between the cyst and the joint was closed. Preoperative X-ray changes of the knee were in general slight. The cyst alone was extirpated in 38 cases, and in ten cases, four of which were giant cysts, synovectomy including meniscectomy was carried out at the same time. All these patients had severe rheumatoid synovitis of the knee joint. Recurrence of the cyst was observed at follow-up in six patients, in one patient bilaterally. In four cases the failure was attributed to osteoarthrotic or rheumatoid changes of the knee, whereas in three cases no changes in the knee joint were found. In a total of 12 rheumatoid cases, slight progression of RA or intermittent synovitis was observed at follow-up, but a palpable recurrent cyst was only detected in one patient. No recurrence was observed in the 10 synovectomized cases.

In rheumatoid patients it seems right to extirpate the cyst first and carry out synovectomy later, if necessary. Other possible failures of the knee joint should be diagnosed preoperatively and treated.

AMPUTATIO CRURIS WITH A SAGITTAL TECHNIQUE

B. M. Persson (Lund, Sweden)

It has been demonstrated that below-knee amputation is a realistic possibility in the majority of ischaemic gangrenes (Burgess & Sarmiento) and that a selection of amputation level is determined by the condition of the skin more than by pulsations and the arteriographic picture. A postoperative plaster shell is valuable whereas direct prostethic fitting has to be combined with strict limitations of loading. Aseptic and atraumatic technique is important. The anterior flap necrosis

Table 1. Below-knee amputations for ischaemic gangrenes by operative technique. Number of patients, mean ages, occurrence of diabetes, frequency of re-amputations to above-knee, local revisions and delayed healing only. Lund 1966–1971.

Technique of below-knee amputation	No. of patients	Mean age	Rate of diabetics	Re-amputations to above-knee level	Local revision only	Delayed healing only
Sagittal (medial and lateral flaps)	58	73.9	18/58 (31 %)	6/58 (10 %)	3/52 (6 %)	6/49 (12 %)
Conventional (anterior and posterior flaps)	41	73.7	23/41 (56 %)	16/41 (39 %)	2/25 (8 %)	6/23 (26 %)

has induced changes in techniques as the posterior flap technique (Gormley 1947) and the one presented here, similar to the technique of Tracy (1966).

The sagittal technique is an alternative way to reduce the amount of pretibial skin, still giving two symmetric flaps and well-shaped stumps: Medial and lateral musculo-cutaneous flaps. Tibia cut by saw in a 45° angle to support the myoplasty and conform to the shape of the stump. No drill holes and no osteoplasty. The muscles and the fascia are sawn from side to side with Supramid and the skin with 4–0 atraumatic nylon, resulting in a sagittal scar. No bloodless field and no drainage. Penicillin-prophylax is given. Plaster above knee for two weeks.

In ischaemic gangrenes with or without diabetes the attempted below-knee amputation was 93 per cent and the achieved below-knee level was 82 per cent of the total amount of below and above-knee operations during 1971.

THE LOW PRESSURE LEG IN OBLITERATIVE VASCULAR DISEASE

P. Holstein (Copenhagen, Denmark)

In obliterative vascular disease the blood pressure in the arterial tree distal to the occlusion is maintained at a lower level than that of the aorta.

Measuring of distal blood pressure is highly informative concerning the degree and the level of occlusion. We have measured the distal arterial blood pressure by two methods. Both are indirect. The first method employs a mercury strain gauge as detector as described by Strandness & Bell. By placing a cuff proximal to the detector we can measure the blood pressure at the level of the cuff. We measure the blood pressure at the first toe, the ankle, the calf and at the thigh.

Concerning amputation in obliterative vascular disease the condition of the skin is of particular importance. We measure the cutaneous perfusion blood pressure. A solution of Xenon-133 or Antipyrine labelled with J^{131} or J^{125} is injected intradermally. A small amount of histamine in order to produce local vasodilatation is added. The depot is covered by a cuff and the cutaneous blood pressure can be

measured as that external pressure which is sufficient to arrest the wash-out of the isotope. The method is described by Lassen & Westling.

It is our experience that healing of a surgical wound, or an ischemic ulcer, demands a cutaneous perfusion pressure above 15–20 mm Hg. In performing below-knee and above-knee amputation distal to an arterial occlusion we have found a considerable increase of the cutaneous blood pressure in the amputation stump. This is fully in accordance with the law of Poiseuille.

ARTHRODESIS OF THE FIRST METATARSO-PHALANGEAL JOINT

B. Næs & A. Rugtveit (Oslo, Norway)

100 feet with hallux valgus, half of which were operated with sucapital osteotomy (Hohmann) and the other half with arthrodesis of the metatarso-phalangeal joint, constituted the material. Mean observation time in both groups was 31 months.

Before operation mean valgus position of the big toe was 49° in the arthrodesis group and 36° in the Hohmann group. In 41 and 25 feet respectively metatarsalgia was present. The average age was higher in the arthrodesis group.

The subjective valuation of the treatment was approximately equal for the two operations. In both groups there were ca. 10 per cent bad results (unchanged or worse).

The number of feet with metatarsalgia was reduced by 66 per cent after arthrodesis, compared with 28 per cent after Hohmann's operation: this in spite of the fact that in all the worst cases of metatarsalgia, arthrodesis was performed.

Further, when no special procedure was used to relieve the metatarsalgia (such as exicion of painful metatarsal heads), arthrodesis had a clear effect on the metatarsalgia.

The effect on metatarsalgia in the Hohmann group was related both to the shortening of the first metatarsal bone and to the postoperative valgus of the first toe.

Conclusions:

1. Arthrodesis of the first metatarsio-phalangeal joint increases the probability of curing metatarsalgia with hallux valgus.
2. The functional results after arthrodesis equals those after Hohmann's operation both subjectively and objectively.

