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UPPSALA, SWEDEN, JUNE 1974

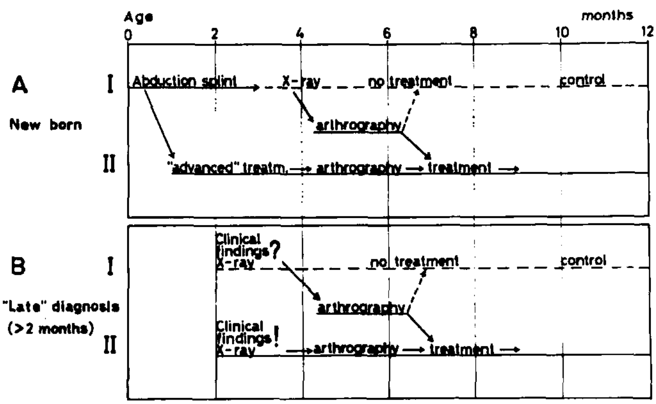
ARTHROGRAPHIES OF DYSPLASTIC AND CONGENITALLY DISLOCATED HIPS DURING THE FIRST YEARS OF LIFE

Bo Almby & Torsten Lönnerholm (Uppsala, Sweden)

During the period 1972–1974 a total of 40 patients, 2 months to 2 years old, with dysplasia and/or dislocatable hip(s) were examined using arthrography (in general bilateral examinations).

All hip joints were punctured 1 cm medial to the femoral artery without any complications.

The material was classified (see Table).



The 15 children in group "A" had dislocatable hip(s) at birth and were treated with an abduction splint for 3 months and then examined with survey X-rays.

In subgroup "A I" all 10 children, about 3 months old, had clinically normal hips but the survey X-rays showed dysplasia. The arthrographies showed only delayed ossification of acetabulum and femoral head and no anatomical defects.

The five cases in subgroup "A II" had, in spite of regular treatment, dislocatable hip(s) at 3 months of age. Arthrography was necessary to select cases for operation and to find the best position for the femoral head in the joint.

Group "B" consisted of 25 cases. All children were at least 2 months old when a clinical diagnosis of hip disorder was made.

In subgroup "B I" all 13 children had solitaire limitation of abduction. The survey X-rays were either normal or showed dysplasia. The arthrographies were all normal except two which showed delayed ossification.

The 12 cases in subgroup "B II" are the classical luxation cases. The indications for arthrography are the same as in subgroup "A II".

THE IMPORTANCE OF ANALYSIS OF SKELETAL DEFORMITIES IN CONGENITAL CLUBFEET FOR ADEQUATE SURGICAL TREATMENT

Ake Hjelmstedt (Uppsala, Sweden)

The main skeletal deformities recorded in congenital clubfeet are medial and plantar dislocation of the navicular bone, medial and plantar deviation of the talar neck and head, flattening of the trochlea, medial bowing of the calcaneus and medial subluxation or deviation of the cuboid. Many dissection studies on foetuses and the newborn have shown that the skeletal deformities vary from being rather slight to being very extreme. In the latter cases conservative treatment or soft tissue operations are insufficient corrective methods.

Figure 1 a. Simultaneous arthrography of the tibio-talar and talo-navicular joints in a 2½ year old boy. Lateral view of the right foot. Normal arthrogram.

Figure 1 b. Same case as in 1 a. Arthrogram on a congenital clubfoot (left foot). Note the slight flattening of the trochlea and the small recesses of the ankle joint. There is plantar deviation in the talo-navicular joint which because of its medial deviation has an oval appearance.

Figure 2 a. Same case as in Figure 1. Normal arthrogram of the right foot with the talus seen from above.

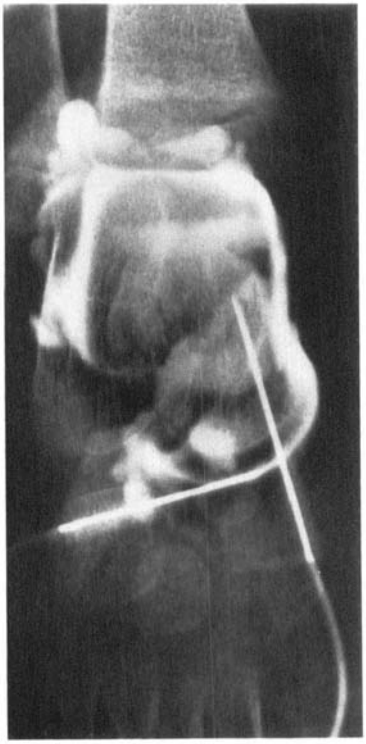


Figure 2 b. Same case. Arthrogram of the patient's congenital clubfoot (left foot). The deformed talus is seen from above. Note the pronounced medial deviation of the navicular facet of the head.

In cases where conservative treatment has failed operative procedures are indicated. As a guide to the choice to be made between the different procedures an analysis of the skeletal deformity by arthrography has proved to be of great value. In clubfeet with slight to moderate talar dysplasia and with only slight deformity of the talo-navicular joint, reposition of the navicular bone and restoration of the muscle balance by soft tissue procedures is sufficient. In cases with extreme deformity soft tissue procedures should be supplemented by correction osteotomies through the talar neck and the calcaneus.

ARTHROGRAPHIC ANALYSIS OF THE CONGENITAL CLUBFOOT

Bo Sahlstedt (Uppsala, Sweden)

In congenital clubfoot the principal skeletal changes are localized in the talus, the calcaneus and the navicular. The trochlea tali is flattened and the head and the neck of the talus have a plantar and medial deviation. There is often a medial and plantar luxation of the navicular bone.

Through simultaneous arthrography of the tibio-talar and talo-navicular joints it is possible, even in small children and infants, to judge the contours of the talus and measure the plantar and medial deviation of its head and neck. The navicular luxation can be demonstrated through a secondary flattening of the navicular facet of the head of the talus. Arthrography also gives important information about the joint recesses. This anatomical demonstration is a good guide in the selection of operative procedures. The method requires precise and standardized projections, the most important being the lateral view of the trochlea and the frontal view of the foot. Fluoroscopic control facilitates the positioning of the deformed foot and makes it possible to study the mobility of the ankle.

Puncture of the joints is relatively easy. Talo-navicular joint puncture is most easily accomplished with a dorsal approach and that of the tibio-talar joint from an antero-medial direction.

94 arthrographies have been performed on congenital clubfeet and 20 on secondary clubfeet without complications. Of the congenital clubfeet investigated, 40 per cent had a pronounced medial deviation of the head of the talus and 25 per cent a pronounced plantar deviation (Figures 1 and 2, pages 953–954).

ARTHROGRAPHY IN DIAGNOSIS OF EARLY LOOSENING OF A HIP PROSTHESIS

G. Hallin & L.-E. Lörelius (Uppsala, Sweden)

Arthrography has been used to detect early loosening of a hip prosthesis. We have used the technique described by Salvati et al. (*J. Bone Jt Surg.* 1971 No. 4).

In 18 patients with 16 cups and 18 shafts the arthrographic results were compared with findings at reoperation. One cup and seven shafts loose at reoperation were not revealed by arthrography. These false negative arthrographies were more frequent when the cement was mixed with barium. Three cups and one shaft were diagnosed as loose at arthrography but this could not be verified at reoperation. These false positive arthrographies were more frequent with radiolucent cement. We have found that arthrography in diagnosing early loosening of a hip prosthesis is for the moment not a very reliable investigation.

ANATOMICAL PHYSIOLOGICAL AND ARTHROGRAPHIC STUDIES ON BURSA GASTROCNEMIO-SEMIMEMBRANOSA

P. G. Lindgren (Uppsala, Sweden)

On autopsy material, 116 knee joints were examined by arthrography and dissection. The frequency of bursa gastrocnemio-semimembranosa was almost the same as in a series of unselected routine arthrographies. It is higher in elderly people.

The dissection studies showed that a valve mechanism in the connection between the knee joint and bursa gastrocnemio-semimembranosa is present. Pressure measurements have been carried out in the knee joint and bursa gastrocnemio-semimembranosa simultaneously and the findings verify the possibility of this valve mechanism.

CORRELATION BETWEEN ARTHROGRAPHIC AND OPERATIVE FINDINGS IN RUPTURE OF KNEE DISCS

Per Edvardsen & Bjørn Samstad (Trondheim, Norway)

From 1953–1973, 994 patients were treated for rupture of the knee disc. 768 of these patients were investigated with arthrography using various techniques, but with a double contrast method from 1962.

The majority of cases of both sexes were in the third decade; the number of male to female patients was about 4:1. The relation between rupture of medial to that of lateral disc differed between the two sexes, being about 4:1 in men and 2:1 in women. Further a slight sex difference was found as regards side affected, the right knee predominating in men and the left in women.

In 571 patients rupture was proved quite positively; out of these cases 565 were operated upon. In this group one false positive case was found. In another group of 125 patients having probably positive arthrograms, 108 were operated. In this group two false positive diagnoses were observed. In a third group, consisting of 72 patients with negative radiological findings, 28 were operated on because of the clinical signs and a rupture was revealed in all cases.

Out of the total number of arthrograms of the knee menisci, a false positive result was obtained in 0.3 per cent, whereas a false negative one was obtained in 4.0 per cent.

LOCKING OF THE KNEE JOINT CAUSED BY EXTRAMENISCAL LESIONS

Henrik Schmidt (Nykøbing Falster, Denmark)

The main reasons for carrying out arthrography of the knee joint are lesions of the menisci. As mentioned by Stable in 1972 many other diseases in the knee joint are easily diagnosed on double-contrast arthrography. Some of these may cause locking of the knee with symptoms quite similar to those of the meniscal ruptures.

Such diseases are: foreign cartilaginous bodies in the femoropatellar joint, chondromalacia of the patella, hypertrophy of the fat body of Hoffa and hypertrophy of the synovial membrane.

Examples of each category are found in a material of 300 double-contrast arthrographies made by the author since November 1971. In each case the disease in question has been diagnosed on the arthrograms and was found to be the only (though uncommon) cause of locking.

The technique used is a modification of the method of Van de Berg & Crèvecoeur (1951) with special attention to the axial patella-position of Knutsson & Wiberg.

Each example illustrates the widened use of knee joint arthrography.

THE DIAGNOSTIC SIGNIFICANCE OF ARTHROGRAPHY IN ACUTE LESIONS OF THE JOINT OF THE FOOT

Gudmund Vilhelmsen & Holger Glastrup (Stege, Denmark)

An experience of 13 years of working with arthrography of the joint of the foot is presented. More than 200 examinations have been made without any complications having been observed. The technique is described, and it is concluded that arthrography of the joint of the foot is an important method of examination which should be applied in all cases, where a justified suspicion of a lesion of the capsule or ligament of the joint of the foot is present. It is stated that during the past two years attention has been drawn to the fact that a lesion of the subtalar ligaments is presumably being found rather often, and that these lesions have a great prognostic significance. As they cannot be visualized by arthrography they also present diagnostic and therapeutic problems.

THE DIAGNOSTIC VALUE OF ACUTE ANKLE ARTHROGRAPHY ESTIMATED FROM THE FINDINGS AT OPERATIONS

E. Lindholmer, N. Foged, O. Ginnerup & J. Th. Jensen (Aalborg, Denmark)

In a retrospective survey we have compared 116 ankle arthrographies with the operative diagnoses. In this way it was found that ankle arthrography has a satisfactory diagnostic value.

For the different arthrographic signs and combinations of these the diagnostic percentages—sensitivity, specificity, predictive value of a positive criterion and predictive value of a negative criterion—have been calculated.

As to the rupture of the anterior talo-fibular ligament there were only three to five false positive diagnoses (depending on the criterion used) out of 100. The negative diagnostic value has not been examined for this ligament, since only patients with a pathologic arthrography have been operated on.

As to the rupture of the calcaneo-fibular ligament, we find a lower, but still satisfactory diagnostic value. The best criterion for rupture of this ligament is found to be lateral contrast escape, defined by escaped contrast behind the middle of the lateral malleolus in the lateral projection. By this criterion the diagnostic percentages were 65 to 76 per cent. From the point of view that the anterior talo-fibular ligament should be sutured, it is of less practical value to diagnose rupture of the calcaneo-fibular ligament, since the anterior talo-fibular ligament is always torn in cases of rupture of the calcaneo-fibular ligament.

SURGICAL TREATMENT OF OSTEOSARCOMA

Ulf Nilsonne (Stockholm, Sweden)

The surgical management of osteosarcoma almost invariably includes amputation. Previously such amputations were often performed with a somewhat conservative approach, providing what was macroscopically deemed to be a sufficient margin to the tumour site. More recently a more radical approach has been adopted, aimed at total resection of the skeletal structure harbouring the tumour site. In osteosarcoma of the femur, for instance, this involves exarticulation at the hip joint. In current international practice treatment consists of preoperative irradiation followed by radical amputation in the absence of metastases after six months. The possibilities of local resection in cases of osteosarcoma will also be discussed at the symposium.

In view of the possible virogenetic nature of osteosarcoma, combined treatment has been started with an antiviral agent in the form of Interferon; the preliminary experiences of this therapy will be reported. In addition, treatment of solitary metastases, specifically in the lungs, by means of lobectomy or pulmonectomy will be discussed.

IRRADIATION OF OSTEOGENIC SARCOMA

Lars A. Baldetorp (Lund, Sweden)

Osteogenic sarcoma has a relatively low radio-sensibility. Its devitalization requires doses between 7000–10000 rads over 7–10 weeks. High-voltage irradiation, however, now enables adequate doses to the tumour without objectionable side effects in the skin or surrounding healthy tissues.

A 5-year survival is attainable in 11–12 per cent of patients treated solely with irradiation (Sweetnam et al. 1971, Friedman et al. 1972). Tumours of Grade I are best suited for irradiation, which is primarily recommended for osteogenic sarcoma in the arms in order to maintain their important function.

Cade states that preoperative irradiation, with amputation after 4–6 months, gives a survival-rate comparable with the best results of surgery (Lee et al. 1967, Sweetnam et al. 1971, Allen et al. 1973). Adequate tumour doses give acceptable protection 3–6 months prior to selective ablation, and patients showing general malignancy can be spared amputation.

Irradiation with fast neutrons can perhaps increase our possibilities of curing osteogenic sarcoma without ablation. Irradiation combined with chemical therapy is being tried, but our experience is limited. Prophylactic irradiation of microscopic metastases in the lungs is being done, but the results are difficult to evaluate (van der Werf-Messing 1973, Caldwell 1973).

EXOGENOUS INTERFERON THERAPY OF OSTEOGENIC SARCOMA

Hans Strander, Kari Cantell, Per Å. Jakobsson, Ulf Nilsonne & Gunnar Söderberg (Stockholm, Sweden and Helsinki, Finland)

Conventional treatment of osteogenic sarcoma consists of amputation with or without preoperative irradiation. Prognosis is poor, 20 per cent survive 5 years. New therapeutic efforts are urgently required.

Animal experiments have shown that the anti-viral agent interferon enhances the cytotoxic ability of sensitized lymphocytes to kill tumour cells. It also exposes surface antigen on tumour cells and inhibits the growth of malignant cells in various systems *in vitro* and *in vivo*. A method was developed for the large scale production of human leukocyte interferon. This type of preparation was found suitable for therapeutic trials in man and also exerted growth-inhibitory effects on human osteogenic sarcoma cells *in vitro*. It has now been used for the last two years as adjuvant therapy of osteogenic sarcoma.

During the last 2-year period, nine consecutive patients with osteogenic sarcoma were given exogenous interferon together with conventional therapy at the Karolin-

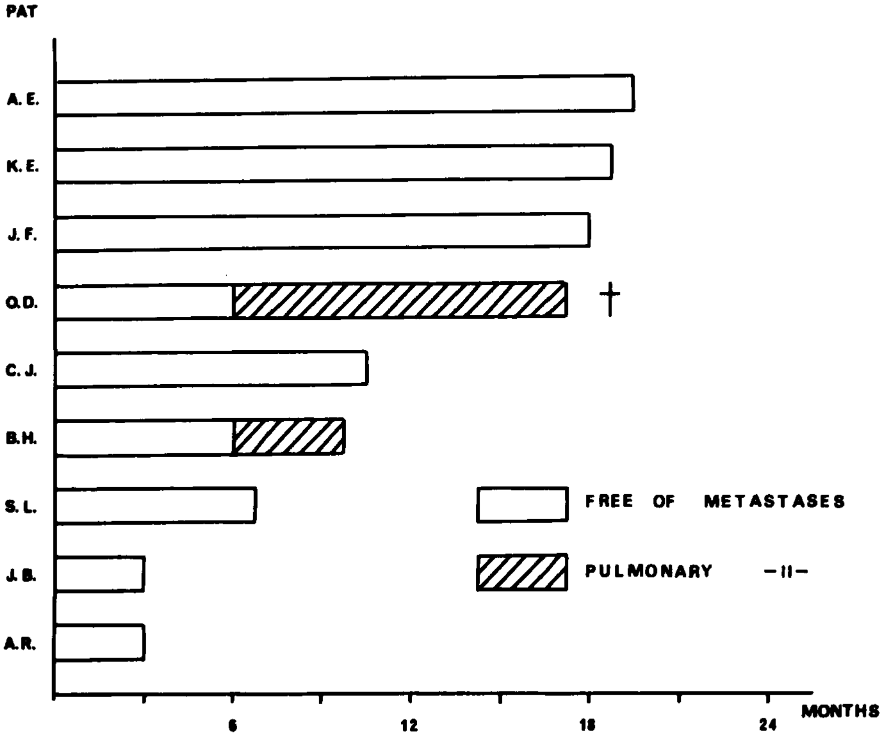


Figure 1. Length of therapy and metastases in individual patients.

ska Hospital. The interferon was given i.m. in a dose of 2.5×10^6 standard interferon units three times weekly. Age on admission varied from 9 to 29 years. One patient had fibroblastic-osteoblastic, two patients had fibroblastic, one patient had chondroblastic and five patients had osteoblastic sarcoma. One tumor was situated in the humerus, two were situated in the femur, five in the tibia and one was localized in the fibula. No toxic effects of the interferon therapy were observed. Figure 1 shows that seven of the nine patients treated so far are free from detectable pulmonary metastases. The result is encouraging and the potentiality of exogenous interferon therapy should be further evaluated.

