

JOINT MEETING OF
THE SCANDINAVIAN ORTHOPAEDIC ASSOCIATION
AND
THE BRITISH ORTHOPAEDIC ASSOCIATION

SHOULDER SYMPOSIUM

THE RANGE OF MOVEMENT OF THE SHOULDER JOINT AT
VARIOUS AGES

by *L. Saario*, (Jyväskylä, Finland)

The research material comprises the active range of movement of the shoulder joints in 1280 persons. The joints included in the survey were confirmed as healthy by clinical and anamnestic examination. They did not reveal pathological symptoms nor did they suffer accidents.

It emerged from the investigation that the average range of forward and backward lifting of the upper arm was 240° in the youngest age group, i.e., below 16, while it was 190° in the oldest group (above 70). During aging the range of movement therefore diminished 50° or approx. 21 %.

The average abduction range was 166° in young people and 116° in old people. The decrease was therefore 50° or 30 %.

The corresponding average figures for the rotation movement were 175° and 125° : in this instance the range of rotation decreased 50° or 28 %.

Raising of the upper arm to the vertical position was successful in only $\frac{1}{4}$ of all the 16 age groups and after 50 years of age this was only successful in exceptional cases.

Complete 180° abduction occurred in the youngest age group in about 40 %. After 50 years of age complete 180° abduction occurred only in a few persons.

A fundamental factor causing changes in the range of movement in combination with aging is the changed position of the shoulder blade. With increasing natural convexity of the spine the shape of the thorax changes and the shoulder blade leans forward at the same time as its position is altered in a sagittal direction. This limits both the ability to raise the upper arm forward and also the range of external rotation.

FAMILIAR CLINICAL SYNDROMES IN LESIONS OF THE SHOULDER

by *W. D. Collart* (London)

Mr. W. D. Collart (London) referred to the four outstanding and readily identified clinical syndromes associated with the scapulo-humeral joint, which may be designated (1) The Ruptured Supraspinatus, (2) Supraspinatus Calcification, (3) The

Painful Arc, and (4) Frozen Shoulder. These syndromes could be referred to as *Primary Intrinsic Painful Shoulder* because they could be identified by physical signs in the scapulo-humeral joint, and in that way distinguished from the very large number of extraneous lesions which may cause pain referred to the shoulder—although such things as cervical spondylosis, angina pectoris and cerebral hemiplegia may later on produce ankylosis and pain perhaps due simply to immobility. The symposium did not need to concern itself with such obvious causes of Painful Shoulder as fracture or tuberculous arthritis.

These familiar syndromes were all described by *Codman* over 30 years ago, were referred to in a British symposium in 1949, and were well known: what was important was to relate them correctly to *Morbid Anatomy*. These shoulders have been explored by Surgeons, and three pathological entities have been described: (1) Degenerative lesions of the supraspinatus part of the musculo-tendinous cuff, (2) Calcifying lesions in the tendon and occasionally in the sub-deltoid bursa, and (3) Complete adherence of the capsule to the head of the humerus.

The problem of the Frozen Shoulder would be dealt with by Dr. *Magnusson*. In the other three syndromes treatment was fairly well standardized. The ruptured supraspinatus could be identified by the Procaine test and arthrography as described by the late *V. H. Ellis* (1953), but recent discussion amongst experts in the United States suggested that surgical repair was seldom necessary and that immediate repair had no advantage over a delay of 10–14 days. In the 'painful arc' hydrocortisone injections had proved of value, and acromionectomy was seldom required. The surgical removal of the plaque of calcified material in the supraspinatus tendon was a satisfying procedure, and easily done provided a correct incision was used. Acute attacks of pain from bursting of the calcified material into the sub-deltoid bursa would usually result in a spontaneous cure, and rest with heavy sedation was as effective as aspiration or deep X-ray therapy during the short acute phase.

Speculation as to the reason for idiopathic supraspinatus degeneration was interesting, and was made more so by the observations of *Inman* and his colleagues on the comparative anatomy of the shoulder (1944). The facts suggested an increased significance in function of the deltoid and either diminishing or altering function of the supraspinatus.

References:

- Symposium on the Painful Shoulder*. Journal of Bone & Joint Surgery 31 B: No. 3, 1949.
Ellis, V. H. & Brown, Tulloch: Ibid. 35 B: No. 1, 1953.
Inman et al.: Ibid. 26 A: No. 1, 1944.

PERIARTHRITIS HUMERO-SCAPULARIS

by *Ragnar Magnusson* (Linköping, Sweden)

During the years 1950–61, 272 patients were treated in the Orthopaedic Clinic of the Central Hospital in Linköping, 115 men and 155 women, with periarthritis humero-scapularis. In 22 cases the illness was present in both sides. The average age for men was somewhat higher than for women, 55.4 and 52.8 respectively, although the difference is not statistically proven.

The main objective symptom is a limitation of abduction dependent on inflammatory changes in the joint capsule. As a result of this a merging of the normally wide pocket in the distal part of the joint occurs and this is the *only* reason for the limitation of abduction. Many etiological factors can give the above symptoms e.g. infections of the shoulder joint, fractures and trauma of the joint or its surrounding parts as well as direct or indirect trauma or distortion of the shoulder joint. Take away all known etiological factors and there still remains a majority of cases where there are no directly obvious causes. This type of periarthritis one could call *genuine* periarthritis.