BONE RESEARCH

EXPERIMENTAL OSTEOPOROSIS

J. A. Sevatikoglou (Umeå, Sweden)

This is a short report of the main studies on generalized experimental osteoporosis carried out in recent years in the Orthopaedic Research Laboratory in Umeå. Adult male Sprague-Dawley rats maintained on a low-calcium, normal-phosphorus diet with adequate amounts of total protein and vitamin D have been used throughout.

After about 6 months the skeleton of rats treated as above from 1 week up to 12 months underwent significant mass reduction. The remaining bone had normal

structure, degree of mineralization and chemical composition. Increased serum and bone 45Ca specific activity, normal or decreased bone accretion and occasionally subnormal serum calcium levels were also registered.

Similarly treated rats showed significantly increased parathyroid volume and function as compared with normal animals. Significant variation of their serum calcium level was observed. There was a coincindence of periods of parathyroid hyperfunction and decreased serum calcium level. These observations were thought to indicate that osteoporosis was in this case connected with parathyroid hyperfunction. However, previously thyroparathyreoidectomized rats maintained on the low-calcium diet for 6 months developed the same type of osteoporosis as the intact rats. It seemed, therefore, that prolonged low-calcium intake induced osteoporosis in the adult rat, also in the absence of the parathyroids.

Fluoride given in 0.01 and 0.02 g/kg body weight in rats maintained on the low-calcium diet for 6 months did not prevent the development of osteoporosis. When after 6 months on the low-calcium diet the rats were given a high-calcium diet for another 6 months, certain indications of reversibility of the skeletal changes were observed towards the end of the observation period.

References:

S.-E. Larsson (1969) *Acta orthop. scand.*, Suppl. 120.

VITAL MICROSCOPY OF BONE AUTOGRAFTS IN THE RABBIT EAR CHAMBER

In vivo fluorescence of tetracycline labelling

Einar Sudmann (Oslo, Norway)

To be published in *Acta Orthopaedica Scandinavica.*

EXPERIMENTAL HETEROTOPIC OSSIFICATION IN THE ISCHEMIC RAT KIDNEY

T. Sam Lindholm, Ralf V. Lindholm & Robin Hackman (Helsinki, Finland)

It is known that Ca salts precipitate in injured or dead tissue and that bone can be formed in soft tissue without any direct connection with the skeleton. Transitional epithelium of the urinary tract has been shown to induce bone formation in adjacent connective tissue.

By unilateral ligation of the renal vein and artery an ischemic state was produced in rats. The histological changes in the ischemic kidneys were then studied by hematoxylin-eosin and van Kossa staining and by using microradiography, oxytetracycline fluorescence, 45 Ca-autoradiography and electron probe microanalysis.

The weight and sectional area of the ischemic kidneys decreased successively (Figure 1). Ingrowth of inflammation cells and beginning fibrosis in the papilla were found on the 22nd day. Calcification as seen after v. Kossa staining started subcapsularly and reached a maximum on the 72nd day. Oxytetracycline fluorescence, roentgen density in the microradiographs and incorporated 45 Ca were maximal at about 100–150 days after ligation (Figures 2 and 3). Trabecular bone was found on the 91st day in close contact with strings of epithelium. According to electron probe microanalysis the osteoid areas contained Ca and P in the same amounts as normal bone.

When formation of fibrous tissue and ingrowth of transitional epithelium in the papilla and the simultaenous subcapsular calcification have taken place, trabecular bone is formed from connective tissue cells without any intermediate cartilagineous stage.

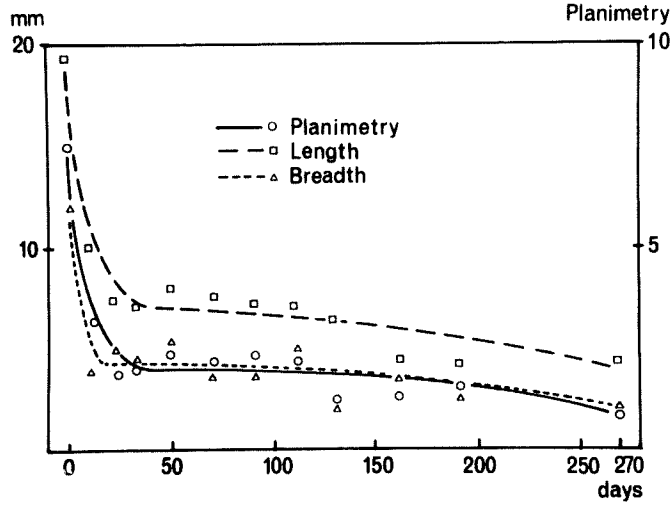


Figure 1. Length, breadth and section area of the ischemic kidneys as function of time.

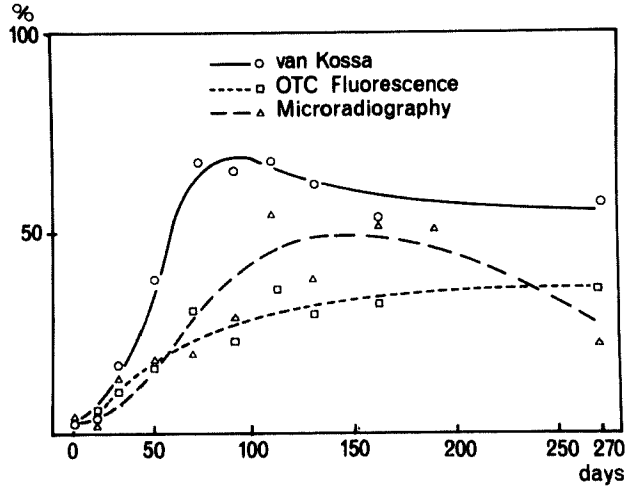


Figure 2. The calcified areas of kidneys sections demonstrated by the v. Kossa staining method, tetracycline fluorescence and by microradiography.