CELLULAR IMMUNITY AGAINST TUMOR ASSOCIATED ANTIGENS IN HUMANS: LYMPHOCYTE STIMULATION AND SKIN REACTION

Farkas Vánky (Stockholm, Sweden)

3M KCl-extracts prepared from human tumors (14 sarcoma, two astrocytoma, three nephroblastoma Wilm's and one melanoma) and from non-malignant tissues (nine muscle, three skin, two cartilage, one kidney, two brain and one bone marrow) have been used to stimulate autologous and allogenic lymphocytes and as antigen in autologous skin tests. The results of the lymphocyte stimulation by autologous tumor biopsy cells and their KCl-extracts were concordant. Moreover, these *in vitro* results correlated well with the *in vivo* immune reactivity indicated by skin tests. Tumor cell suspensions were weak allogenic stimulators, and KCl-extracts were stimulatory only after presensitization. When tumor cells and their KCl preparation were used in autologous and 11 allogenic tests the degree of autologous stimulation with tumor cells was as high as the highest allogenic one and the KCl-extract stimulated with similar strength the autologous lymphocytes. The results strengthen the validity of the lymphocyte stimulation test as an assay for a tumor specific reaction.

CELLULAR IMMUNITY AGAINST SARCOMA-ASSOCIATED ANTIGENS IN HUMANS: LYMPHOCYTE STIMULATION AND SKIN REACTIONS

Farkas Vánky, Ulf Nilsonne & Eva Klein (Stockholm, Sweden)

The existence of a specific antitumor immunity demonstrated by various *in vitro* assays is by now well documented. The dilemma is not to demonstrate such reactions but to determine the relevance, if any, of the *in vitro* findings to the complex *in vivo* situation. We have tried to remedy this deficiency by using the same antigen preparation both *in vitro* and *in vivo*.

The lymphocyte stimulation (LS)-test was used in the search for tumor specific cellular reactivity in humans. There is good reason to believe that lymphocyte stimulation by autologous tumor cells represents a tumor specific phenomenon. Such observations as the lack of stimulation obtained by non-malignant cells and the "dose-dependence" of the lymphocyte tumor cell interaction support this idea. Soluble antigens prepared with hypertonic KCl from tumor and non-malignant tissue biopsy cells were used successfully as stimulators and parallel tests with cells and extracts gave corresponding results in 26 out of 28 cases.

Thirty-one patients were tested for their ability to develop a delayed type hypersensitivity reaction to the reinjected KCl-extracts of autologous tumor and non-malignant cells. Reaction against the tumor extract occurred in 15 skin tests.

The *in vitro* results of the LS-test correlated well with the *in vivo* cellular immune reactivity measured as delayed type hypersensitivity in 25 out of 31 cases.

Lymphocyte stimulation *in vitro* with cells or cell extracts may thus reflect *in vivo* events of cellular immunity and seems to correlate with the clinical stage of the malignant disease.

BONE SCINTIGRAPHY IN PRIMARY BONE TUMOURS

Jan Heerfordt & Lise Vistisen (Copenhagen, Denmark)

The Copenhagen centre for sarcoma treatment receives an increasing number of patients from the eastern half of Denmark and from Greenland. It comprises three departments, the orthopaedic, pathology and radiotherapy departments working in close cooperation.

Bone scintigraphy with technetium-polyphosphate and/or radioactive fluorine was introduced at the centre 1½ years ago. An assessment of the clinical usefulness of this sensitive but unspecific method has been attempted, and it has been found that in many cases bone scintigraphy will not add to the information regarding diagnosis and treatment; however, in three situations we find the method valuable: 1) As a simple and rapid investigation, for example, easily performed in the out-

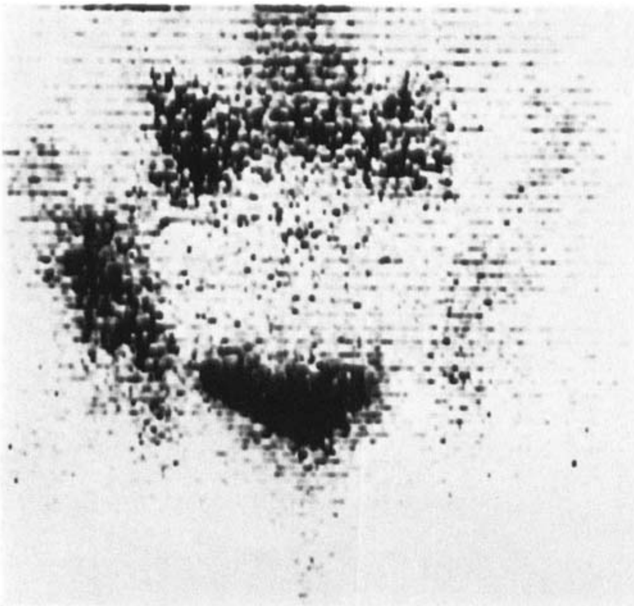


Figure 1. Fibrosarcoma in the right iliac bone. Fluorine scan shows normal sacro-iliac joints; hemipelvectomy seemingly is radical.

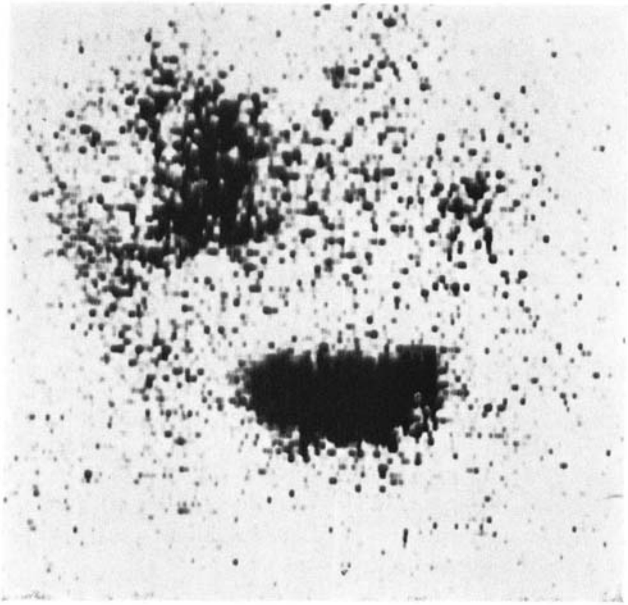


Figure 2. Osteogenec sarcoma in the right iliac bone. Fluorine scan shows affection of the right sacro-iliac joint; hemipelvectomy was macroscopically radical, but recurrence soon occurred.

patient department, scintigraphy can indicate whether an osseous process is likely to be benign or malignant. 2) In a soft tissue sarcoma close-to-bone scintigraphy can indicate whether radiologically normal bone is invaded by tumour tissue or not. 3) In patients with sarcoma of the pelvis scintigraphic examination of the os sacrum and the sacro-iliac joints may help regarding the indication and effectiveness of hemipelvectomy (Figures 1 and 2).

Technetium-polyphosphate, in other situations a valuable agent for bone scintigraphy, has in our hands been less reliable than radioactive fluorine, especially in this group of patients; false positive scintigraphies are seen, most frequently due to uptake of technetium-polyphosphate in tumorous or non-tumorous soft tissue.

BONE TUMOURS AND INTRAMEDULLARY PRESSURE

P. H. Widmark (Malmö, Sweden)

The intramedullary pressure was measured in 11 cases with metastatic or primary bone tumour.

In chondrosarcoma, giant-cell tumours and metastatic hypernephroma the pressure was increased.

Great variations in the pressure occur in prophylactic intramedullary nailing.

RESECTION TREATMENT OF PRIMARY BONE TUMOURS

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

In resection treatment of destructive bone tumours the defect may be substituted with an autogenous or homologous bone transplant or an endoprosthesis, in which case mobility of the joint may be retained. The alternative is to replace the defect with grafted bone, combined with arthrodesis. Modern methods of osteosynthesis are well suited to regeneration of the transplants and to bony union at the juncture, which takes a comparatively long time in massive bone transplants. This resection *en bloc* is indicated in carefully selected cases and depends on the behaviour of the tumour.

In a series of 130 patients subjected to resection of bone tumour, benign tumours were found in 78 cases, semi-malignant tumours in 21 cases and malignant tumours in 31. Giant cell tumours and fibrous dysplasia were each involved in about one quarter of the cases; the other cases included aneurysmal bone cyst, chondroma, chondrosarcoma, fibrosarcoma and osteosarcoma.

In the subseries of 52 malignant or aggressive tumours, a successful result ensued in 19 out of 21 giant cell tumour cases; there was one recurrence, which left the patient paraplegic with metastases. An extremity threatened by a cartilaginous tumour was saved in 21 out of 23 cases (including seven reoperations, four of them for recurrence). One extremity was amputated and one patient (recurrence) was lost. Seven out of nine extremities with other sarcomas were saved, whereas there was one amputation and one postoperative death.

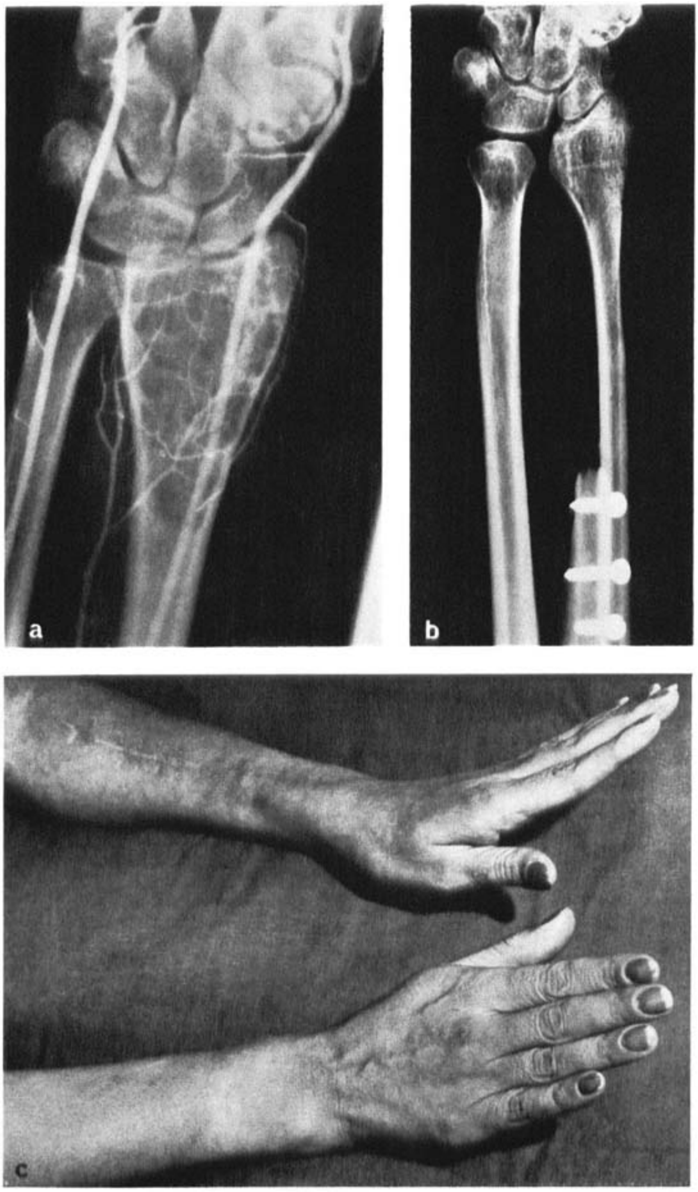


Figure 1.a. Chondrosarcoma of the left distal end of the radius. Angiography showed early tumour stain.

b. Treatment by resection of the distal part of the radius and substitution of the proximal part of the fibula.

c. Good bony union and good functional result. The patient is fully able to work as a clerk. No recurrence in three years.

INTRODUCTION TO PAPERS ON AMPUTATIONS AND PROSTHESES

Tor Hierton (Uppsala, Sweden)

Once representing a surgical masterpiece amputation has gradually come to be regarded as a sign of surgical defeat. The performance often was entrusted to the less experienced member of the staff. Unfortunately it took a long time for people who had lost a limb to be fitted with a prosthesis.

The modern total contact prostheses have placed greater demands on the surgeon at the operation and during aftercare. It has become natural to regard the fitting of a modern prosthesis as a direct continuation of an orthopaedic treatment in which amputation is only the first phase in a rehabilitation programme. Amputation seen in relation to prosthesis fitting becomes a reconstructive procedure that aims to provide functional improvement and freedom from pain.

For the last 10 years these theses have been taught at the Amputee Training and Research Unit, "Gåskolan", of the University of Uppsala Orthopaedic Department.

This aroused interest among all personnel involved and the key to success was the team work: orthopaedic surgeon, physiotherapist and prosthetist centred around the patient.

IPOPF certainly has contributed a great deal to the realization of the importance of team work, atraumatic surgical technique, prevention of oedema by plastering and the great physiological effect of early prosthetic fitting.

The first main topic of our congress deals with amputation and prosthesis. On that subject a great number of interesting papers will follow.

THE CUTANEOUS BLOOD FLOW IN PATIENTS WITH GANGRENE OF THE LEGS, EXAMINED WITH ^{133}XENON AND THERMOGRAPHY

Ole Schousbo & Danilo Zdravkovic (Odense, Denmark)

During the period of 1971–72 at the Orthopaedic Department of the Odense University Hospital, twenty-three patients with arteriosclerotic gangrene were investigated for cutaneous blood flow with ^{133}Xenon by the method of Sejrsen (*Scand. J. clin. Lab. Invest.* Suppl. 99, **19**, 52–59, 1964). The mean age was 70.2 years, with a range of 48 to 92 years. The control group (criteria for this group were foot pulses and no claudicatio symptoms) had a mean age of 58 years.

The blood flow results are shown in Table 1.

Table 1.

Blood flow ml blood/100 g tissue/min	No. of patients	
	Gangrene	Control
0.0–0.9	6	0
1.0–2.9	8	8
3.0–4.9	5	9
5.0–6.9	3	9
7.0–8.9	1	4
9.0–10.9		2

It can be seen that there were no control cases with a cutaneous blood flow under 1 ml blood per 100 g tissue per minute. We found that it was not necessary to reamputate the crus in patients who had a blood flow of over 0.7. We could not find any correlation between healing time and cutaneous blood flow.

Ten control double-sided thermographics have shown near equal thermographic status (on thighs in seven cases, on legs in nine cases), but in every case there was a difference between thigh and leg temperature. On two of them thermographic findings could be considered as pathologic and in these two cases Xenon blood flow results were just above 1.

Ten patients with gangrene showed only a pathologic pattern.

SCANNING OF THE PERIPHERAL CIRCULATION OF THE LIMBS USING A NEW TYPE OF GLUCOSE-POLYMERIC MICROSPHERE AS ISOTOPE CARRIER

Krister Wulff, Ulf Rothman, Bertil Nosslin & Tage Bramstång (Malmö, Sweden)

A new type of isotope-labelled microsphere synthetized from glucose-polymers (Rheotard, Pharmacia, Sweden) is presented. It is completely broken down by the endohydrolases of the blood and the time required for break down can be changed by variation of the synthesis.

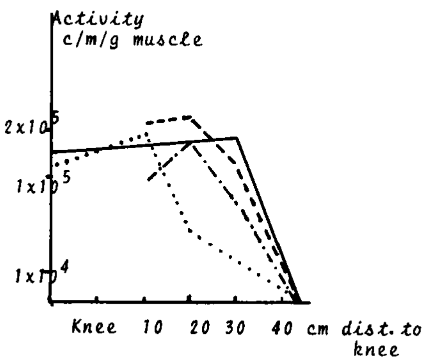


Figure 1.

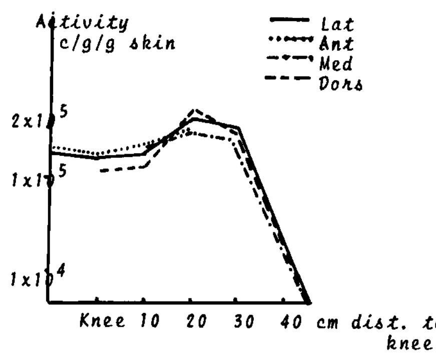


Figure 2.

Figures 1 and 2. Activity of biopsies from muscle and skin, respectively, at different levels and aspects of the limb in a patient with arteriosclerotic circulatory insufficiency. 1 mg Tc^{99}-Rheotard was infused in a. femoralis *preoperatively. Only the muscles show different activity at the same level, with reduced blood flow to the muscles of the anterior compartment.*

The Tc^{99}-labelled microspheres of uniform size (30 to 35 microns) have been injected into the femoral artery in patients with circulatory insufficiency. The microspheres are caught in the capillary bed related to the flow and the distributions have been estimated with scanning of the affected limb (Figures 1 and 2).

The method is presented together with results from different kinds of circulatory disturbances and its value as a predictor of the level of amputation is discussed.

DISTAL BLOOD PRESSURE AS GUIDANCE IN CHOICE OF AMPUTATION LEVEL

P. Holstein (Copenhagen, Denmark)

In 53 BK-amputations the skin blood pressure (SBP) was measured preoperatively immediately proximal to the amputation level by an isotope clearance technique. Below 20 mmHg (Figure 1) reamputation on the thigh was carried out because of major wound necrosis in 75 per cent of the cases. In the 20 to 40 mmHg interval reamputation was performed in 26.3 per cent, in one case because of skin necrosis, in four cases because of skin necrosis combined with infection or hematoma. Above 40 mmHg only 7.7 per cent failed. 26 cases (49.1 per cent) were classified in this relatively safe group of above 40 mmHg. According to the postoperative measurements, however, 63.4 per cent belonged to this group. Various factors may contribute to this increase in SBP: a) increase of systemic blood pressure, b) spontaneous improvement of the condition of the arterial pathway, c) hemodynamic effect of the amputation, i.e. elimination of a major part of the low-pressure vascular bed. It is possible to determine this hemodynamic effect by measuring the skin blood pressure during a pseudo-amputation accomplished by a blood pressure cuff inflated to a supra-systolic pressure level (Figure 2). Using a photoelectric technique, SBP was determined in 43 cases. 47.6 per cent had a SBP of above 40 mmHg, but by employing the pseudo-amputation 64.3 per cent could be registered in this group. Thus a pseudo-amputation is important in judging the prognosis with regard to wound healing.

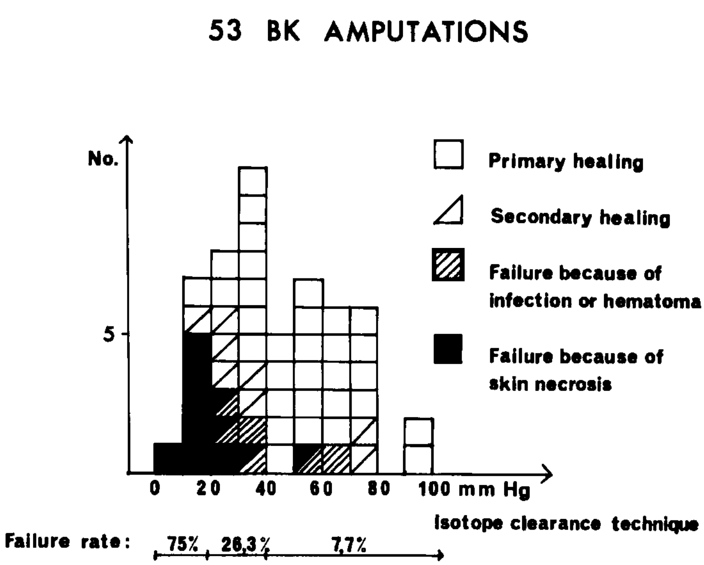


Figure 1. Results in 53 BK-amputations related to preoperative measurement of the skin blood pressure (isotope clearance technique).

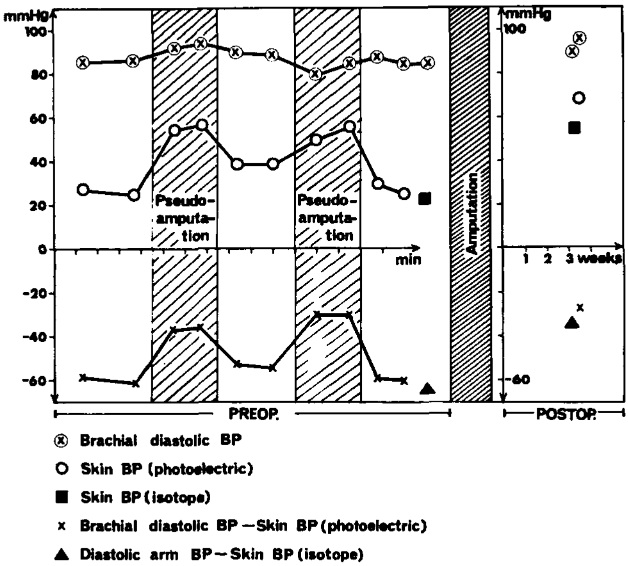


Figure 2. Increase in skin blood pressure during preoperative pseudo-amputation compared to postoperative measurement of skin blood pressure. The wound (BK-amputation) healed primarily.

BELOW-KNEE AMPUTATION IN ISCHAEMIC GANGRENE: SAGITTAL OR TRANSVERSAL TECHNIQUE?

Niels B. Termansen (Odense, Denmark)

During the period June 1972 through 1973, a total of 72 patients had amputation carried out on the lower limb. In 58 of these patients, or 81 per cent, 64 extremities were amputated because of ischaemic gangrene. Primarily below-knee amputation was done in 49 extremities (77 per cent), above-knee amputation in 13 (20 per cent) and amputation on foot and toes in 2 (3 per cent).

Two techniques of below-knee amputation were used; a transversal technique with a long posterior flap as described by Ghormley (1946) in 26 patients (born in odd years), and a sagittal technique with medial and lateral flaps as described by Persson & Sundén (1971) in 23 patients (born in even years). The incidence of diabetes was 50 per cent in the first group, 35 per cent in the second one, otherwise no differences of importance could be demonstrated between the two groups.

At follow-up, primary healing was found in 11 patients (48 per cent) treated by sagittal technique, and in 6 patients (23 per cent) treated by transversal technique. The difference is not significant ($0.05 < P < 0.10$). The rate of revision from below-knee to above-knee was the same (sagittal technique 30 per cent, transversal technique 27 per cent); nor could any difference between the two techniques be demonstrated as judged by rate of local revision, mortality, fitting of prosthesis, ambulatory or social status after amputation.

PARTIAL FOOT AMPUTATIONS: RESULTS AND FACTORS OF PROGNOSTIC VALUE

G. B. J. Andersson & U. Larsson (Göteborg, Sweden)

From 1959 to 1971, 196 partial foot amputations were performed on 174 subjects suffering from diabetes mellitus or arteriosclerosis. Thirteen died during the early post-operative course. Of the remaining 183 amputations on 161 patients, 60 per cent healed distal to the ankle joint whereas 40 per cent had to be re-amputated at a higher level.

Ninety-two were amputations of one or several toes, 71 were amputations through the metatarsal bones, and 33 were amputations through or proximal to Lisfranc's joint. Amputations of one toe only healed in 80 per cent of the cases. Multiple toe amputations or amputations proximal to the toes healed in about 40 per cent. Several operations were often necessary to achieve healing.

Factors of good prognostic value were found to be related both to the lesion and to the condition of the patient. Good healing was achieved when the gangrene was localized, and when the progress was slow. Other favourable prognostic signs were lower age, low pre-operative temperature, low E.S.R. and normal haemoglobin value. No difference was found between patients with diabetes and primary arteriosclerosis.

PANEL DISCUSSION ON AMPUTATION TECHNIQUE AND POSTOPERATIVE MANAGEMENT

Moderator: *T. Hierton.*

The panel: *G. Holmgren* (CPO.hon. Dr med. by invitation), *Knud Jansen, C. Lindquist, B. Nisses* (Physiotherapist, by invitation) and *Th. Wüller.*

For prosthetic purposes the ideal stump should be well healed, pain-free and covered by healthy skin. It is further more emphasized that length, mobility and power should be adequate and the stump should have achieved a stable cylindrical or slightly conical shape. The patient benefits from early exercise. Information about the whole program is of importance—but often lacking.

The discussion concentrated on the BK stump which nowadays is the most important site.

An ultra-short BK stump is to be preferred to a through knee or an AK amputation.

The panel emphasized adequate planning and an atraumatic performance of the operative procedure. In ischemia the use of the long posterior flap was recommended.

The indications as well as advantages and difficulties with *I*mmediate *P*ost-*O*perative *P*rosthetic *F*itting (IPOPF) for ischemic and non-ischemic cases were discussed.

In spite of enthusiastic reports from Burgess and his research group in Seattle and their own experience the panel realized the organizational difficulties involved. Accordingly IPOPF is not to be recommended for routine use in ischemic cases.

Preventing edema of the stump by plastering and by evacuating hematoma by suction drainage were considered very important measures. Early weightbearing however should be avoided—particularly in ischemic cases. The short timelag between amputation and definitive prosthetic fitting was recognized as a positive feature of the IPOPF program. The most important effect, however, that this program has brought about has been the renewed interest in amputation technique and prosthetic fitting. In many places where team work between amputation surgeon, physiotherapist and prosthetist previously didn't exist the IPOPF program has made it mandatory. Furthermore clinical research on the problems of the amputees and technical development in prosthetics have been stimulated.

The moderator drew attention to two alternative methods used in Uppsala for early ambulation and early temporary prosthetic fitting in cases of *ischemia:*

1. BK amputation. Tubigrip + tuber ischi bearing temporary prosthesis.
2. BK amputation and a *semi-rigid dressing with Unna paste* around the operation site and up above the knee. This light dressing prevents edema and flexion contracture of the knee. One or two days post-operatively a cast is made and from this a socket is manufactured to which a pylon is attached.

   The Unna paste dressing which acts as a "soft liner" is readily changed for inspection of the wound. Afterwards the same temporary plaster socket can be used.

   This technique with semi-rigid dressing so far seems to be safer and have advantages over the rigid postoperative plaster.

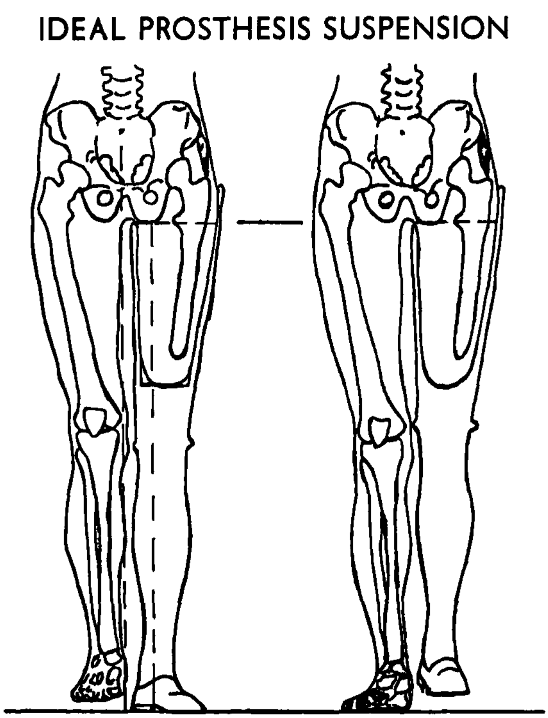


Figure 1.

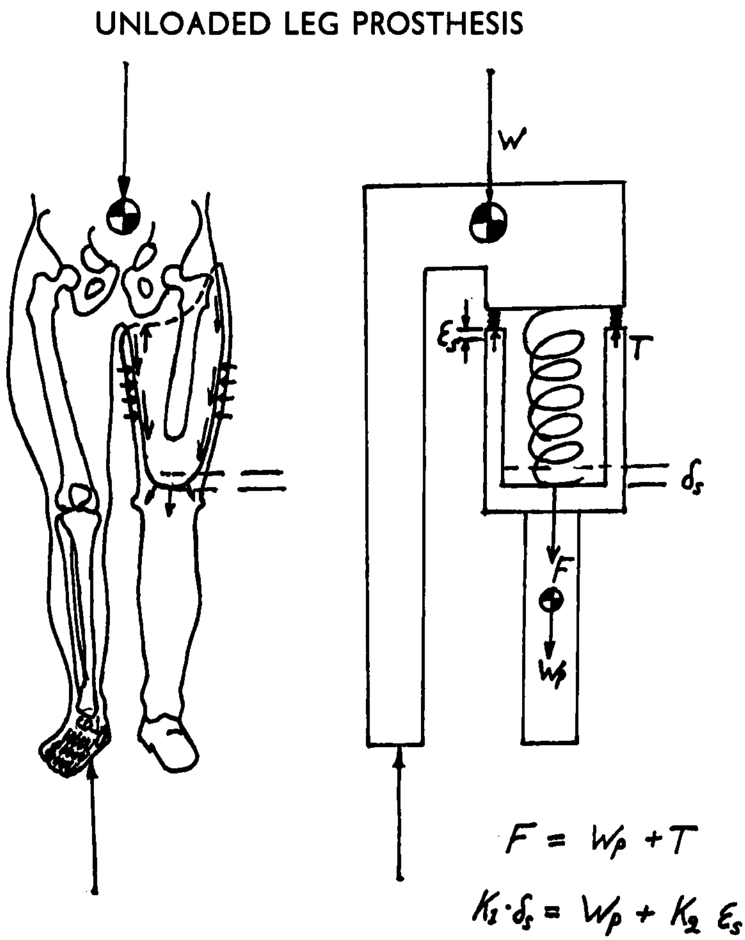


Figure 2.

THE IMPORTANCE OF THE PRE-STRETCHED SOFT TISSUES FOR PROSTHETIC FITTING

Kurt E. T. Öberg (Uppsala, Sweden)

A good prosthetic fitting for leg amputees in order to transfer the required forces from the prosthesis to the amputation stump, to give an optimal function, depends on many factors. One very important factor is the principal of the prosthetic suspension. One quantitative measure of the quality of the prosthetic suspension is the vertical relative displacement between the prosthesis and the skeleton.

With the so-called suction socket (below atmospheric pressure suspension) this relative displacement is reduced. With an accurate shape of a closed socket an adhesion of the stump to the socket occurs because of the suction pressure. In a similar manner to conventional suspension with bands or corsets the soft tissues of the stump can be pre-stressed in order to get an increased suspension also for the suction socket. With an increased pre-stretching of the soft tissues their stiffness increases allowing a better suspension of the prosthesis.

The suction socket gives the amputee more freedom and comfort and better function with the prosthesis. The conventional bands and corsets can be eliminated.

This good function requires, in addition to a very skilful job by the prosthetist, also the strong personal involvement of the patient. He must learn how to put on his prosthesis in the right way by himself.

DYNAMIC DEMANDS ON SOCKET CONSTRUCTION

Gunnar Holmgren (Uppsala, Sweden)

The compensatory effect of a prosthesis depends upon the stability of attachment between prosthesis and body. As the femur is surrounded by displaceable soft tissues, this attachment is rendered difficult, and unless a satisfactory connection is achieved both the effect and transmission of power will be reduced, with consequent difficulty in walking.

To increase stability, negative pressure and total contact are used and the soft tissues are intentionally deformed to produce some tension.

In constructing the socket it must be remembered that different pressures are exerted over different stump regions. Active muscles must also be considered. Thus the socket cannot exactly reflect the stump configuration; e.g. proximally in the horizontal plane it is rectangular.

The four muscle groups to be especially considered are the long knee flexors, rectus femoris, adductor longus and gluteus maximus. These muscles must be given room to function satisfactorily.

The medial and posterial radius of the socket brim must be well adapted to the stump. If it is too small it will prevent hip extension; if it is too big a large support area for taking up weight vertically is lost.

The socket wall height is determined by the pressure and counterpressure to be established, with regard to the ischial tuberosity.

STUDIES OF THE SUSPENSION OF BELOW-KNEE (BK) PROSTHESES

Sven Grevsten (Uppsala, Sweden)

Since 1969 the suction PTB-prosthesis for below-knee amputations has been clinically tried at the Orthopaedic Department in Uppsala.

This prosthesis is an analogue suspension to the suction prosthesis for above-knee amputations. The difference in mechanics and soft tissue relations above and below the knee means quite different considerations when constructing the socket.

Studies were performed to describe the relations in the BK socket.

A roentgenological study analysed the stump movements in imitated walking. The vertical displacement of the amputation stump was on average 1.25 cm less in the suction prosthesis than in the PTB-prosthesis.

A study of the pressure variation showed level differences in the pressure, negative pressure in swing phase and positive pressure in stance phase.

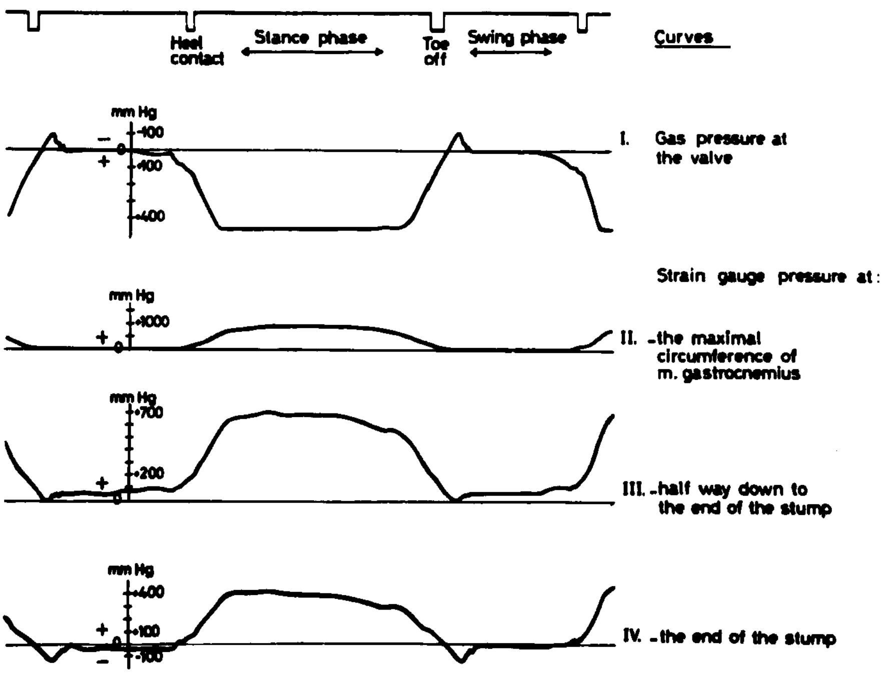


Figure 1. Pressure variations for the stump end-socket cavity and for posterior limb-socket interface surfaces at progressively lower levels. Note that trace I is inverted and that scales for traces I and II are different.