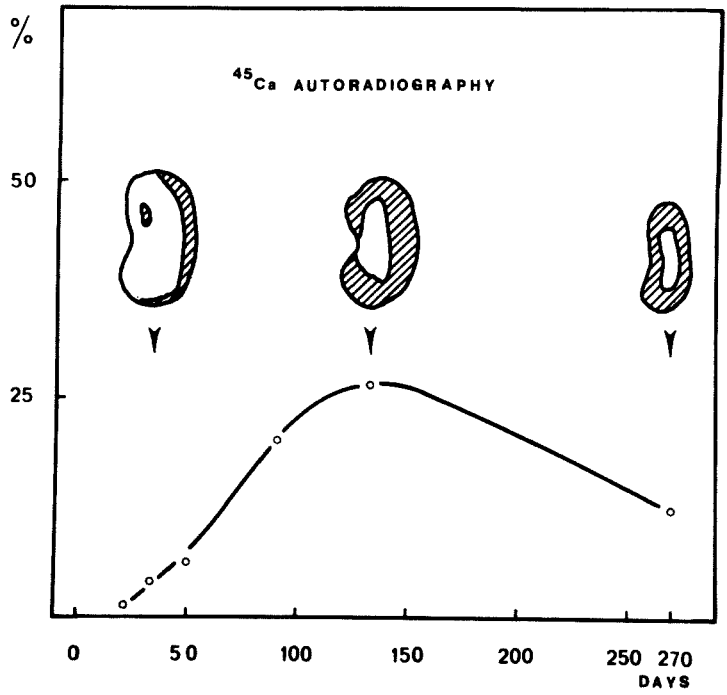


Figure 3. The calcified areas of kidney sections demonstrated by ^{45}Ca autoradiography.

QUANTITATIVE DETERMINATION OF GROWTH STIMULATING EFFECT OF GROWTH HORMONE

Lars Ingvar Hansson & Karl-Göran Thorngren (Lund, Sweden)

Method

Female rats were hypophysectomized at the age of 60 days. Administration of growth hormone and thyroxin started 15 days postoperatively. With the aid of the tetracycline technique the growth from the proximal growth plate of the tibia during the first 15-day period and the following 20-day period was registered.

Group A. Thyroxin 5–40 μg/kg daily for 20 days.

Group B. Growth hormone (bovine–NIH) 25 μg/daily for 20 days.

Group C. Growth hormone as in group B combined with thyroxin as in group A.

Group D. Bovine, ovine and human growth hormone 1–400 μg/daily for 10 days combined with thyroxin 20 μg/kg daily.

Results

A. Thyroxin had a growth stimulating effect, which was optimal at 10–20 μg/kg daily. The accumulated growth amounted to 300 μ compared to 20 μ without thyroxin.

B. Growth hormone for 20 days resulted in 600 μ.
C. The optimal dose of thyroxin was the same as in A and the growth amounted to 1100 μ, a synergistic effect.
D. 25 μg bovine growth hormone daily resulted in 600 μ, and 100 μg in 1100 μ. The effect of bovine and human growth hormone was lower. The effect of thyroxin amounted to 200 μ.

Conclusion

Growth hormone and thyroxin have a stimulating effect on the longitudinal bone growth in hypophysectomized rats. Combined administration of thyroxin and growth hormone has a synergistic effect. The biological activity of various doses of growth hormone and of various growth hormone preparations is possible to quantitate.

THE INFLUENCE OF OESTRADIOL-17B UPON COLLAGEN SYNTHESIS IN FEMURS OF CASTRATED FEMALE RATS

N. Langeland (Oslo, Norway)

Young adult female rats, about 170 g body weight, were castrated and from the day of operation given daily intramuscular injections of 0.5, 1.0, 2.0, 5.0, 10.0, and 20 μg oestradiol-17β respectively. One group of castrated and one group of uncastrated rats of the same body weight served as controls and received injections of the vehicle only. Twenty-four hours before being killed the rats received 25 μCi proline-C-14 intraperitoneally.

The rats receiving 1 and 2 μg oestradiol pr. day had a significantly lower dry weight of femur than the controls and than these receiving 5, 10 and 20 μg. On the other hand, the rats receiving 1 μg oestradiol pr. day had the highest hydroxyproline-C-14 specific activity (SA) while those receiving 10 and 20 μg pr. day had the lowest SA.

The rats receiving 1 and 2 μg oestradiol pr. day seem to have had both the highest collagen synthesis rate and the highest collagen resorbtion rate. At the highest doses of oestradiol there may have been a reduced collagen turnover and especially a reduced resorbtion. The hydroxyproline-SA/proline-SA ratio were reduced when the rats received 10 and 20 μg oestradiol pr. day.

NORMAL REPAIR OF ORTHOTOPIC AUTOLOGOUS CANCELLOUS BONE GRAFTS

P.-O. Grönblom & P. Slätis (Vasa, Finland)

In 36 adult rabbits cylindrical cancellous bone grafts were obtained with a specially designed punch-out instrument transversally from the metaphysis of the femur and axially from the tibial condyle. The grafts, which extended throughout their respective bones, were lifted out and subsequently treated in two ways: in one group of animals the cylindrical graft was reinserted, in the other the cancellous bone was crushed prior to its replacement into the donor site. The progress of repair was evaluated by a triple fluorochrome labelling technique and fluorescence microscopy in addition to ordinary histological procedures. The animals were killed 1, 2, 3, 6 and 16 weeks after the operation.

Cancellous bone grafts with the trabecular structure intact revealed scanty fluorescence in the marginal parts of the cylindrical block, whereas the central part of the graft remained unlabelled. Thus, the areas of the graft closely facing surrounding vital cancellous bone retained their viability. Two weeks after the operation, bone bridges were discernible between the surrounding bone and the graft. New bone was laid down along the previous cancellous bone, which served as a scaffolding lattice-work for invading tissue. The repair proceeded centripetally until the entire graft was incorporated.