An electromyographic study of the amputation stump while walking with a suction prosthesis has shown that the muscular activity pattern is similar to that in a normal leg. Walking with the PTB-prosthesis there are usually simultaneous contractions of antagonistic muscles.

An optimal prosthetic suspension must simultaneously counteract movements in the socket and distribute the load over the stump. Thus a socket should have

1. the shape of the individual stump and
2. and adhesive fixation in the socket, but
3. the adhesive fixation means only a minimal compression of the soft tissues. Otherwise the circulation in the stump is jeopardized.

The total contact in a suction prosthesis has

1. a lower pressure at the bottom of the socket than higher up,
2. friction in the socket
3. the adhesive effect between two surfaces.

STUDIES OF MUSCLE STRENGTH AND PROSTHETIC ATTACHMENT IN ABOVE-KNEE AMPUTEES

Urban James (Uddevalla, Sweden)

A group of healthy active male unilateral above-knee amputees were studied. The mean stump length was two thirds of the length of the intact femur. All were fitted with a total-contact suction socket.

Mean total cross-sectional area of the amputation stump was calculated to be 63 per cent of that of the intact thigh. Mean cross-sectional area of skin and subcutaneous tissue of the stump exceeded that of the intact thigh by 12 per cent ($0.01 > P > 0.001$). Muscle and bone tissues of the stump were 55 per cent ($P < 0.001$) and 27 per cent ($0.01 > P > 0.001$) less, respectively, than those of the intact thigh. In the stump, skin and subcutaneous tissue were calculated to occupy a mean of 41.8 per cent, muscle 53.9 per cent and bone 4.3 per cent of the total cross-sectional area. Corresponding tissue proportions in the intact thigh were 21.3 per cent, 75.0 per cent and 3.7 per cent.

In relation to the intact side, the hip joint on the amputation side exhibited a reduction in strength of the flexor, extensor, abductor and adductor muscles of approximately the same extent, i.e. 43–48 per cent on an average. The muscle strength in the hip joint on the amputation side, like the relative volume of the stump, was significantly correlated to the stump length.

The femoral stump showed appreciable movement in the soft tissues within the socket. An arc of considerable dimension at the level of the knee and the sole of the foot corresponded to observed changes in angulation of the femoral stump within the socket. On full weightbearing on the prosthesis alone the distal end of the femur assumed its most distal, lateral and posterior position, obviously as a result of active muscular function for achievement of lateral stabilization of the pelvis and prevention of flexion (collapse) of the prosthetic knee joint.

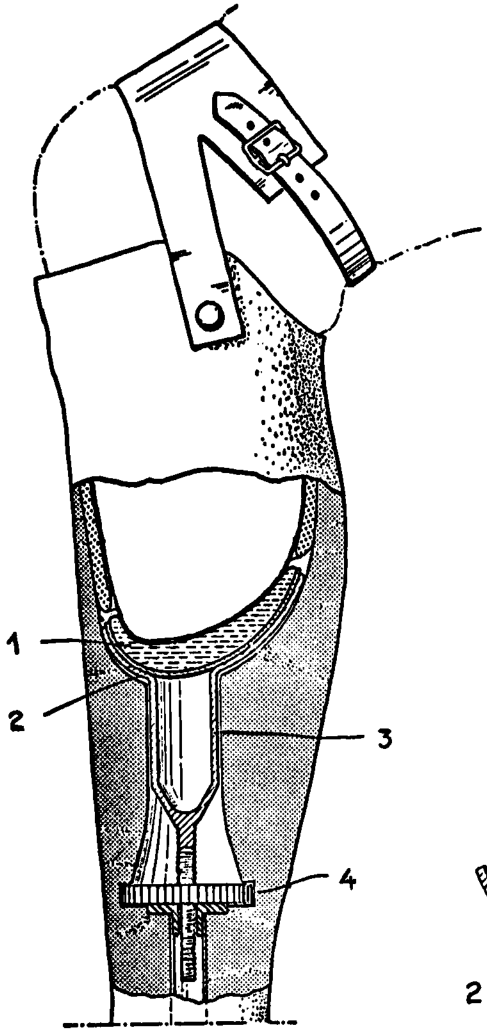
A NEW LEG PROSTHESIS SOCKET

Per Renström, Ian Goldie & Tryggve Eeg-Olofsson (Göteborg, Sweden)

A crucial problem for the leg amputee is the connection between the amputation stump and the socket of the prosthesis. Looseness of the socket results in instability; excessive tightness impairs the circulation and causes tissue damage. We have designed a socket with the object of providing a closer adjustment to the constantly varying shape of the stump, thus giving the individual the sensation of being "at one with his artificial leg".

The socket bottom consists of a floating pad filled with ordinary water connected to a pivot in the leg shell. Thus the socket adjusts itself to circumferential and longitudinal variations of the amputation stump. The amputation stump rests on a floating pad (1), which is attached to a cup (2) affixed to the pivot (3). The pivot can be lowered or heightened by turning the screw (4) which protrudes slightly outside the shell for manual control by the bearer. Because of the characteristic incompressibility of a fluid the connection between the amputation stump and the prosthesis becomes very solid. This solid connection gives very good contact with the ground for the bearer.

Figure 1.



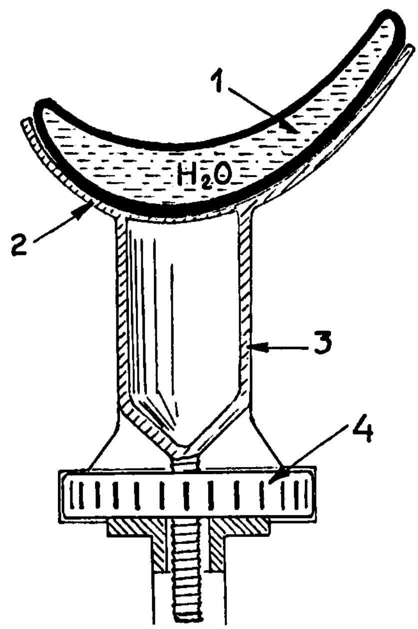


Figure 2.

This prosthesis has been used for three very difficult amputation stumps during a five-month trial period. One patient is a young man who for three years had continuous trouble and had tried no less than eight prostheses. During the time he has used the new design, his skin wounds have healed and he has been able to run, to do a full day's work, to drive a car and to dance. He has also reached full social adaptation.

METHODS FOR EVALUATION OF PROSTHETIC GAIT

Kurt E. T. Öberg & Urban James (Uppsala, Sweden)

Studies of prosthetic gait can be made from different aspects. In general a physical description of gait can be contained by the following factors:

Characteristic events	– temporal factors
Motion	– displacement
Dynamics	– changes of forces

A variety of measuring methods are available. There are optical methods and electromechanical methods. Also electromyography gives important information towards the physical description of gait as well as the physiological description.

In the clinic the following gait characteristic variables are measured:

- Swing and stance duration
- Step length and stride width
- Knee angles

The measuring equipment consists of:

- Test shoes with heel and foot switches
- Paper on the walkway for footprints
- Electrogoniometers
- Multichannel recorder

An additional non-instrumented study is also made for estimating the behavior of different prostheses, when the amputee is walking on different walkways such as stairs, ramps, etc.

From the measured data other important variables such as gait velocity and step frequency can be calculated.

For each patient comparison with normal gait can be done with respect to each variable. For unilateral amputees the asymmetry of the gait represented by the difference between the intact leg and the prosthetic leg for each variable can be studied.

For a more detailed study of the prosthetic gait a measuring and analysing method is being developed. Using a measuring instrument (SELSPOT) the gait motion and the floor reaction forces are measured. The instrument is connected online to a computer, where the data can be processed immediately.

PHYSICAL WORK PERFORMED BY SURGEONS DURING ORTHOPAEDIC OPERATIONS

Paul Lereim (Oslo, Norway)

Four surgeons participated in a study which aimed to demonstrate the physical work load during operations. Maximal oxygen uptake and maximum heart rate were determined by using the Douglas bag technique and recording the heart rate during the tests. By working at two submaximal work loads heart rate was recorded, and maximal oxygen uptake was determined indirectly.

Using telemetry, heart rate was recorded during the operation, and so the mean oxygen uptake could be determined. In 90 per cent of all operations the surgeons were working at a level of 20 to 30 per cent of their maximal aerobic capacity.

There was an increase in body temperature and a decrease in body weight with all operations. With very long operations a decrease of grip force was noted. My conclusion is that regular physical exercise would make the surgeon better prepared for his daily work, and hence be of benefit to his patients.

INABILITY TO WORK AFTER INJURIES. THE RELIABILITY OF PRIMARY PROGNOSTICATION

E. L. Nordentoft, W. Damholt, P. K. Pedersen & A. Tilma (Odense, Denmark)

The purpose of the investigation was to set up a simple model of graduation of severity of injuries, regardless of their nature or localization. The primary attending physician made an estimate as to the resulting disability in a large group of patients. The estimation was reexamined by checking on the duration of inability to work in 328 who normally do physical work, in the age range 25–50 years, all injured in traffic accidents. There was a wide scatter of results within the individual prognosis groups. However, with a fair amount of certainty, it was possible to define the time when 50 per cent of the injured persons had resumed work, and then to relate this to the estimated prognosis.

The method is judged to be applicable in cost accounting in cost-benefit analysis, and possibly as a basis of prepayment of daily benefits.

POSTOPERATIVE RESTORATION OF MUSCLE STRENGTH AFTER INTRAMEDULLARY NAILING OF FRACTURES OF THE FEMORAL SHAFT

Göran Danckwardt-Lillieström & Staffan Sjögren (Uppsala, Sweden)

During the period 1964–1969 a total of 45 patients with fractures of the femoral shaft were treated by intramedullary nailing after reaming. In 23 of them the isometric muscle strength on hip abduction, knee flexion and knee extension was measured. The values obtained were compared with values collected earlier from a reference material. The results indicated that as a rule the muscle strength in the intact leg was restored to almost a normal degree in two years. The restoration in the treated leg, particularly for knee flexion and knee extension, was significantly poorer. Even in the best group of patients, those below 50 years of age, with a femoral fracture alone and with an observation time of more than 2 years, the muscle strength on knee extension and knee flexion was lower than in the intact leg (9.0 Kp, significant, and 3.4 Kp, almost significant, respectively).

A rotation deformity in the fracture area seems to reduce the ability to regain muscle power in the treated as well as in the intact leg.

Reference:

Danckwardt-Lillieström, G. (1973) Intramedullary nailing of femoral shaft fractures after reaming of the medullary cavity. *Acta chir. scand.* **139**, 155–166.

POSTTRAUMATIC CHANGES OF SERUM IRON (FERRO-KINETIC STUDIES)

Danilo Zdravkovic (Odense, Denmark)

A constant and very strong decrease in serum iron after operative trauma was demonstrated in a selected group of patients. To investigate the problem, ferrokinetics were used on dogs. Five dogs were subjected to transverse femur osteotomies as artificial fractures, which were fixed with plates. Six dogs without trauma or anaesthesia and five dogs under anaesthesia alone were used as controls. The disappearance time for iron isotope (^{59}Fe) from plasma was less in the operated dogs and a very strong accumulation of isotope was observed in hepar, lien and bone marrow. The activity of red blood cells in the first five days, as a test of bone marrow function, was significantly lower after trauma. The reutilisation method with heat damaged red blood cells (^{59}Hb) was used to explore the role of the reticulo-endothelial system in posttraumatic iron metabolism. These investigations showed that the affinity of the reticulo-endothelial system for iron is increased posttraumatically and releasing of iron from the reticulo-endothelial system is blocked for a short period of time (about 14 days). Thus bone marrow has a shortage of iron for red blood cell production but purpose of this phenomenon is not yet known.

DICLOXACILLIN (DICLOCIL®) IN NON-SPECIFIC OSTITIS AND OSTEOMYELITIS

Per Holstein & Ole Hvid-Hansen (Hillerød, Denmark)

During the period 1.11.1967–31.10.1968 a consecutive and prospective series of 25 patients with non-specific ostitis or osteomyelitis was treated with dicloxacilline (Diclocil®) as an adjuvant to surgical therapy. In cases of infected osteosynthesis the practice was to let the osteosynthesis material remain *in situ* until stability at the fracture had been achieved. In 20 patients the infection healed during treatment, and in one patient the infection healed spontaneously later. Below-knee amputation had to be undertaken in one patient, and in three patients fistulae persisted. The follow-up period was 1–3 years. Dicloxacilline was found suitable for long-term therapy in bone infections. Side effects were few and no toxic damage to bone marrow, liver or kidney was registered.

LATE DIAGNOSED HIP JOINT DISLOCATION IN CHILDREN

Kurt Palmén (Falköping, Sweden)

During 1973 a total of 54 cases of late, i.e. after the newborn period, diagnosed hip joint dislocation or dysplasia in children were treated in the Swedish orthopaedic clinics. Only 13 came after one year of age. 39 were diagnosed between one to 6 months. Out of these six had luxation, six had subluxation and eight a slight dysplasia.

In 19 cases the diagnosis was uncertain. In my opinion several of these have had limited abduction owing to pelvic obliquity caused by a habitual one-sided posture. In such cases the X-ray examination is often misleading as the pelvic obliquity, among other things, gives a false increase to the acetabular angle. Such one-sided limited abduction disappears spontaneously during infancy.

49 cases were born at maternity clinics where a paediatric consultant, trained in hip joint examination, examined all the newborn. So we must accept that the diagnosis of hip dislocation cannot be made in the newborn period in a few cases.

In all cases during the second year of life it has been the mothers who have detected the limp in the children and come for help. To obtain an early diagnosis it is important to inform the doctors at the child health centres to examine the hip joints at every health check.

CONSERVATIVE TREATMENT AND OSTEOTOMY IN COXA PLANA. A RADIOLOGICAL STUDY

Tage Marklund & Bengt Tillberg (Linköping, Sweden)

The course of the disease and the primary end results have been compared in two treatment groups of coxa plana patients. One group was conservatively treated (33 patients—Thomas' splint), and the other group was submitted to osteotomy (28 patients—subtrochanteric derotation and varus osteotomy). The osteotomy group was younger on the average. The epiphyseal changes at discovery were also more advanced, indicating that the osteotomy treatment was given later in the disease than the conservative treatment.

For each patient a curve was made representing the course of the disease. From the serial radiographs the extent of the involvement of the epiphysis was assessed and plotted as a percentage of the normal epiphyseal volume against time. The curve has a descending part—the destructive phase and an ascending part—the phase of reconstruction. The turning point is situated where destruction changes into reconstruction.

In each group the curves were superimposed with their turning points coincident in time. The two sets of curves were then compared. There are no obvious differences between the two groups in the rates of destruction and reconstruction. This was statistically confirmed. The distribution of the extent of the maximal involvement is the same in the two groups.

In the same groups the primary end results were assessed. The deformity of the femoral heads was visually judged and classified from the radiographs. The slightly better result in the osteotomy group can be explained by the age distribution.

The course of the disease is obviously the same in the two groups. Osteotomy has neither arrested the destructive phase, nor influenced the rate of reconstruction. The end results (the shapes of the femoral heads) were roughly the same in the two groups. The conclusion is that the effect of the two treatments would seem to be equally good, equally bad or equally futile.

CORRECTION OSTEOTOMY OF THE TALUS AND CALCANEUS IN RELAPSING OR INCORRIGIBLE CLUBFEET. PRINCIPLES AND TECHNIQUE

Åke Hjelmstedt (Uppsala, Sweden)

In congenital clubfeet where conservative treatment has failed operative correction is indicated. In infants the choice of procedure has mainly been based on clinical examination. Detailed information of the skeletal deformity can, however, now be obtained by arthrography of the ankle and talonavicular joints.

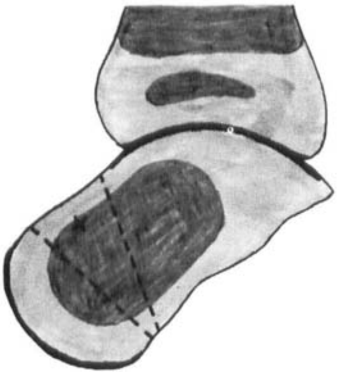


Figure 1 a. Lateral view of a clubfoot talus. Note the flattening of the trochlea and plantar deviation of the neck and head. The osteotomy lines are marked with short dashes. The cross indicates that the base of the wedge should as a rule be on the dorsolateral side of the neck.

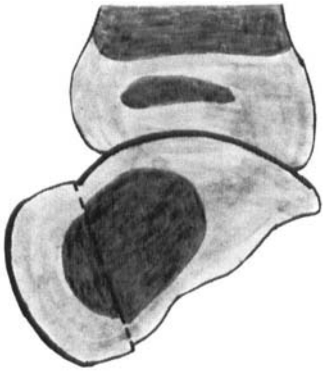


Figure 1 b. Correction after wedge osteotomy. The actual shortening of the talus will be about 10 per cent of its former length.

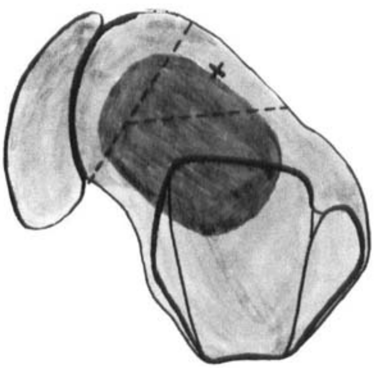


Figure 2 a. A clubfoot talus and the navicular bone from above. The joint borders are marked with broad lines and the osteotomy lines with short dashes. Note the pronounced medial deviation of the talar neck and head and the obliteration of the original talonavicular joint.