The process of repair was more rapid where the trabecular structure of the graft had been left untouched.

THE REPAIR OF BONE DEFECTS WITH FREE PERIOSTEUM

V. Ritsilä & S. Alhopuro (Helsinki, Finland)

Controversial views of the osteogenic capacity of free periosteal grafts are still prevalent in the literature. Perhaps it is because of this confusion that free periosteum has had no clinical use today. In our earlier experiments constant bone formation was observed in autogenous periosteal grafts transplanted to experimental locations. In the present study this strong bone forming capacity of free periosteal transplants is used to repair different kinds of bone defects. Experimental defect in the calvarium of a growing rabbit could be reconstructed with this material and after two months the bony healing of the defect was complete. Ulnar shaft defect has been another model. A part of the ulnar shaft of a growing rabbit was resected and free fat transplant was placed as an interposition material to prevent the healing of the defect. After two months this fat could be taken away and the bone defect was ready for studying different kinds of bone transplants. Free periosteum formed a strong bony union over the defect. The physiological maxillary defect in the palatal bone of a growing rabbit has also been a location for periosteal transplantation. The defect could be filled with bone with this method, but simultaneous growth disturbance of the upper jaw occurred. This proved to be due to the stapling of the premaxillo-maxillary suture.

Based on these studies, free periosteal grafts have been used in the Finnish Red Cross Plastic Surgery Hospital (Chief Surgeon: Aarne Rintala) in the primary repair of the congenital maxillary clefts in cleft palate children. Free periosteum from the anterior side of the tibia has been transplanted across this defect. Good bone formation has occurred, and by this method it has been able to stabilize the loose alveolar segments and give rise to a solid symmetrical alveolar arch.

THE EXPERIMENTAL ELIMINATION OF PARTIAL PREMATURE EPIPHYSEAL CLOSURE

K. Österman (Helsinki, Finland)

Trauma to the epiphyseal growth plate of a child provoking a bone bridge between the epiphysis and metaphysis often causes growth disturbances of a leg. When treating deformities like this the bone bridge has been left intact (Salter et al. (1963) *J. Bone Jt Surg.* **45**-A, 578). Recent clinical observations (Langenskiöld (1967) *Acta orthop. scand.* **38**, 267) encouraged investigating whether it is possible experimentally to normalize growth by removing the bone bridge surgically.

The distal femoral growth plate of a rabbit was partially destroyed and when angulation appeared the bone bridge was removed. To prevent a new bridge the hole in the bone was filled with different interposition materials or no material at all. The other femur was a control. 178 animals were used and the results were analyzed using X-ray, histology and tetracycline labelling. The results show that it is possible to prevent progression of deformity by removing the bone bridge. By using interposition materials it is possible to prevent the recurrence of bone bridges and to produce correction of deformity. The best results were reached by using dead cartilage as interposition material. The results of this study support the view that in selected clinical cases the operative elimination of a bone bridge between the epiphysis and metaphysis and filling the gap with some interposition material are indicated. The detailed results of this study will be published later.

DISCUSSION:

A. Langenskiöld (Helsinki, Finland)

Österman has built a firm experimental basis for the operation I described in 1967 (*Acta orthop. scand.* **38**, 267). During the last two years seven patients have been operated on by this method for partial epiphyseal closure. The results are very encouraging. The operation should be carried out under a microscope. It can be recommended for general use. The results are quite in accordance with my investigations concerning the growth mechanism of the epiphyseal plate carried out over the last twenty-seven years.

HAND SURGERY

PRIMARY MOBILIZATION AFTER SECONDARY FLEXOR TENDON SURGERY

G. Bakalim (Helsinki, Finland)

At the Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, primary mobilization after secondary flexor tendon surgery has been used for two years. It is a condition that the graft should be adequately fixed. Distally the graft is carried through a canal drilled from the distal phalanx to the upper side of the nail and the fixation is reinforced by a knot tied in the transplant. Some metal sutures are applied to prevent undoing of the knot (Figure 1). Proximally Pulvertaft's technique is used. The graft is carried twice through the ruptured end of the flexor tendon. Anastomosis is carried out at the level of the m. lumbricalis. As a rule, the tendon of the m. palmaris longus is used as graft, otherwise the long extensor of the toes. A reinsertion is made wherever possible. Volar transverse incisions over the finger joints give a good cosmetic result. The scars do not show, and the pulley mechanism is not injured.

The end results have been classified according to active flexion of the interphalangeal joints, "good" meaning that the distal crease of the palm is reached with the finger tip. An extension deficiency by 30° or more places the result one class lower. A condition for a good result in the thumb is that mobility should be at least 50 per cent of the normal. Moreover, a good pinch is required. The end results in the total series are shown in Table 1: good 57/93 (61 per cent), fair 22/93 (24 per cent), poor 14/93 (15 per cent). The results for the thumb and ring finger

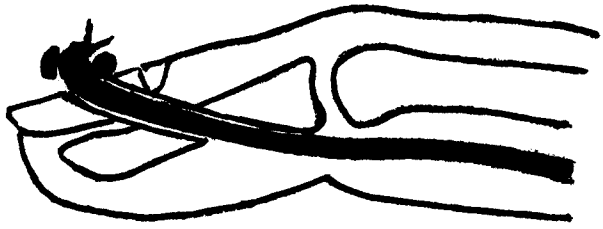


Figure 1. Distal fixation of the graft.

were best. The results for the index finger were poorer because of the frequent presence of complicating lesions such as lacerations and crushing, and nerve injuries. The results were best in the age group 21–25 years, poorer in the group 16–20 years. Zones 1 and 2 were about equal, zone 3 with 10/15 poor results was poorest. Somewhat better results were achieved when the sublimis was intact (27/45) than when it was ruptured (17/35). The differences as compared to previous results may be attributed to the use of primary mobilization.