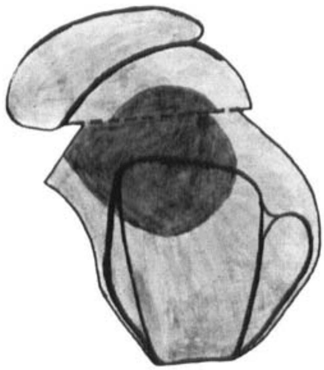


Figure 2 b. Correction after osteotomy.

The arthrogram will often show a pronounced plantar deviation of the talar head even when the talus is in maximal dorsiflexion (Figure 1 a). Correction seems possible only by performing wedge osteotomy (Figure 1 b).

Pronounced medial deviation of the talar head is a common feature and when it is combined with an obliteration of the original talonavicular joint (Figure 2 a) correction by osteotomy seems to be the only rational procedure (Figure 2 b).

A wedge osteotomy through the distal part of the calcaneus is done simultaneously.

The operation also includes the following procedures:

1. always a lengthening of the posterior tibial tendon and section of the tibionavicular ligament.
2. as a rule an extra periosteal release of the plantar fascia and the abductor hallucis muscle and shortening of the peroneal tendons.
3. sometimes a lengthening of the tendon Achillae the necessity for which is based on the arthrographic study of the ankle joint mobility.

CRURAL FRACTURES IN CHILDREN

J. Greiff, B. A. Hansen & F. Bergman (Gentofte, Denmark)

Eighty-one patients with fissures, infractions and fractures in the lower leg were studied 13–36 months after the trauma. A "spot" orthoradiogram was made and analysed. It was found that the increase in growth depended on the age generally, on the angulation at the time healing had occurred and around puberty also on sex.

Furthermore it showed that the difference in the tibial length caused by a fracture is not of significance for the well-being of the patients.

The conclusion made was that crural fractures in children especially around and after puberty should be treated with the same claim for reduction as in adults, spontaneous correction being somewhat less frequent than generally agreed.

THE EFFECT OF PSEUDARTHROSIS ON LONGITUDINAL GROWTH

Soini Ryöppy, Reijo Mäkinen & Erkki Karaharju (Helsinki, Finland)

The experience acquired from clinical practice shows that a congenital or acquired pseudarthrosis causes a diminution of longitudinal growth. Theoretically, this phenomenon could have several pathogenic factors, e.g. change of mechanical stresses to the bone, change of circulation etc. Very little information is available about the factors involved.

In this study the effect of an experimentally produced non-union on the longitudinal growth of the fibula and the tibia was investigated using the rabbit. An operative resection of the fibula was performed on rabbits aged three weeks. The union was prohibited by placing a polyethylene film between the fragments. Metallic markers were placed in the tibia and the fibula and the longitudinal growth was checked weekly by X-ray. The animals still in the growing period were given oxytetracycline one week before sacrifice at six to twenty-eight weeks after the operation.

The growth of the tibia of the operated leg was slightly retarded compared to the control side. The longitudinal growth of the operated fibula was statistically significantly retarded some weeks after the operation (Figure 1). On the animals with fusion of the resected area the growth of the fibula continued almost normally. The growth of the fibula with non-union took place at a slower rate than that of the control side, but otherwise the growth curves had the same form.

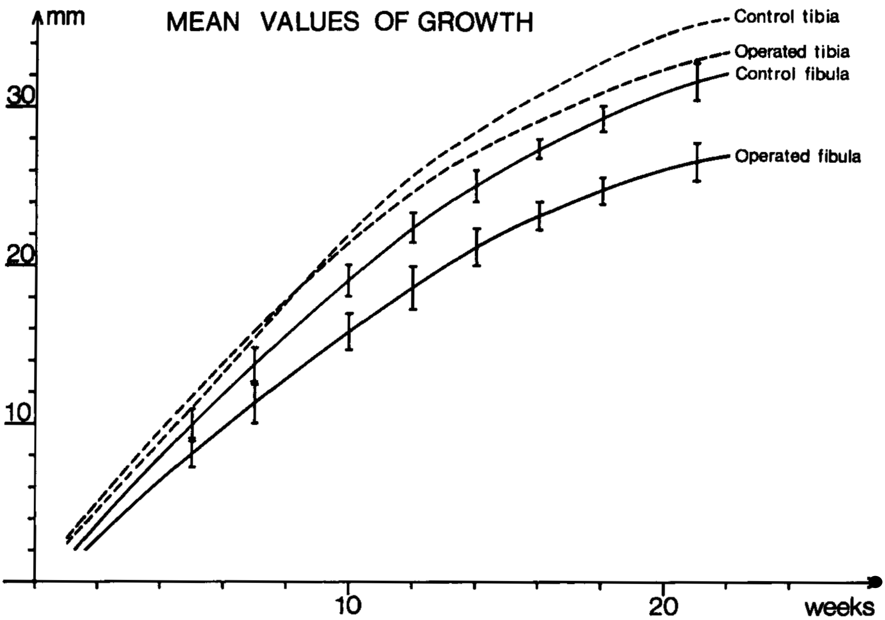


Figure 1. Mean values of longitudinal growth of the proximal epiphysis of the leg with an experimentally produced non-union of the fibula on the rabbit.

From the evidence obtained it is concluded that:

1. An experimentally produced non-union in a growing long bone causes a gradually increasing retardation of the longitudinal growth.
2. This phenomenon can be produced without functional inactivity.
3. It seems evident that the cause of this phenomenon is not a circulatory one. Instead, the epiphyseal growth is probably dependent on the mechanical stimulus transmitted by the continuity of the bone.

OPERATIVE TREATMENT FOR GROWTH DISTURBANCE AFTER EPIPHYSEAL INJURY

A. Langenskiöld (Helsinki, Finland)

In 1967 the author reported a case in which a deformity in the tibia had been caused by a bony bridge between the epiphysis and the metaphysis. The deformity was partly corrected by growth after resection of the bone bridge and its replacement with a free fat transplant.

After experimental studies on animals, nine children with partial premature epiphyseal closure were operated on with a positive result. The effect of the operation is based on three experimentally proved facts: 1. When part of an epiphyseal plate is destroyed and the formation of bone tissue uniting the epiphysis to the metaphysis is prevented, the destroyed portion of cartilage is replaced by regeneration of cartilage from the adjacent parts of the plate (Langenskiöld & Edgren, *Acta chir. scand.* (1949) **99**, 353). 2. When a bone bridge connecting an epiphysis to a metaphysis is resected and replaced with a free fat transplant recurrence of the bone bridge is prevented. 3. When the deforming effect of partial premature closure of a growth plate is eliminated gradual correction of the deformity by growth can take place (Österman, *Acta orthop. scand.* (1972) Suppl. 147).

Two of the operated cases in which an angulation deformity of 20–30 degrees was completely corrected by growth are reported.

STUDIES OF GROWTH HORMONE IN GIRLS WITH IDIOPATHIC STRUCTURAL SCOLIOSIS

S. Willner, K. O. Nilsson & C. G. Bergstrand (Lund, Sweden)

It has been noticed that girls with idiopathic scoliosis are taller (even before the diagnosis has been made) and leaner than comparable nonscoliotic controls in Sweden (Willner, *Clin. Orthop.* (1974) in press).

It was thought that this difference might be related to the growth hormone (GH) and for this reason GH was determined in plasma by double antibody radioimmunoassay during the following conditions: 1. insulin hypoglycemia; 2. glucose tolerance test; 3. exercise.

Results:

A. After overnight fasting and after at least one hour of rest the GH level was 9.8 ± 11.1 ng/ml in the scoliotic girls (n = 48) and 2.2 ± 1.1 ng/ml in the controls (n = 15). The difference is significant ($0.02 > P > 0.01$). B. In the insulin hypoglycemia test the peak GH value was 33.2 ± 19.1 ng/ml in the scoliotic girls (n = 27) and 20.8 ± 8.3 ng/ml in the controls (n = 8). This difference is, however, not significant ($0.1 > P > 0.05$). C. In the exercise test the maximal value was observed at different times from the start of the test: at 20 minutes in the scoliotic girls (n = 14. GH 17.3 ± 11.8 ng/ml) and at 40 minutes in the controls (n = 9. GH 16.0 ± 6.6 ng/ml). D. In the glucose tolerance test the GH level was suppressed in both groups but the mean GH levels tended to be higher during the first 120 minutes of the test in the scoliotic girls.

Conclusion:

The observed differences in growth hormone response during the various tests, including statistically significant higher basal values, could indicate an increased GH secretion in idiopathic scoliosis.

NUCLEIC ACIDS IN HUMAN ARTICULAR CARTILAGE—NORMAL AND OSTEOARTHRITIC

Hans Telhag (Malmö, Sweden)

Adult jont cartilage was formerly regarded as a tissue with relatively little metabolic activity. Research during the past few decades has shown, however, that degenerative changes of the cartilage are accompanied by an increased synthesis of DNA, glycosaminoglycans and collagen, changes which are regarded as signs of repair.

At operations on joints of patients with osteoarthritis specimens of severely degenerated cartilage of the femoral head were removed and as control material, cartilage from knee joints at meniscectomy. DNA and RNA concentrations were reduced in advanced osteoarthritis, whereas synthesis of DNA and RNA was increased in relation to the number of cells in the tissue. Since there is a constant relationship between the DNA concentration and the number of cells in the tissue, the investigation shows that the remaining chondrocytes in the markedly degenerated cartilage are metabolically more active than those in normal cartilage.

LATE OSTEOARTHRITIS OF THE HIP AND KNEE JOINT IN NORWEGIAN FOOTBALL PLAYERS

Asbjørn Roaas & Ragnar Bjørn-Hansen (Sandvika, Norway)

Twenty-five former football players were compared with 25 persons who had not taken part in any athletic activity.

There was no significant difference in occurrence of osteoarthritis of the hip joints between the two groups as judged by roentgenological and clinical examinations.

As regards the knee joints, there were 40 with osteoarthritis in the football group against 35 in the control group, but there was a greater occurrence of varus in the football group and more osteoarthritis in the varus than in the valgus group. Furthermore there were more overweight footballers.

It is concluded that there is no significant difference in the frequency of osteoarthritis of the hip or knee joints in the two groups. It seems that "overuse" or "repeated micro-traumas" do not play any important role in the development of osteoarthritis in the hip and knee joints.

GUNSTON ARTHROPLASTY OF THE KNEE

Uolevi Kankaanpää & Pauli Raunio (Heinola, Finland)

From 1971 to 1973 Gunston arthroplasty was performed at the Rheumatism Foundation Hospital, Heinola on 54 knees in 50 patients afflicted with rheumatoid arthritis. Fifty of the knees have been followed up from 6 months to 3 years (average 1 year and 6 months). The mean age of the patients was 51 years (ranging from 22 to 62 years).

At first the indications for arthroplasty were the same as for arthrodesis, but later they were modified.

The alleviation of pain was the greatest benefit from the procedure in the pa-

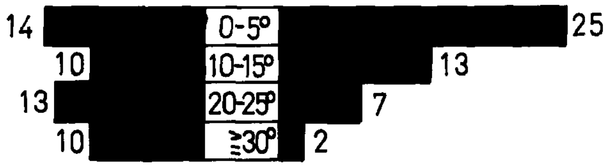


Figure 1. Distribution of the knees according to the degree of flexion contracture pre- and postoperatively.

Table 1. Distribution of the knees into the categories of pain in the first and second operation period.

Oper. period	Pain category				Total
	0	1	2	3	
I	6	9	7	1	23
II	4	20	1	0	25
total	10	29	8	1	48

tients' opinion as well. Forty-five out of 50 patients felt that the knee had markedly improved after surgery. Knees without pain totalled 10 (20 per cent), and in 29 knees (58 per cent) there was intermittent pain while walking.

When the material was divided into two chronological groups, one with a follow-up of 2 years and 6 months (operation period I) and the other with a follow-up of 1 year and 3 months (operation period II), the former group showed poorer results (Table 1). The categories of pain were: 0 = no pain, 1 = intermittent pain, 2 = continuous pain on attempting to walk, 3 = severe pain.

The mean decrease in flexion was 11° (103°–92°), whereas the decrease in range of movement averaged 3° (85°–82°).

The improvement of flexion contracture was good (Figure 1).

Prior to surgery the number of unstable knees totalled 34 (more than 5° instability when loaded) and the stable ones numbered 14. After surgery the situation was almost the reverse, the unstable totalled 13 and the stable 35. Out of the postoperative complications three knees with deep infection may be mentioned. Geometric arthroplasty was performed on one of these at a later stage and the other two were fused in connection with the removal of the endoprosthesis. Furthermore, two femoral prostheses were broken; one breakage led to arthrodesis and the other was one of the cases of deep infection mentioned above.

Narrowing of the joint space, which was considered to be due to the tibial prosthesis sinking into the bone as well as to the HDP plastic wearing off, was revealed roentgenologically in 22 out of 48 patients during the follow-up. The intensity of these changes was in direct relation to the length of the follow-up.

RECONSTRUCTION OF THE KNEE JOINT WITH THE FREEMAN-SWANSON PROSTHESIS

Peter Herberts & Gunnar Andersson (Göteborg, Sweden)

Preliminary results were presented of twenty knee arthroplastics using the Freeman-Swanson knee prosthesis. Nineteen patients had severe rheumatoid arthritis, one patient had an advanced osteoarthrosis. All patients were studied preoperatively and postoperatively at fixed intervals in relation to the operation. The operation was offered to those who were chair-bound and to those patients who would accept an arthrodesis. Time of observation varied from six to twenty-four months. Pain, walking ability, range of movement, flexion deformity and valgus or varus deformity combined with instability were evaluated. In an attempt to make a total assessment of the procedure 75 per cent were graded as good. They were pain-free, able to walk outdoors and had a range of movement from –5° to 90°. The knees were stable and showed a varus or valgus deformity of less than 10°. Twenty per cent were improved and graded as acceptable and only 5 per cent were unchanged or deteriorated and graded as poor. No infection or loosening was observed in this study.

ALLERGIC COBALT REACTION (METALLOSIS) FOLLOWING KNEE ARTHROPLASTY WITH VITALLIUM ENDOPROSTHESIS *AD MODUM* WALLDIUS

Anders Wigren & Torkel Fischer (Uppsala, Sweden)

A case report is given of a woman with rheumatoid arthritis and severely deformed knee joints. She had a knee arthroplasty with a metal-to-metal Vitallium endoprosthesis *ad modum* Walldius. Eight months after the arthroplasty a sterile fistulation began from the knee joint. The fistula was closed operatively. Fifteen months after the arthroplasty there was eczema of the skin of the operated knee. The eczema followed the projection of the contours of the endoprosthesis on the skin. An epicutaneous test for cobalt before the arthroplasty was negative. Fifteen months after the operation it was positive. A pathological investigation of the eczema and the epicutaneous test area of the skin showed deep inflammatory reaction equal for the eczema and test skin area.

The patient had no pain in the operated knee and the function of the prosthesis was good throughout the observation time.

Treatment with local steroids made the eczema disappear in 3 months. It is suggested that the metal-to-metal contact will increase the release of ions from the cobalt chromium alloy Vitallium and that the proximity of the prosthesis to the skin is a possible explanation for the skin reaction.

CIRCULATORY AND RESPIRATORY DYSFUNCTION DURING TOTAL HIP REPLACEMENT

The importance of thromboplastic products, fat embolism and acrylic monomers

Jan Modig, Christer Busch & Sven Olerud (Uppsala, Sweden)

The operative procedure of total hip replacement involves a considerable trauma, and there are many reports in the literature of serious cardiovascular reactions and even deaths during intramedullary orthopaedic surgery using acrylic bone cement. These complications occur notably following impaction of the femoral prosthesis into the bone marrow cavity filled with acrylic cement. Many tentative explanations for these reactions have been suggested.

In order to study this more closely an investigation concerning respiration, circulation and coagulation was performed in patients undergoing prosthetic hip surgery using the Charnley technique. Operations were performed under epidural analgesia with the patients awake and breathing air. Additional experimental work with intravenous injections of acrylic monomers was performed in dogs.

Major respiratory and circulatory depressions occurred regularly after impaction of the femoral prosthesis and minor depressions appeared after insertion of the acetabular prosthesis. It is established from these studies that the circulatory and respiratory phenomena are mainly caused by the release of tissue thromboplastic products into the circulation causing aggregation of platelets and fibrin in the lungs, i.e. intravascular coagulation. The fat droplets *per se* in the pulmonary circulation are of minor importance and the release of acrylic monomers into the lungs is probably of no importance.

INTRAOSSEOUS PRESSURE OF THE FEMORAL HEAD BEFORE AND ONE TO THREE YEARS AFTER OSTEOTOMY IN OSTEOARTHRITIS OF THE HIP JOINT

N. B. Termansen & K. Okholm (Odense, Denmark)

In 22 patients with osteoarthritis of the hip joint intraosseous pressure was measured before and 11½ to 33½ months after intertrochanteric osteotomy. The mean pressure of the femoral head was higher than that of the greater trochanter. After healing of the osteotomy the mean pressure of the femoral head in all 22 patients was reduced, but not significantly. Significant reduction of pressure was found in patients with high primary pressures (above 35 mmHg) and in patients re-examined less than 2 years after osteotomy, whereas there was a tendency for increasing pressure after that time.—The clinical effect of the operation was good. Only one patient suffered from rest pains at the re-examination.—Disappearance of rest pains may be explained by reduction of intraosseous hypertension lasting for some years. After that intraosseous hypertension might be slowly re-established.