Table 1. Results of tendon surgery per finger.

Finger	I	II	III	IV	V	Total
Good	13 (100%)	10 (50%)	11 (52%)	11 (73%)	12 (50%)	57 (61%)
Fair	–	7	5	2	8	22 (24%)
Poor	–	3	5	2	4	14 (15%)
Total	13	20	21	15	24	93 (100%)

SURGICAL METHODS TO IMPROVE HAND AND ARM FUNCTION IN C_5–C_6–PARAPLEGIA

E. Moberg (Gothenburg, Sweden)

For the C_5-C_6-paraplegias surgeons have tried to produce a three-pulp pinch. This requires arthrodesis-tenodesis methods involving thumb and fingers, which will interfere with the valuable interlacing finger function for a fork or spoon.

In twenty such hands the sensibility level, so far not mentioned in earlier work, was found to differ from the motor level up to two segments. The two-point discrimination test as well as the possibility to feel a metal shaft of a knife in the thumb-index web was used. Such great individual variations in anatomy are important to map out before surgery. Our own attempts to reconstitute an active sensory grip are directed to the key grip, which has broad surface for the special need of such hands. Pinch grip is for them rare, grips for books, paper, dressing and eating dominating. This makes the surgical reconstruction less complicated. Even cases where the only useful muscle in the forearm was brachio-radialis gave an active grip. Eight hands operated upon all gave positive results; no function was lost in any.

In one case active elbow extension could be obtained by use of a part of the deltoid, permitting the patient to move from chair to bed without assistance, which was impossible before surgery.

Results are here shown in a film.

AFFERENT IMPULSES AND HAND PROSTHESES

E. Moberg (Gothenburg, Sweden)

My work with C5–C6 paraplegias has taught me that the important grip function in high degrees of lost hand function is the key grip, not the three-pulp pinch. *Afferent impulses is the leading factor. The second is broad, soft gripping surfaces* with friction. The key grip is also more cosmetic than the three-pulp pinch, never used by a resting hand.

In work the triceps of a cat has some 50,000 afferent and efferent impulses/sec—a hand certainly much more. A prosthesis has perhaps 3–4 efferent, non-afferent impulses.

Obviously a major change in the practical value of hand prostheses must now be based on the supply of afferent impulses to the patient's conscious mind. This is possible since I was able to prove that cutaneous receptors are able to register in a normal way passive motion and position of moving limbs, the receptor system in muscles, tendons and joints being excluded. Thus, from an artificial finger the factors mentioned can be linked up with skin far away and a system of functional afferent impulses can be created. Tests are going on with other factors. A simple key-grip model hand prosthesis was demonstrated.

Progress must be built upon close cooperation between technology and the hand surgeons, who have so far hardly contributed enough.

DISCUSSION:

Knud Jansen (Copenhagen, Denmark)

The research in hand function, control sites and priority of finger movements form an important part of the recent research programme within prosthetics. It is general experience that the specialised devices offer optimal capacity.

Mr. German's hand from the Netherlands does offer the movements required by Erik Moberg.

Other research work has investigated the mechanisms of proprio- and of ecteroception.

For the below-elbow amputee the mechanical prosthesis is still the most useful.

LATE RESULTS OF 137 NEURORRHAPHIES IN UPPER EXTREMITIES

U. Kankaapää & G. Bakalim (Helsinki, Finland)

Altogether 137 neurorrhaphies were performed for 96 patients in the upper extremities between the fingers and the upper arm. This series consists of cases treated at the Department of Orthopedics and Traumatology, University of Helsinki Central Hospital, during the years 1960–1969.

The nerve lesions were distributed between various nerves as follows: median 28, ulnar 23, superficial radial 1, hand and finger nerves 85.

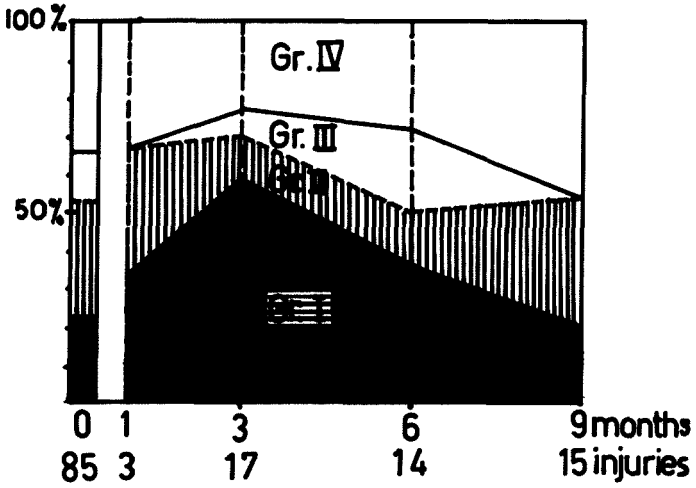


Figure 1. The effect of suture delay on the results evaluated by 2-point discrim. test. 0 = primary suture.

The average follow-up time was 4 years, 11 months (1 to 10 years).

In 62 patients the lesions were cuts (including 7 attempts of suicide); 33 patients had crush injuries.

Only the results of 2-point discrimination (2-pd) are presented here. The results were classified as follows: Group I – 2-pd 0–6 mm, Group II – 2-pd 7–15 mm, Group III – 2-pd 16–20 mm, Group IV – 2-pd over 20 mm.

The proportion of Group I in the case of each of the various nerves was: median nerve 7/28 = 25 per cent, ulnar nerve 3/23 = 13 per cent, hand and finger nerves 29/85 = 34 per cent.

The proportions of Group I were clearly related to age, i.e. it was reduced from 100 per cent in the age group 0–10-year-olds to 15 per cent in the age group 51–60-year-olds.

There were 85 primary and 52 secondary suturations. In the entire material, the proportion of Group I was 21 per cent in the primary and 38 per cent in the secondary suturations. These results were, however, opposite if the material was divided into lesions involving the forearm or wrist on the one hand and hand lesions on the other. Thus, it would seem that better results will be achieved by primary suturation in the area of forearm or wrist and by secondary suturation within the hand area (Figure 2).

One explanation for this is the fact that the proportion of crush injuries was 24 per cent in the area of wrist, while it was 42 per cent in lesions involving hands and fingers.

The effects of delayed suturation are shown in Figure 1. The proportion of good results was highest, or approximately 59 per cent, during a period ranging from 1 to 3 months following the original injury. After this time, good results became increasingly more rare, their proportion being approximately 20 per cent one year after the injury.

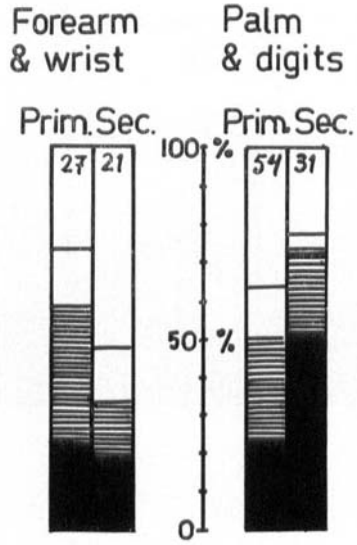


Figure 2. The results of primary a. secondary suture of forearm nerves compared with those of palm a. digits.

RESTORATION OF PINCH GRIP IN TRAUMATIC PARALYSIS OF THE ULNAR NERVE

K. A. Solonen & G. Bakalim (Helsinki, Finland)

This report is based upon operative treatment of 34 patients with loss or weakness of pinch grip due to traumatic lesion of the ulnar nerve. The nerve was injured 6 months to 32 years earlier. Surgical repair of the nerve had been impossible or unsuccesful. Reconstruction of the mechanism for pinch grip was just a part of the total surgical treatment. To restore the mode and strength of pinch tendon, transfers for adduction of the thumb and abduction of the index finger were adopted. Both the extrinsic extensors and flexors were used. The functional results, followed up for between 4 months and 8 years, show a marked improvement both in dexterity and strength of the pinch. In all but two cases the patients considered the hand more skillful than it was preoperatively.

TREATMENT OF LUNATOMALACIA WITH DISTAL RADIUS SHORTENING

Rune Axelsson (Gothenburg, Sweden)

The etiology of lunatomalacia has still not been solved. There is statistical support only for that theory advanced by Hultén at the end of 1920, the so-called minus variant of the ulna. To eliminate that from the view of weight-bearing unfavourable minus variant, Hultén made osteotomy with shortening of the radius. By placing the osteotomy proximally in the metaphysis, however, angulation of the osteotomy occurred and thereby a great limitation of the rotation of the forearm. Hultén found, however, that the structure of the lunate was almost normal 3 years post-

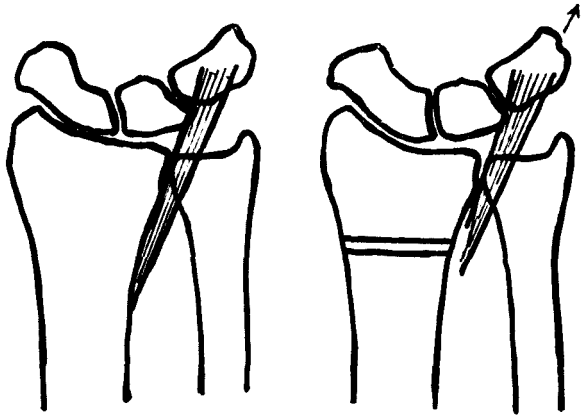
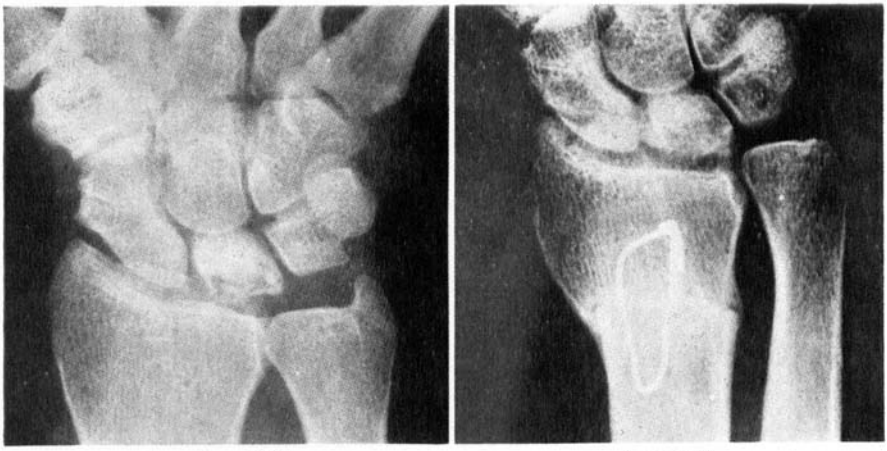


Figure 1. The oblique part of the dorsal radiocarpal ligament cut at the osteotomy of the radius.

operatively and the patient was free from complaints except for the limitation of the rotation.