FEMORAL FRACTURES AFTER MOORE ARTHROPLASTY OR McLAUGHLIN OSTEOSYNTHESIS

Børge Ruben Hansen (Copenhagen, Denmark)

The insertion of an inert surgical implant in living bone alters the biomechanical factors and induces stress concentrations in the transmission zones. Loading of the system repeatedly results in minute relative movements between the implant and the bone and may be the fundamental cause of a late fracture.

Thirty-six patients with a hip prosthesis and twenty-three patients with a proximal internal fixation sustained a secondary fracture. Most of the fractures were localized to or below the level of the shaft of the prosthesis or the McLaughlin plate—all were oblique fractures with considerable instability.

In unstable fractures secondary to a Moore arthroplasty an internal fixation with a lateral eight-hole plate has been considered the most convenient method. In fractures secondary to a McLaughlin operation the original implant has been replaced with a long-plate McLaughlin.

RECURRENT DISLOCATION OF THE SHOULDER. TREATMENT WITH SUB-CAPITAL ROTATION-OSTEOTOMY

B. G. Weber (St. Gallen, Switzerland)

Most procedures such as tightening up the enlarged anterior soft tissue compartment of dislocating shoulders are successful, as they more or less limit external rotation. This general experience applies to our own 66 patients, operated on from 1960 to 1966, with a modified Putti-Platt technique. On the average, these patients showed a loss of external rotation of 32°—none of them had a recurrence.

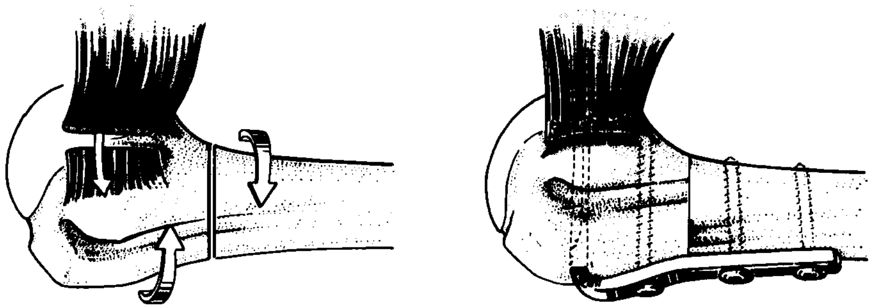


Figure 1 c.

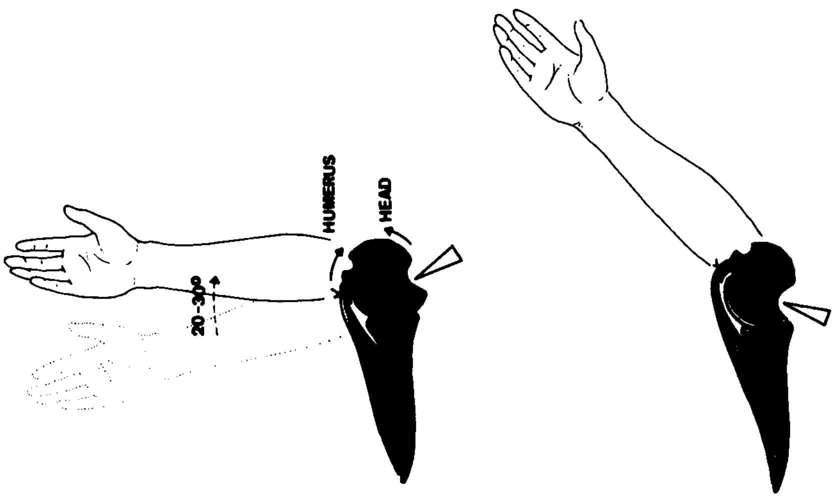


Figure 1 b.

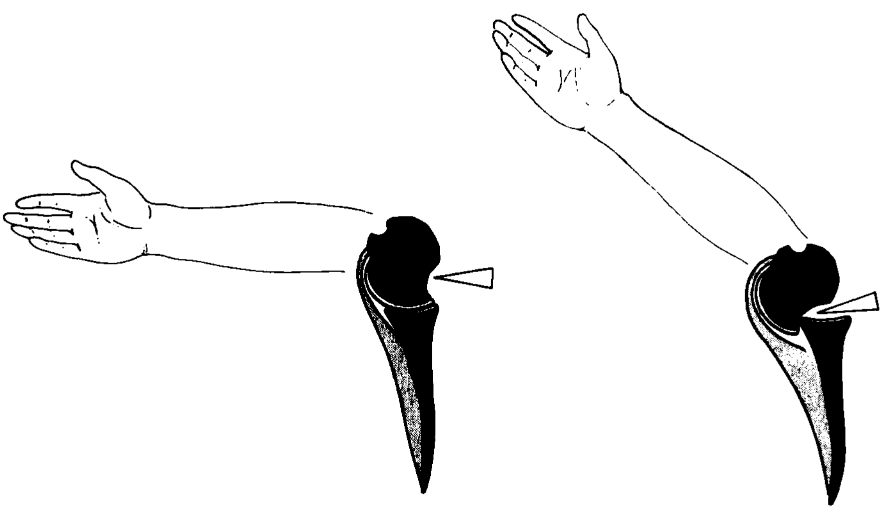


Figure 1 a.

Once in 1964 and another 67 times, from 1967 to 1972, in cases with a marked "encoche de *Malgaigne*", i.e. a typical impression-fracture of the humeral head on its posterior surface (*Hill-Sachs, Hermodson*) an operation was tried out according to the idea demonstrated in Figure 1:

a) Subluxation occurs in external rotation as the posterior humeral defect slips over the anterior glenoid margin.
b) Prior external rotation allows the posterior defect no access to the glenoid rim for dislocation to occur, if by means of an osteotomy the humeral head has been rotated inwards in relation to the long axis of the humeral shaft.
c) Such a rotation osteotomy of 20 to 25 degrees, performed from a standard delto-pectoral aproach, is stabilised with an adapted small AO-compression plate, actually refined as a dynamic-compression plate. The subscapularis tendon is shortened at the same time by 1 cm.

The aftercare is very simple. No splintage is needed, but free movements may be allowed a few days after operation, progressing to full mobility in 6–8 weeks, in step with healing of the osteotomy.

In our whole series of 68 cases, no recurrence has occurred. One case had a low grade infection with staphylococcus albus, subsiding after removal of the plate, but never the less had a perfect end result. In contrast to many other operations, the osteotomy described does not sacrifice joint mobility; there is free external rotation, a fact not only very important to sportsmen, but also in every day life.

FRACTURE OF THE SHAFT OF THE TIBIA

Per Edwards (Malmö, Sweden)

The prognosis of a tibial fracture is above all dependent on
1) The etiology—the type of fracture.
2) The extent of soft tissue injury—the size and location of the wound.
3) Complications—especially infection.
4) The age of the patient.

The difficulty in comparing different methods of treatment lies in the fact that there are no universally, accepted definitions of the different variables: The type of fracture, the extent of soft tissue injury, the evaluation of healing time and the end result etc.

It is proposed that the Scandinavian Orthopaedic Society defines these variables for publishing of papers in Acta orthop. scand.

Open treatment of closed tibial fractures of the transverse type causes a high frequency of complications, especially when treated by AO compression osteosynthesis (Olerud & Karlström 1972). The use of the AO-plate on a large scale does not seem to improve the functional end results (Bender 1970).

A careful estimate of the value of new closed methods is of great importance, therefore a prospective series has been started in Lund and Malmö treating different types of tibial fracture with PTB-cast with a movable ankle joint according to Sarmiento.

Open fractures, especially those with big lacerations of the skin, are the great problem. I think that the treatment of those fractures should be centralized.

PRIMARY OPERATIVE TREATMENT OF LONG BONE FRACTURES IN PATIENTS WITH MULTIPLE INJURIES

Erik B. Riska & Timo Paavilainen (Helsinki, Finland)

Early mobilization is essential for patients with multiple injuries in order to prevent thrombo-embolic disease, weakening of muscle power, stiffening of joints, psychical inactivity and hospitalization, perhaps even death. This applies particularly to the treatment of patients with several long-bone fractures together with

Table 1. Long-bone fractures in 33 patients with multiple injuries.

Bone	Number	Number of open fractures
Femur	42	9
Tibia	22	10
Fibula	19	10
Humerus	6	
Radius	11	
Ulna	10	2
Total	110	31

Table 2. Methods of osteosynthesis of long-bone fractures in 33 patients with multiple injuries.

Method of osteosynthesis	Number of bones treated operatively
Intramedullary nailing (Küntscher)	*40*
of femur	27
of tibia	12
of humerus	1
Screw and L-plate fixation (AO)	*8*
of distal femur	8
Screw and plate fixation (AO)	*17*
of femur	1
of humerus	2
of radius	6
of ulna	8
Screw fixation (AO)	*4*
of tibial condyle	4
Osteotaxis (Hoffmann)	*3*
of tibia	3
Jewett, Barnes, or McLaughlin	*6*
of femoral neck	6
Total number of long bones	*78*

Table 3. Treatment of associated injuries in 33 patients with multiple injuries and operatively treated long-bone fractures.

Methods of treatment	Number of cases
Thoracotomy	2
Abdominal operation	3
Tracheostomy	5
Antero-lateral decompression	1
Osteosynthesis of pelvis (AO)	2
Screw fixation of short bones (AO)	4
Repair of injured ligaments	3
Patellectomy	2
Resection of aortic arch	1
Repair of big artery	1
Osteosynthesis of facial bones	2

Table 4. Mobilization, and duration of hospital treatment of 33 patients with multiple injuries and operatively treated long-bone fractures.

Mobilization on crutches after	Number of patients	Duration of hospital treatment	Number of patients
3 weeks	2	3 weeks	2
4 „	5	4 „	6
5 „	1	5 „	2
6–7 „	7	6–7 „	3
2 months	2	2 months	3
2½ „	5	2½ „	5
3 „	5	3 „	3
3½ „	3	3½ „	3
11 „	1	4 „	2
Bedridden	1	5% „	3
Death	1	Bedridden	1
Total	33	Total	33

other injuries. The conservative treatment of these fractures with reduction and plaster immobilization was one of the main factors in preventing early mobilization and has therefore been replaced in our clinic by rigid internal fixation since 1969. Ever since that year and up to 1972 thirty-three patients with multiple injuries and at least two long-bone fractures were treated at the intensive care unit after which the hospital treatment was continued traditionally.

Of these 33 consecutive cases, 24 were men and 9 women; 25 were under 50 years and 8 aged over 55 years at the time of the accident. All together 110 long bones were broken in 33 patients (Table 1). Thirty-one were open fractures. Additionally,

Table 5. Results of treatment of 33 patients with multiple injuries and operatively treated long-bone fractures.

Working capacity	Number of patients
Returned to former work	*23*
4 months after the accident	2
5 " " " "	2
6 " " " "	2
7 " " " "	1
8 " " " "	6
9 " " " "	1
10 " " " "	1
11 " " " "	2
12 " " " "	4
13 " " " "	1
16 " " " "	1
Returned to light work	*3*
10 months after the accident	1
15 " " " "	1
16 " " " "	1
Permanently unable to work	*4*
Retired on pension before the accident	*2*
Death	*1*
Total	33

Table 6. Complications in the treatment of 33 patients with multiple injuries.

Complication	Number of cases
Fat embolism (7 before surgery)	*8*
Thromboembolic disease	*2*
Wound infection	*5*
Death (heart disease, 80 years)	*1*
Pseudarthrosis	*3*
of distal femur	1
of tibia	1
of ulna	1

16 patients had a cerebral injury, 18 a chest injury, five an intra-abdominal injury, ten a pelvic fracture, four a fracture of the spine, one a rupture of the brachial artery, and one a rupture of the aortic arch.

The primary operative treatment of long-bone fractures was given within 2 weeks after the accident; in most cases within the first day (Table 2). At the same time

Table 7. Results of treatment of 33 patients with multiple injuries and operatively treated long-bone fractures.

Result	Number of patients
Complete recovery with no disability	*12*
Recovery with slight disability	*14*
Recovery with severe disability	*6*
1 patient with paraplegia	
1 patient with hemiplegia	
1 patient with paralysis of brachial plexus	
1 patient with chronic alcoholism	
1 patient aged 68 years with severe limp	
1 patient aged 59 years with severe limp	
Death	*1*
Total	33

or at a separate operation additional procedures were indicated because of associated injuries (Table 3).

With primary operative treatment of long-bone fractures of patients with multiple injuries it was possible to mobilize 30 patients out of 33 within three and a half months, and 29 were allowed to leave hospital within 4 months (Table 4). With the exception of the death of an 80-year-old woman, no severe complications because of the treatment could be registered, and 22 patients returned to work within one year (Table 5). The fat embolism syndrome was not a contraindication for surgical intervention (Table 6). Twelve patients recovered completely, and 14 remained slightly disabled (Table 7). The results of these 33 operatively-treated patients indicate the advantages of more active treatment of patients with multiple injuries and long-bone fractures as opposed to the usual conservative treatment of to-day.

SKIN AND SOFT PART INJURIES IN 150 OPEN FRACTURES OF THE TIBIA

P. A. Tønnesen, J. Heerfordt & M. Pers (Copenhagen, Denmark)

The records of 150 consecutive, open fractures of the shaft of the tibia, treated at Dept. M, Bispebjerg Hospital, Copenhagen, Denmark, between 1958 and 1970, were reviewed in order to examine the relationship between the severity of the trauma, the method of treatment, the number and type of complications and the time for recovery.

140 cases were rated as high-energy trauma according to the definition of Bauer et al., being roughly equivalent to grade 2 and 3 according to the soft part injury grading from 1 to 3 of Matter and Olerud, 65 per cent of the cases were treated with plaster-casts alone or in combination with skeletal traction. 35 per cent had conventional, non-compression plate osteosynthesis done. Intramedullary nailing, compression-plates and osteotaxis were not employed in this series. Decompressive incisions and split-skin grafting were used fairly extensively. In spite of this a

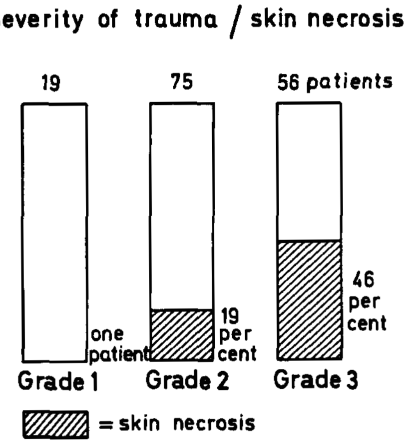


Figure 1.

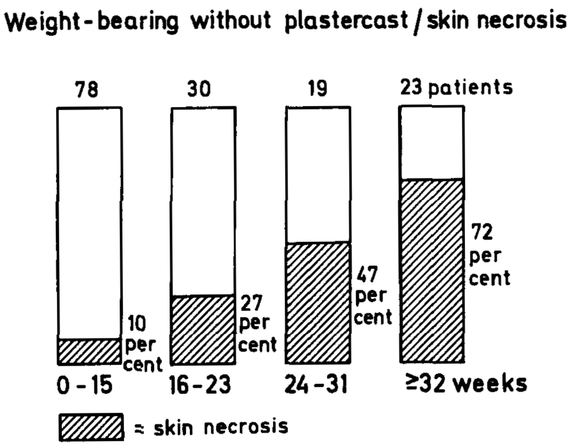


Figure 2.

rather considerable incidence of skin necrosis occurred, increasing with the severity of trauma (Figure 1).

The even more striking correlation between skin necrosis and delayed union is demonstrated in Figure 2.

Well aware that no patent solution exists for the problems posed by open tibial fractures caused by high-energy trauma we conclude that neither internal fixation nor plaster-cast treatment seem to be ideal. It is suggested that immobilization is instead accomplished by transfixation by the Hoffmann method, and primary closure by a sufficiently critical and radical application of the principles of plastic surgery.

FRACTURES OF THE SHAFT OF THE TIBIA TREATED WITH TRANSFIXATION

Erik Hørlyck (Næstved, Denmark)

Thirty-five patients with unstable fractures of the shaft of the tibia were treated with transfixation and plaster. Steinman pins were drilled through the tibia transversely one or two on either side of the practure. Reduction was performed and a plaster cast applied from toes to groin. The pins were kept in the plaster. The patients were mobilized after one week when possible.

Thirty-two patients had comminuted fractures many with severe comminution and 24 had open fractures. In 19 patients the fracture was situated in the distal part of the shaft sometimes including the metaphysis. Secondary dislocation during transfixation was seen in four patients. Transfixation was maintained for 2–3 months. A shorter time of fixation resulted in a risk of secondary dislocation. Loosening of the pins was seen in seven cases. Suppuration from the pin holes occurred in four; in all cases it was short-lasting. Immobilization in plaster continued until fracture healing was achieved. In 15 patients this was achieved in less than 4 months, in six from 4 to 6 months and in 14 it took more than 6 months. Pseudarthroses developed in four patients. In three cases of pseudarthroses the transfixation could not be held responsible. With a follow-up study we found only 10 per cent had a slight restriction in the movement of the knee joint. In the ankle joint flexion/extension was restricted more than 10° in 25 per cent and inversion/eversion restricted more than one third in 10 per cent.

FRACTURES OF THE TIBIA—A COMPARISON BETWEEN CONSERVATIVE TREATMENT, PLATE-OSTEOSYNTHESIS AND OSTEOTAXIS *AD MODUM* HOFFMANN

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

A series of 524 fractures of the tibia was reviewed. Sixty-five per cent were traffic accidents. Forty-five per cent of the fractures were open. Special attention was paid to skin infection, ostitis, pseudoarthrosis and amputation correlated to primary skin injury, level of the fracture and degree of displacement. Primary skin injury and displacement were found to be most important for the prognosis. Pseudoarthrosis was most frequent in the proximal part of the tibia.