By a series of anatomical dissection studies and bench experiments on wrist joint preparations in the beginning of the 1960's, I found that a transverse osteotomy of the radius placed as distally as possible, so as not to disturb the distal joint between radius and ulna, was the best one. With the osteotomy in that part of the radius you have to cut the insertion of the oblique part of the dorsal



Op. May 1968 Aug. 1968

Figure 2. Man, 36 years old, with lunatomalacia in fragmentation stage. Operation May 1968: distal radius shortening. Already 3 months later the lunate shows normalization of its structure.

radiocarpal ligament which reduces the weight-bearing of the lunate. Shortening of the radius is attained by removing a bone plate in the osteotomy. The thickness of this plate is calculated on the degree of variant and in a case with normovariant the bone plate should not be more than 3–4 mm thick so as not to disturb the distal radioulna joint. From my bench experiments I found that a steel wire through bore canals in a dorsovolar direction on each side of the osteotomy and an AO plate with screws both gave good stability without reduction of the shortening of the radius during the experiment. I choose steel wire because it is much less metal to be implanted.

With this operation procedure I have treated 19 cases with lunatomalacia during 1963–1969. The patients, 5 women and 14 men, were 19 to 62 years old with a mean age of 35 years at the operation. The distribution of the variant of the ulna was preoperatively 9 minus, 9 normo and no plus variant. By the follow-up with the average of 2 years postoperatively the distribution of the variant was 14 plus, 5 normo and no minus variant. The compression quotation of the lunate, according to Ståhl, has an average increase of only 0.13. Concerning the healing of the lunatomalacia, I found a normalization of the structure of the lunate in my cases in 37 per cent. The patients had no complaints after the time of treatment and all the patients but two have been able to return to their preoperatively heavy jobs. They have very little limitation of rotation and no complaints about it.

The results have been encouraging and the complications which were easily dealt with have been very limited.

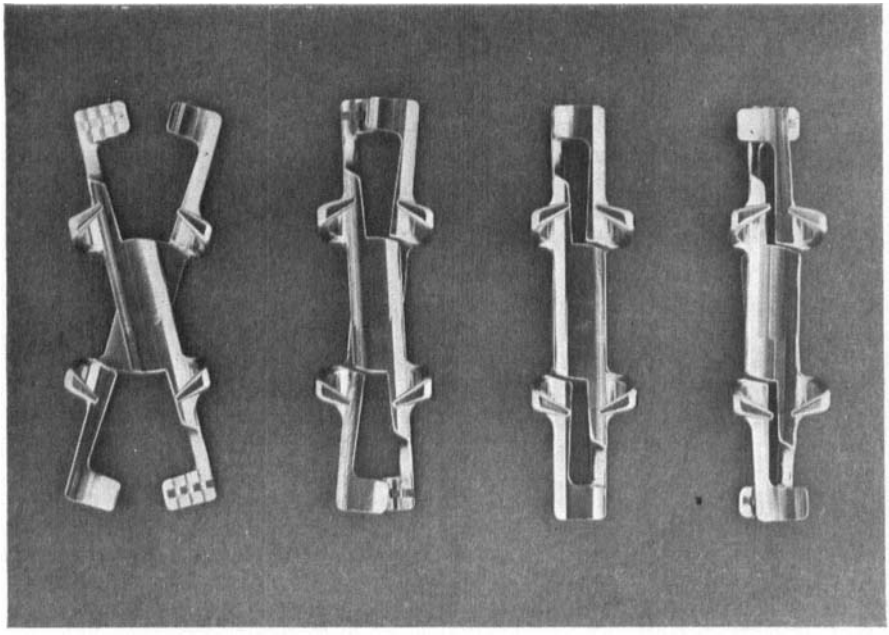


Figure 1. The under surface of the device; open, and in different positions of locking. *(For text, see upper half of page 146.)*