The conservatively treated fractures had the shortest time of healing and the smallest number of complications. Osteotaxis *ad modum* Hoffmann showed a lower frequency of ostitis and pseudoarthrosis compared with plate osteosynthesis.

510 fractures were healed, nine cases still have support and four were amputated at the time of review.

TREATMENT OF LEG FRACTURES

Gunnar Aas-Aune (Trondheim, Norway)

A 10-year survey of 2717 diaphyseal fractures in 1969 at this hospital showed a restrictive attitude to operative treatment of leg fractures, in particular the open ones. The frequency of pseudoarthrosis in 1163 leg fractures was 3.3 per cent.

During the period 1970–72 a more enthusiastic attitude to surgery was attained, and in the present survey a comparison of treatment and results of leg fractures among adults during the years 1970 and 1973 has been carried out. It appears that in both years 55 leg fractures were treated, the number of open fractures in 1970 and '73 being 12 and 8, respectively.

In the groups treated conservatively, the rate of complications was two out of seven, and four out of 34 for open and closed fractures, respectively, whereas in the operatively treated groups the figures were two out of 13 and 19 out of 55.

It is concluded, that open fractures should preferably be treated by operative methods, whereas closed fractures should have a more conservative treatment.

SEGMENTAL TIBIAL SHAFT FRACTURES

Ø. Langård & O. Bø (Oslo, Norway)

This report concerns a total of 54 cases with double fractures of the tibia treated during the period 1968–1972.

Sixty-eight per cent of the cases were pedestrians hit by a car. Fifty-two per cent were open fractures.

Operative treatment predominated; osteosynthesis was performed in 33 cases, whereas 21 were treated conservatively. Plate-osteosynthesis was accomplished in 15 cases, seven had intramedullary nailing, and two were treated by Hoffmann's external fixation device. Only one patient sustained a severe complication, i.e. deep wound infection and osteomyelitis; however, even this infection was transient.

All fractures healed except those in two patients who died within three months; these deaths, however, were without any causal relationship to the osteosynthesis.

One patient had a traumatic vascular lesion concomitant with the fracture, and his leg was amputated three days after the injury. Another patient had his leg amputated one year after his accident; this also because of injury to the vessels and nerves. None of these amputations could be ascribed to the osteosynthesis.

It is concluded from the present series that segmental, i.e. double tibial shaft fractures do not entail more complications nor exhibit a slower rate of union than simple tibial shaft fractures if the treatment is individualized and also if due consideration is given to the soft tissue injury.

TIBIA FRACTURES—EFFECT OF FRACTURE TYPE ON HEALING TIME AND NON-UNION FREQUENCY

V. Valdemar Surin, Göran Markhede & Krister Sundholm (Borås, Sweden)

The material is an analysis of 337 tibial diaphyseal fractures in patients over 15 years of age. In analysing the sex distribution of the fracture patients a very high over-representation of the male sex was appearent, especially in patients with transverse dislocated fractures (ratio 6:1). This does not correlate with the sex ratio for traffic accidents (2:1) from the general Swedish statistics. One explanation may be the different mechanical behaviour of female tibial bone.

The authors investigated by statistical methods the healing time for different fracture groups. The most protracted healing time was in the transverse dislocated fracture group. By investigating factors influencing the healing course, chronic suppuration was found to have the most deleterious effect. An open wound had a significant effect on fracture healing time only in transverse dislocated fractures and only in wounds of grade 3 magnitude. Factors of no significance were age, sex and associated trauma. Operation proved of no significant effect except on the 95 per cent values for both transverse and oblique fractures, which were significantly lengthened.

In statistically evaluating factors influencing development of non-union the following were evident: Factors without significance were age of patients and comminution of the fracture site. Factors enhancing the risk for non-union were operation, especially osteosynthesis with Rush pins and cerclage and infection, both recent and late. Open wounds had a significant effect only when of grade 3 magnitude and continuous traction only in cases with more than 3 weeks duration.

OSTEOMYELITIS AFTER OPERATIVE FRACTURE TREATMENT

Rolf Hagen (Bærum, Norway)

During the years 1967–1972 a total of 50 patients with a history of 51 fractures were treated at Martina Hansens Hospital for osteomyelitis after osteosynthesis.

The lower extremities were fractured in 88.2 per cent of the cases, mainly tibia and femur, and 56.9 per cent of the material were closed injuries. The fractures, mostly caused by traffic accidents and falls, were immobilized by plates in 22 and intramedullary nails or pins in 21 patients.

On admission, staphylococci aurei were cultured in 41 cases (80.4 per cent), 70 per cent of them were penicillin-resistant, but in 32 out of 41 cases the organisms were highly lincosin-sensitive and only three patients with four osteomyelitic lesions presented lincosin-resistance.

The treatment consisted chiefly of sequestrectomies and saucerizations supported by 3–12 months' duration of lincosin treatment. In 24 operations a closed irrigation-suction technique was used, perfusing the wound with lincosin-solution. It was found that intramedullary rods with rigid fixation should be left in place until the fracture is clinically solid.

At follow-up, the results were recorded according to definite criteria and judged as good in 76 per cent, fair 4 per cent and poor 20 per cent.

The results are encouraging, but the amputation rate was 14 per cent, continuously emphasizing the therapeutic challenge posed by this type of osteomyelitis. A certain reservation is probably reasonable in the use of osteosynthesis with plates in the case of comminuted tibial fractures with considerable damage to soft tissues.

FINAL RESULTS OF OPERATIVELY VERSUS NON-OPERATIVELY TREATED FRACTURES OF THE TIBIA

Erkki O. Karaharju, Jorma Nieminen & Antti Alho (Helsinki, Finland)

A series of 160 fractures in 155 patients treated at the Department of Orthopaedics and Traumatology, University Central Hospital, Helsinki, is reported. Eighty patients were treated operatively, using an intramedullary nail in 33, an AO-plate in 29 and screws in 18 cases. The non-operative group of 80 patients was selected so that there were no marked differences in wound complication, fracture comminution, localisation, pattern or instability between the groups. Two early and five late infections occurred in the non-operative group. In the operative group 23/80 patients developed an infection; 6/33 operated on using an intramedullary nail, 11/28 using an AO-plate and 6/18 using screws. In the final evaluation, an average of 3 years after trauma, the following findings were recorded using Edwards' (1965) criteria: pain, working capacity, limp, knee, ankle and foot movement, swelling, amputation, osteomyelitis and non-union. If any of these criteria was classified as poor (or fair) the final result was given correspondingly. The result was classified as good in 39/80, fair in 27/80 and poor in 14/80 cases in the non-operative group and 40/80, 25/80 and 15/80 cases in the operative group. The main delayed complaint was a loss of ankle or foot movement, which was observed in 19 patients in both groups. Leg swelling was observed in 13/80 patients in the non-operative and 16/80 in the operative group and it was recorded as the main complaint in 6/80 and 8/80 cases, respectively. Persistence drainage was found in 2/80 in the non-operative and 4/80 in the operative group. Fracture comminution had a statistically significant effect on foot and ankle movement.

THE SOCIAL PROGNOSIS AFTER LEG AMPUTATION

Sv. Rosendahl & M. Møller-Hansen (Copenhagen, Denmark)

During the period 1970–71 eighty-five patients had lower limb amputations at Kommunehospitalet in Copenhagen, 9th Dept. All the survivors, 34 patients, were followed up for two years after the operation particularly to illustrate the social prognosis.

The mean age of all the patients was 72.6 years and 45 per cent died within the first year. All the patients were amputated because of senile arteriosclerosis except for 11 cases of diabetic gangrene.

No patient had a below-knee amputation. Fifty-five patients were amputated through the knee; primary healing was atained in 21 cases and 24 underwent secondary above-knee amputation. A total of 54 above-knee amputations resulted in primary healing in 33 cases.

The follow-up series consists of 22 men and 12 women. Eighteen patients lived at home, sixteen patients in institutions. Thirty amputees were fitted with prostheses but only 18 used their prosthesis. Fifteen patients were able to walk well, inside and outside, and to care for themselves without help. An analysis of the wheelchair patients and those who used their prosthesis showed no difference in age and level of amputation, but 12 men and only three women were able to walk well.

Unsuccessful fitting and bilateral amputation were essential causes of failures in prosthesis walking.

Fifty per cent of the amputees in the whole material were not fitted with a prosthesis because of severe cardio-vascular and pulmonary disease in half of the cases, and debility and bilateral amputations in the rest of the cases. Only one among 12 bilateral amputees was able to walk well.

LEG AMPUTATIONS IN A DANISH COUNTY 1961–71, WITH A FOLLOW-UP STUDY

Sten Christensen (Aalborg, Denmark)

In the period 1961–71 the County of Aalborg had 240,000–260,000 citizens, and 372 extremities on 321 patients were amputated. (14.9 per 100,000).

The indications for 326 amputations were vascular diseases, of these 151 were

Figure 1.

combined with diabetes and 14 had previously undergone a vascular-operation. Twenty-nine were amputated after trauma.

The duration of the symptoms varied from weeks to years, on average 29.5 weeks for arteriosclerotics and 23.2 weeks for diabetics.

Most of the amputations were above the knee: 268 against 102 amputations below the knee and 2 at the knee.

The occurrence of complications for arteriosclerotics and diabetics were equal in frequency (approx. 25) but above-knee amputations were safer with 19 per cent sustaining complications against 42 per cent with below-knee amputation. Twelve of the below-knee amputations were later amputated above the knee.

Diabetics could more frequently be amputated below the knee, and diabetics were operated on an average of 3 years younger.

Table 1.

DIAGNOSIS and LEVEL

	below knee	re-amp	above knee	
ARTERIOSCL	33	8	142	175
DIABETES	56	3	95	151
TRAUMATIC	11		18	29
TUMOR	2		7	9
OTHER	2	1	6	8
	104		268	372

ARTERIOSCL	19% → 14%	BELOW	KNEE
DIABETES	37% → 35%	—"—	—"—

The postoperative mortality was 20 per cent; after 3 months 31 per cent of the arteriosclerotics were dead and 24 per cent of the diabetics were dead. After 1 year in both groups 40 per cent had died.

Out of the 372 amputated, 73 died postoperatively. 181 had prostheses (62 below-knee and 119 above-knee prostheses). Of these at least four below-knee and 23 above-knee prostheses were not in use.

The average time from amputation to ambulation was 18 weeks.

195 of the 299 survivors were discharged to their homes.

3–13 years after amputation 62 out of 321 patients are alive. 24 are at work, nine work at home, 55 are in their homes.

50 out of 62 have light to medium phantom pains, three have severe pains.

PATIENTS OF TO-DAY WITH LEG PROSTHESES—A SIX-YEAR SERIES

Björn M. Persson, Tage Plym & Beth Brunk (Lund, Sweden)

During the last decade lower limb amputation was carried out below the knee more often than above as was the case earlier. Success depends on better general care and better surgical care. To see what influenced this better regimen had had on the patients, all amputees possessing a prosthesis were compared to the patients amputated during the same period with special attention to the functional difference between below- and above-knee fittings.

Material and Method

During 1966–1971, 207 patients were amputated in Lund, 83 per cent being ischemics. Meanwhile the workshop delivered temporary prostheses to 94 and permanent prostheses to 365 amputees. With 73 dead, 10 not traceable and 127 from other hospital regions, 155 were contacted and 146 came for reexamination by a physiotherapist in 1973. Evaluation was made of gait, stump condition including range of movement and strength of both limbs, type and condition of prosthesis, ADL-status and general condition of the patient; in total 80 data for each case, all analyzed in a computer.

Results

Only 18 no longer used the device, 16 because of their general condition. In the group walking only 50 per cent were ischemics, reflecting the death rate in this group compared to the trauma group; in this group 55 per cent were BK, whereas in the ischemic group 64 per cent were BK. Age distribution in BK and AK was almost the same allowing statistical comparisons. Evident decrease in ROM was found in 15 per cent in AK and 5 per cent in BK patients but was not statistically correlated to the functional parameters. Loss of muscular strength was also found to be of little importance but was common in the quadriceps of BK amputees with thigh corset devices. Stump abrasions and inequality of leg length in standing were found in 40 per cent both in BK and AK but gait abnormalities differed significantly. Lateral bending and abduction was normal in all but the PTB-users. Freedom from gait supports, good walking distances, unassisted ADL and donning and doffing were significantly better in the BK than in the AK especially in the ages above 64. Most patients were anaware of defects found and an active check-up program is indicated as with automobiles. Special attention is necessary with the early preliminary fittings since many geriatrics never survive to reach the fully-trained stage with a normal permanent prosthesis.

THE USE OF A PROSTHESIS IN LOWER LEG AMPUTEE PATIENTS

Poul Ramsing & Søren Pilgaard (Århus, Denmark)

During the period 1965–1969 a total of 254 patients with lower leg amputations were treated with a prosthesis at the Orthopaedic Hospital, Århus. The average age for the 88 females is 62.7 years and for the 166 males, 53.8 years. Of the patients, 58 per cent died after an average of 3.3 years. Of those still alive (28 females and 78 males) it was found, an average of nearly 7 years after the prosthetic supply, that 78 per cent of the patients were able to use the prosthesis every day and all day.

Nine out of 16 patients alive, treated with bilateral prostheses, could only use the prostheses for a few hours daily or had given up prosthesis use. Six of these were supplied with bilateral femur prostheses.

AMPUTATIONS IN 1970 IN FINLAND

K. Solonen & C. Lindqvist (Helsinki, Finland)

Data about major extremity amputations, i.e. loss of at least four fingers or five toes, were collected from all hospitals in the country. In 1970, 78 amputations on the upper extremity and 800 on the lower were carried out. In that year, the population was about 4,700,000, and the rate of these major amputations was estimated at two per mille. In the group of upper extremity amputees, 13 per cent of the cases were female and 87 per cent male. Their median age was 41.2 years, and the amputations were overwhelmingly due to industrial accidents. In the group of lower extremity amputees, correspondingly, two fifths were female and three fifths male, and the median age was as high as 68.8 years. Vascular diseases dominated as a cause of amputation. There were only 10 per cent which were accident cases, and nearly every second one of these had sustained a cold injury of the feet.

HEMIPELVECTOMIA

Frantz Ole Petersen (Copenhagen, Denmark)

During the period 1952–1974 a total of 50 patients with malignant tumours were treated with a hemipelvectomy operation. The 5-year survival rate was 26 per cent.

Thirty-four patients were supplied with a prosthesis of the Canadian type. About 66 per cent became daily wearers of artificial limbs. Eighteen patients returned to work and three to homemaking. Further details will be published in this periodical.

DANISH AMPUTATION REGISTER (D. A. R.). NATIONWIDE RECORDING OF AMPUTEES AND PROSTHESES

Bent E. Ebskov (Copenhagen, Denmark)

The D.A.R. records present and future amputees in Denmark to obtain statistics on the amputee population for analysis of etiological factors, operative detail, incidence and type of complications and reamputation, per- and postoperative death, duration of hospitalization, mobility on discharge and social information. The D.A.R. records the prostheses delivered, to generate statistics on the number and type and to analyze technical aspects relative to the prostheses. Later the register may yield trend analyses for estimation of future needs of personnel, facilities and economy.

The structure of the register permits the selection of groups of amputees for in-depth analysis by clinical and social examination.

Since mid-1973, 659 medical reports on amputations were received from 55 departments. 338 prosthetists' reports have been received since the end of 1973. The national coverage for both categories is stipulated at two thirds of the total.

The first 500 medical reports have been analyzed, and the results described.

HIGH OR LOW PLASTER FOR FRACTURED SCAPHOID

Antti Alho & Uolevi Kankaanpää (Helsinki, Finland)

During 1970–71 one hundred consecutive patients with a fractured carpal scaphoid were treated at the Department of Orthopaedics and Traumatology, Helsinki University Central Hospital. At random 53 fractures were immobilized with the customary plaster from the interphalangeal joint of the thumb to below the elbow. In forty-seven patients an above-elbow plaster of Verdan was used for 6 weeks (*Surg. Clin. N. Amer.* (1968) **48**, 1083). When necessary, the immobilization was continued using a below-elbow plaster. No differences in the type or localization of the fracture occurred between the groups. The plaster was removed at 2-week intervals to check the consolidation by x-ray and palpation. In eight cases consolidation was not achieved in 3 months and an AO screw fixation was performed followed by a plaster slab for 2 to 6 weeks when required. All fractures united. Excluding these eight patients, the immobilization time was 48.1 ± 2.7 days (mean ± S.E.) in the low plaster group and 49.1 ± 3.8 days in the high plaster group. In conclusion, a below-elbow plaster gives an adequate immobilization for fracture of the scaphoid; an osteosynthesis is warranted if bony union is not achieved in 3 months.

THE EFFECT OF ARDUOUS INDUSTRIAL WORK ON THE SHOULDER JOINT

Peter Herberts, Roland Kadefors & Ingemar Petersén (Göteborg, Sweden)

Using an electromyographic method, clinical examination and soft tissue radiography, the effect of heavy industrial work was evaluated using welders at a shipyard in Göteborg. Unexperienced, experienced and old welders were studied during standardized tasks. Thirty welders were included in the electromyographical study and ten old welders were also examined clinically and roentgenologically.