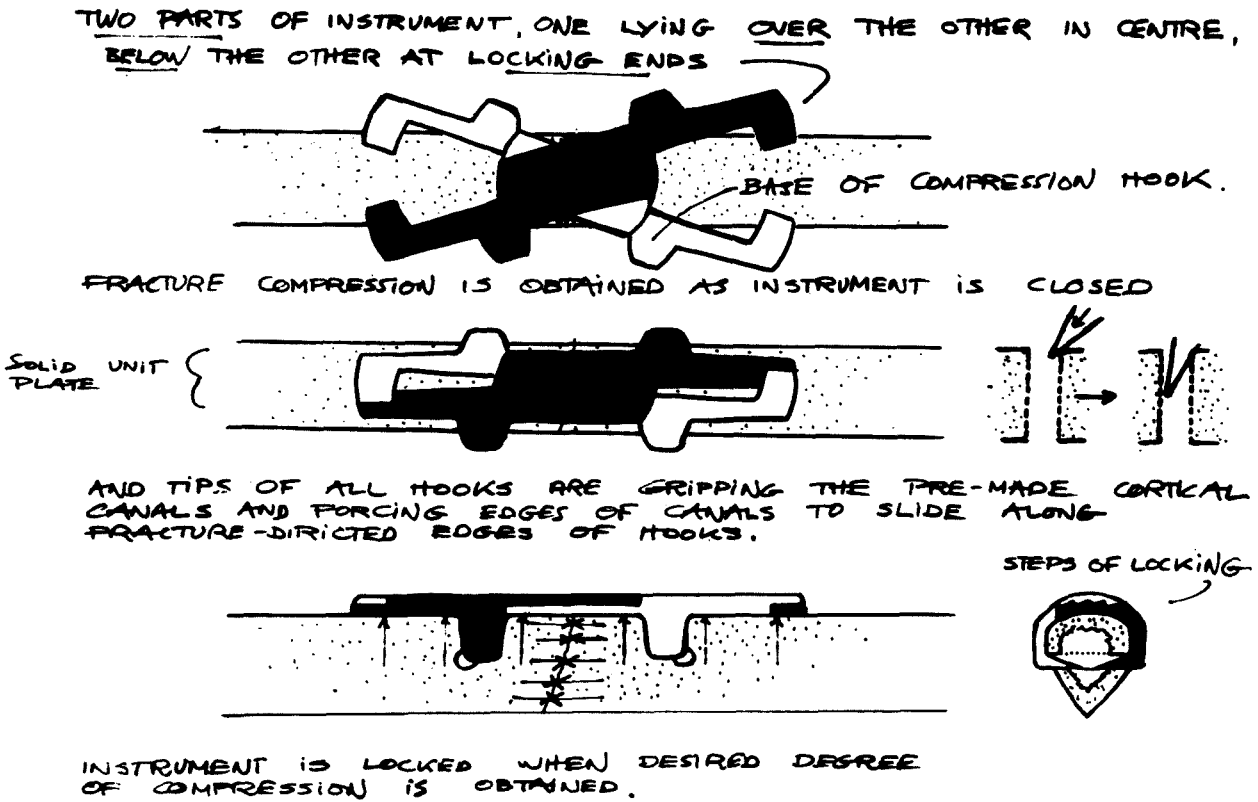


Figure 2. Drawings of the function of the instrument. *(For text, see upper half of page 146.)*

A NEW METHOD IN THE TREATMENT OF SHAFT FRACTURES OF THE FOREARM

H. G. Edeland (Gothenburg, Sweden)

The aim of this work was to develop a nontraumatic and reliable method of osteosynthesis not using screws, thus not interfering with the medullary canal.

The method involves the use of a 316-L steel plate device (Figure 1) of one size, composed of two parts which cross each other. Two pairs of wedges, based on each component of the plate, slide on the rims of pre-drilled holes in the cortex. These wedges compress and fix the fracture to the plate as it is closed and finally locked together (Figure 2). No screws are used. A combined fracture holder and templet-drill guide permit the exact and quick application of the instrument. This is done with a special forceps or two pliers. (For Figures, see pages 144 and 145.)

The method has been used in 16 fractures of the bones of the forearm. The fractures occurred in 10 patients aged 16 to 70 years. Both shafts of the forearm were fractured in 7 patients. Three of these had open lesions. Six of the 16 fractures were comminuted. A circular cast was applied in all cases.

All fractures healed. The functional result is objectively unsatisfactory in one patient because of radio-ulnar synostosis. There have been no infections.

Continued work with the aim to perfect the method is going on.

THE EFFECT OF TRAINING ON THE MYOELECTRIC CONTROL SIGNAL

Peter Herberts (Gothenburg, Sweden)

The possibility of controlling externally powered prostheses by myoelectric signals has been studied in Sweden during the last decade. The research program is carried out on a collaborative basis between engineers and physicians.

Myoelectric hand prostheses (Viennatone, Austria) were applied to a small series of male arm amputees. These patients were trained and followed during the subsequent years in order to evaluate the effect of training on the characteristics of the myoelectric control signal.

All myoelectric control involves training, and the more complex the control task, the longer the training period demanded will be. It is obvious that the signal strength increased considerably (see Figures 1 and 2), as well as the signal difference of the antagonistic control sites. A period of training of about two months is necessary for some patients in order to acquire adequate control of the devices.

With respect to signal processing it is evident that the power spectrum of the myoelectric signal does not change over a training period. If the demand on signal processing will be high, as for instance in pattern recognition, the dynamic power spectrum changes occurring must be compensated for individually. By initially testing the control ability of all patients, it is possible to exclude some from further training and application.

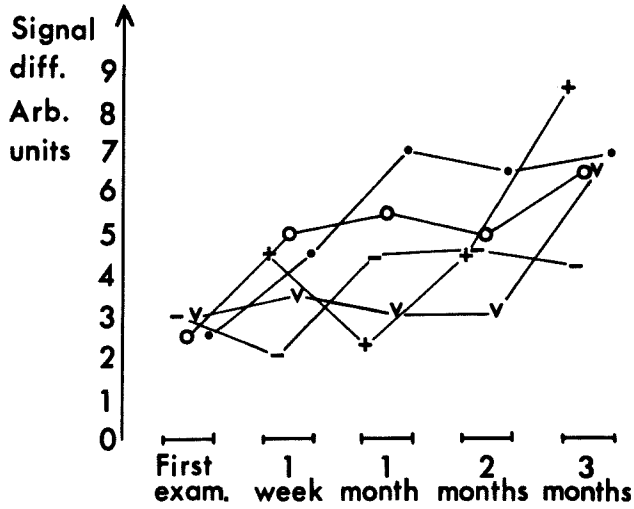


Figure 1. The amplitude difference of the myoelectric signal from the extensor and flexor control sites on the stumps. Measured values at five different examinations. The patients were told to activate the extensor control site by extending the fingers of the phantom hand.

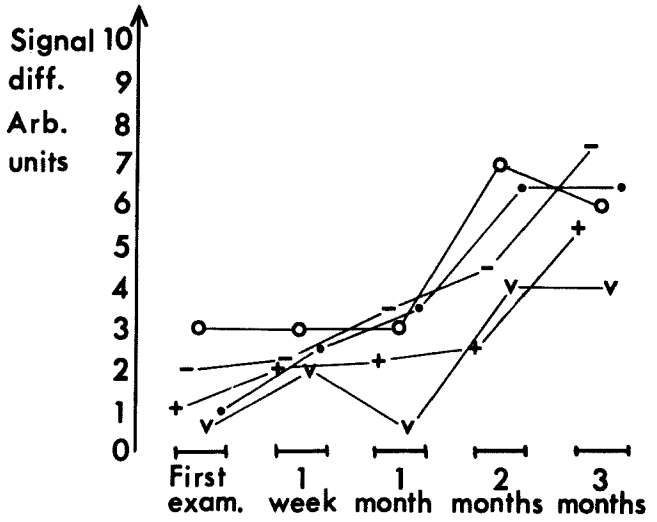


Figure 2. The amplitude difference of the myoelectric signal from the flexor and extensor sites when the patients were told to activate the flexor control site by flexing the fingers of the phantom hand.

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