It was found that spectral variations of EMG indicative of localized muscle fatigue were present in welders in over-head production work. The effect was present and significant in the supraspinatus muscle and the trapezius muscle and for unexperienced welders also in the deltoid muscle. This is illustrated in Figures 1 and 2. The old welders with chronic shoulder pains had a normal range of movement but significantly reduced gross power with respect to flexion, abduction and

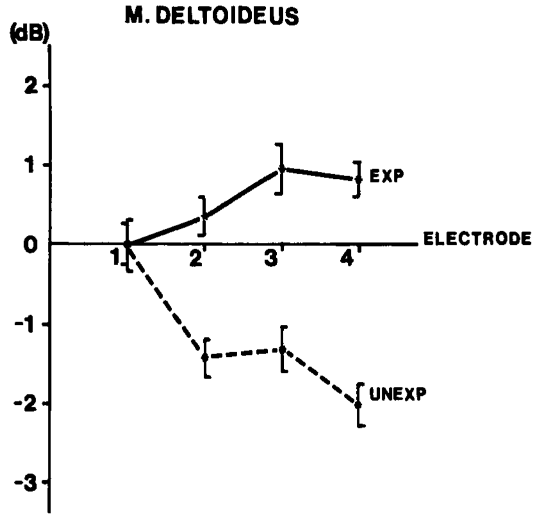


Figure 1. Spectral changes within a high frequency component (500 Hz) in Emg during welding, indicating muscle fatigue. Note the difference between experienced and unexperienced welders. Over-head welding.

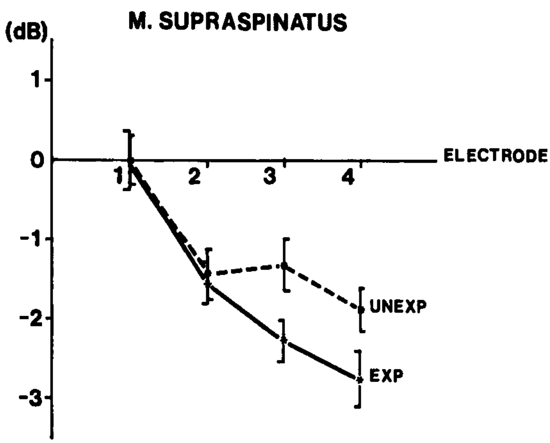


Figure 2. Spectral changes indicating muscle fatigue for both experienced and unexperienced welders with respect to the supraspinatus muscle.

rotation. The roentgenological study showed an inflammatory reaction in the soft tissue lateral to the rotator cuff of the shoulder joint. Our results indicate that over-head welding will constantly fatigue especially the supraspinatus muscle and after many years a chronic peritendinitis of this tendon develops. This is probably the reason for the very common shoulder pain syndrome, affecting old welders. The knowledge obtained may lead to demands for change in the production lay-out or in the planning of the individual work situation.

FEMORAL NERVE COMPRESSION SYNDROME WITH PARESIS OF THE QUADRICEPS MUSCLE CAUSED BY RADIOTHERAPY OF MALIGNANT TUMOURS

A Report of Three Cases

L. E. Laurent (Helsinki, Finland)

Tissue lesion due to radiotherapy, which causes compression of the femoral nerve and paresis of the quadriceps muscle, is obviously rare because no reports have been found of this complication in literature on the subject. After treatment of cancer of the breast by radiation, similar symptoms in the upper limbs, of compression syndrome of the brachial plexus, have been reported (Westling et al. 1968, 1972, Mumenthaler 1964, Stoll & Andrews 1966, Notter et al. 1970).

Three patients with compression syndrome of the femoral nerve were treated at the Orthopaedic Hospital of the Invalid Foundation, Helsinki.

One patient had cancer of the uterus, one cancer of the right ovary, and the third patient a malign melanoma of the skin with later a metastasis in the right inguinal region.

The radiation treatment caused compression on the femoral nerve by X-ray damaged tissue. The first symptom of nerve compression was a pain which radiated in the front of the thigh and also in the medial part of the upper leg. The pain appeared 12 to 16 months after radiation therapy and was irregular, usually being worst during rest. Several months after the pain had begun a decrease in the power of the quadriceps muscle occurred and two of the patients had difficulty in walking. EMG investigations showed typical signs of a peripheral lesion of the femoral nerve.

In the first case, a decompression of the femoral nerve was performed and it was seen to be compressed by scar tissue. Pain greatly decreased after the operation but paresis of the quadriceps muscle remained unchanged.

In the second case, in which the compression was apparently slight, the pain disappeared after two months treatment with cortisone and oxiphenbutazone. The paresis of the quadriceps muscle had almost disappeared six months later.

In the third case a very severe pain disappeared after indural phenolglycerin injection. The palsy of the quadriceps muscle here seems to be permanent and deliberation of the femoral nerve gave hardly any further improvement.

A change in the techniques of radiation therapy is obviously needed. With radiation doses which are successful in treatment, the risk of such complications probably cannot be entirely eliminated (Westling et al.).

LATE RESULTS OF LAMINECTOMY IN THE TREATMENT OF LUMBAR SPONDYLOLISTHESIS

K. Österman, L.-E. Laurent & S. Lindholm (Helsinki, Finland)

In the Orthopaedic Hospital of the Invalid Foundation a total of 130 laminectomies were performed between 1953–71. Of these 50 patients with a follow-up of 5 years or more were re-examined. The follow-up time was 12 years on average. Thirty-nine patients were men, 36 women. Four patients were under 20 years of age, 53 (71 per cent) belonged to the age group 40–59. Most patients had chronic low back or radiating pain; about one third had some neurological findings. Two

Table 1. Late results of laminectomy in different age groups.

Age	Excellent	Good	Fair	Poor	Total
< 20	1	1	2	–	4
20–29	2	4	–	–	6
30–39	–	5	3	3	11
40–49	–	12	9	10	31
50–59	1	7	8	6	22
60–	–	1	–	–	1
Total	4	30	22	19	75

of the adolescents had progressive neurological findings and a total olisthesis. Lumber disc herniation was found in nine patients.

The late results of surgery are presented in Table 1. The result was classified as excellent if the patient was symptomless, good if there was slight pain on exercising, fair if the patient felt better after surgery but had some symptoms, and poor if no relief of symptoms was achieved or further operative treatment was necessary.

Twenty-five per cent of the patients had a progression of slipping of 3 mm or more. Two of these patients were adolescents. The progression of slipping had no effect on the subjective symptoms and seemed to depend on the stability of the underlying disc. Very often the symptoms seemed to be due to the degenerative changes in the lumbar spine. Neurological findings remained unchanged and local tenderness in the operated area was a constant phenomenon. In general the results were better if the patients had moved to lighter work or retired after or shortly before operation.

The operation seems to be best suited to elderly patients with chronic low back or radiating pain; it is contraindicated in children and adolescents because of the risk of further slipping except in cases with a total olisthesis and posterior compression of the cauda by the lamina.

SPINAL RIGIDITY IN RELATION TO LOW BACK PAIN

Kåre Haug (Gjøvik, Norway)

Stiffness of the back is best charted by measuring the motility of the thoracolumbar spine in relation to the pelvis and the median plane of the body. The range of motility is read off in degrees, except for the lumbar spine where it is read off in millimetres of deviation.

The base line for flexion-extension movement is located in the dorsal plane of the sacrum, for lateral flexion it is in the median plane and for torsion it is situated in a frontal plane.

The writer of this paper has constructed spondylometres with a wide scale to obtain an exact reading. For lumbar lateral flexion in particular the deviations of a point 10 cm rostral to the lumbo-sacral junction are noticed.

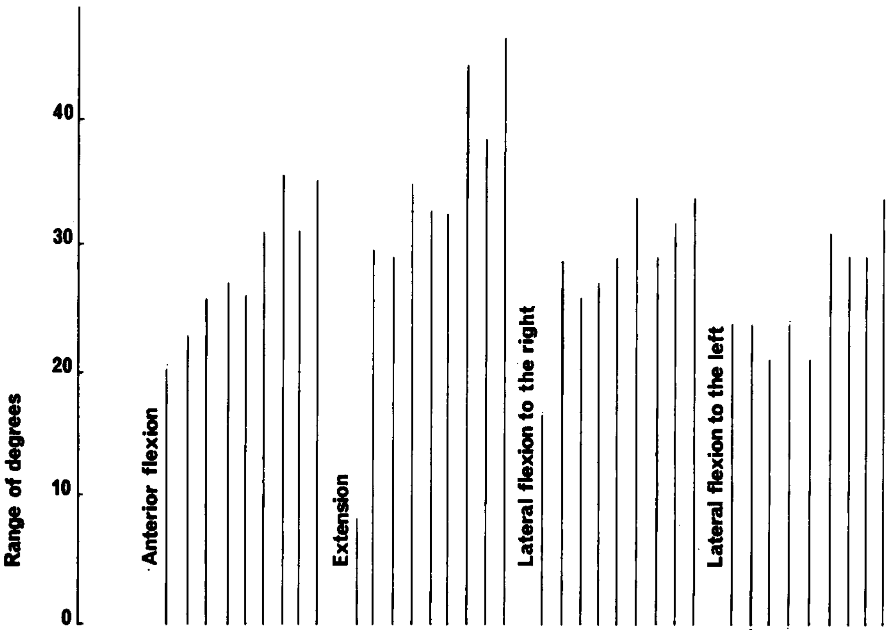


Figure 1. A bar chart showing the change of mobility of the spine during treatment in one patient with left-sided sciatica. Each bar indicates one clinical check-up.

With advancing years the range of motility will decrease and the pattern of spinal movements is found to become, so to speak, more narrow.

In a status of motility the restrictions of range will be marked out, and in particular they are conspicuous in asymmetric motility of the lateral flexion and the torsion.

In this material of 63 patients with chronic low back pain the lumbago-sciatica syndromes account for 90 per cent. Except for three patients measurable restriction in one or more directions was noticed.

The patients were given a uniform conservative treatment: An immobilising plaster of Paris corset followed by active physical training of the spine muscles.

It can be demonstrated that the pattern of motility in a typical low back pain patient changes as the cure proceeds. The various movements are generally increased.

The material was, by clinical judgement, divided into three clearly defined groups: A) consisting of 35 patients with a good improvement;; B) 15 with some improvement and C) 9 with no noticeable improvement.

Group A had the greatest increase of motility, in particular in the lumbar spine, followed by group B, whereas group C developed a further rigidity of the spine during treatment.

The examination shows that frequently spinal rigidity accompanies low back pain syndromes. When the condition improves, motility increases. This indicates the good effect of the therapy used.

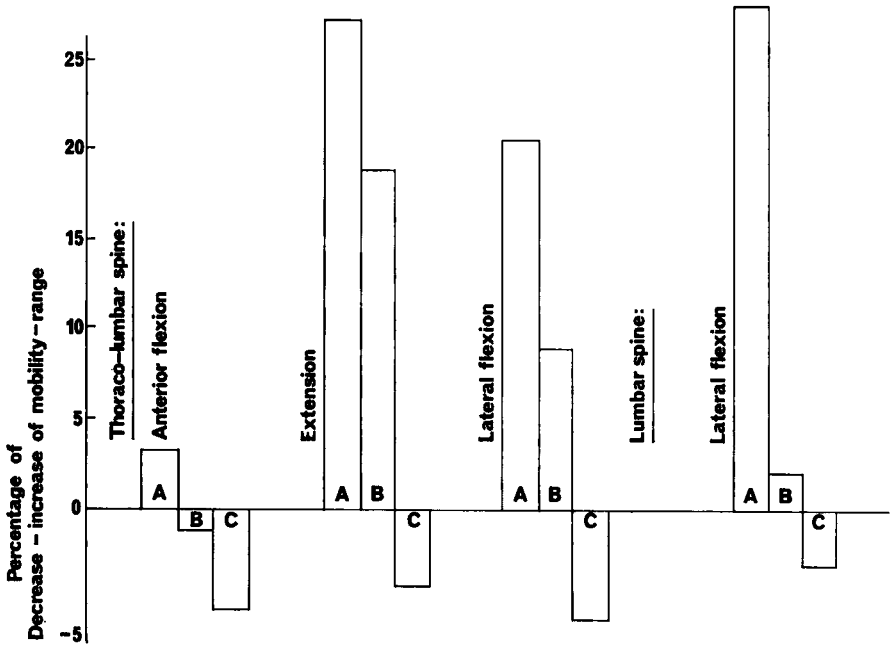


Figure 2. Mobility of the spine related to conservative treatment. Three categories of improvement: A) good, B) some and C) no.

A merely mechanical obstacle as a prime cause of the stiffness in some cases cannot be excluded.

Therefore a conspicuously diminished lumbar lateral flexion, especially if asymmetric, may indicate disc protrusion with root affection.

170 HIPS OPERATED *AD MODUM* CHARNLEY IN A CLEAN AIR OPERATING ROOM

S. Pilgaard (Århus, Denmark)

In 1969 Professor Thomasen took up the total hip replacement *ad modum* Charnley at the OHA. The first 123 hip operations were carried out in an old operating room. Since October 1971 the Weber type of sterile enclosure has been used. The principle of the Weber sterile enclosure is described.

From October 1971 to June 1974, 365 hip replacements have been performed in the sterile enclosure. 170 of these operations have been followed up (1st October '71–31st December '73, average follow-up time 17 months), 170 hips in 135 patients (57 men, 35 bilateral).

The 170 hips are homogeneous in the following respects: operated on by the same surgeon, using exactly the same technique; all having been pre-operatively vaccinated with staphylococci vaccine. No antibiotics were given before operation;

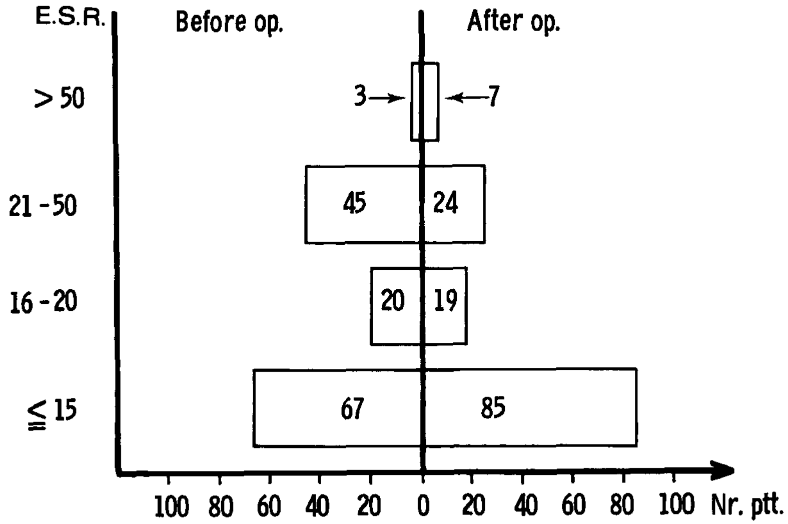


Figure 1.

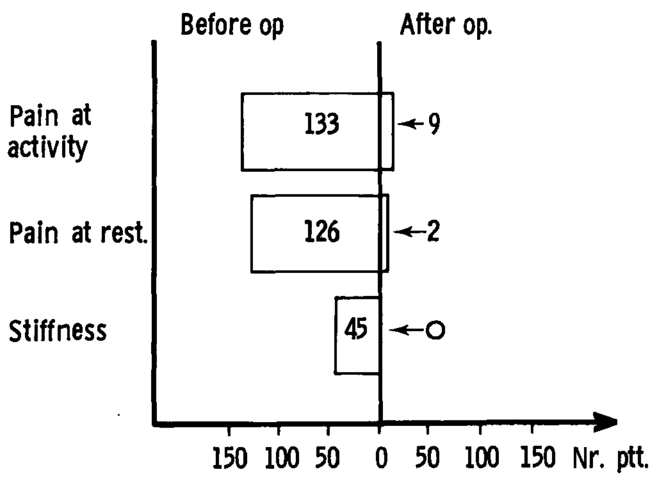


Figure 2.

only in three cases after operation. One patient was anticoagulated before and 22 after the operation. One patient died of a pulmonary embolus (½ per cent).

The results of the 170 operations as regards complications are compared with a follow-up from April '73 of the 123 hips operated on in the old operating room (average follow-up time 25 months).

Wound secretion (3 per cent) and subcutaneous infection showed no change in the two materials. Secondary infection with positive culture after 3 months fell from 12 per cent to below 1 per cent. Secondary infection without positive culture fell from 7 per cent to zero when using the sterile enclosure.

The results concerning loosening and migration of the components showed a great improvement too.

In the 170 hips the ESR value was checked before and after the operation. The result is seen in Figure 1. The effect on pain in the 135 patients is seen in Figure 2.

The use of the sterile enclosure *ad modum* Weber has improved our immediate results (follow-up period 17 months) and in 170 hips operated in that room no components have been removed. One hip has been changed (using cement with gentamycin after secondary infection after operating on a post-operative haematoma). Evaluated from loosening of the stem and cup and fracture of the tip of the femur cement, four more hips are under consideration for changing, but not removal.

STERILE ENCLOSURE

R. Hartmann, R. Meierhans, G. Stühmer & B. G. Weber (St. Gallen, Switzerland)

The film is introduced by Weber, stressing that airborne wound-contamination still is a problem in surgery. Smoke tests and bacteriological studies allow the following conclusion:

1. In any system of laminar flow, the respiratory air of the surgical team must be removed by the use of helmets and an exhaust arrangement.
2. Vertical flow is superior to horizontal flow, since with horizontal flow air-contamination dangerous to the wound is still possible, but this is not the case with vertical flow.
3. Air speed should be 0.5 m/s to maintain sufficient wash-out effect in spite of the inevitable turbulence.

The film shows the development of asepsis with its final result of an individually developed vertical enclosure. The team is demonstrated at work, not being hindered in their activity when wearing an individual type of respiration air exhaust system.

Weber reports that primary wound contamination could be diminished from 50 to 3 per cent. The infection rate after total hip replacement under conventional conditions was 5.7 per cent; after 3½ years of use of the sterile enclosure it is only 0.5 per cent.