Present in this study were 205 cases of genuine periarthritis and 67 cases with a direct or indirect trauma on the shoulder joint without fracture, distortion or similar.

More and more authors have come to the conclusion that genuine periarthritis depends on a cervical disc degeneration with rhizopathy. Here, I will mention only *Frykholm* (1951), who, after taking away disc herniations found a speedy disappearance of the periarthritis symptoms. According to my personal information *L. Hult* had the same experience. My own experience is based on a number of cases of slight periarthritis under out patient treatment where the symptoms disappeared almost immediately by manipulation or extension treatment of the cervical spine. The exact origin of the mechanism of periarthritis is still, however, unknown. It has been thought that the autonomous nervous system is involved in one way or another and there is much to be said for this supposition.

Our patients were treated with abduction and rotation traction, this requires strict supervision of the patients who must give active co-operation in the treatment. During the last 2-3 years we have also used ultra sound treatment which seems to be worthwhile. In 35 cases only was mobilization under anaesthetics needed. The only reason for abduction limitation is a merging of the wide pocket within the distal part of the joint. It is now known (*A. Jacobsson*: personal information) that even with careful mobilization under anaesthetics there arises a rupture in the capsule attachments to the humerus, even the periosteum can be loosened from the humerus. Hydrocortisone injections have been tried but like most other authors we have not found any positive value in this treatment.

In 4 cases (3 women and 1 man) there was recurrence. In a few cases the patient voluntarily terminated treatment, but in all remaining cases all symptoms disappeared subjectively and objectively.

SIMPLE TREATMENT OF THE STIFF SHOULDER

by Sir *Reginald Watson-Jones* (London)

(Demonstration on a patient.)

THE TRAUMATOLOGY OF THE ACROMIOCLAVICULAR JOINT

by *Willy Bust Nielsen* (Aarhus, Denmark)

A clinical and radiological follow-up of 101 patients was performed. A distinction was made between 4 degrees of dislocation and furthermore between vertical and oblique joints (Fig. 1) because a certain relation was found between joint—and dislocation types and osteochondritis. 23 patients were treated with lateral resection of the clavicle, 72 patients with conservative methods, and the results compared.

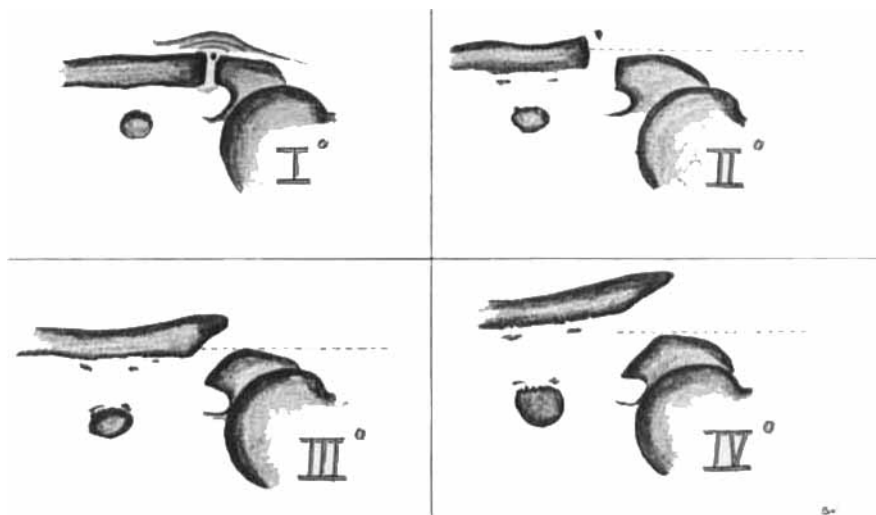


Fig. 1.

In this drawing is shown the typical, but not the only possible, combination between degree of inclination of the acromioclavicular joint and the degree of dislocation. Osteoarthritis is likely to develop in low-degree dislocation in combination with vertical joint-type.

Further an account was rendered denoting which sort of people incurred the lesion, the way they incurred it and the social consequences. Typical accompanying lesions were described. Three clinical types of patients were observed to determine the manner of onset of symptoms. The disability period was shown to be longer in cases with insurance than without, and the number of disabled to be considerably bigger in the former category. A radiological analysis was made of all the patients with respect to frequency and type of coracoclavicular calcifications, decalcification of the lateral clavicular end, osteochondritis of the joint, degree of dislocation and types of joints. Each dislocation group is considered separately as to these characteristics. 40 of the most important symptoms are recorded for each group, after an observation time of 6 years on average. According to this the prognosis in dislocation group I should not be made too optimistic. The 23 resected patients were separately investigated. The average time from accident to operation was 14 months. Postoperative symptoms are recorded and the ability to work is put in relation to the length resected.

Conservative treatment should be the treatment in the acute stage, resection may be the treatment in inveterate cases.

(Publication in full is planned.)

A NEW OPERATION FOR CHRONIC SUBACHROMIAL BURSITIS

by *T. T. Stamm* (London, England)

This operation is intended as an alternative to acromionectomy, its indications being the same as for that operation. The object of the operation is to displace the

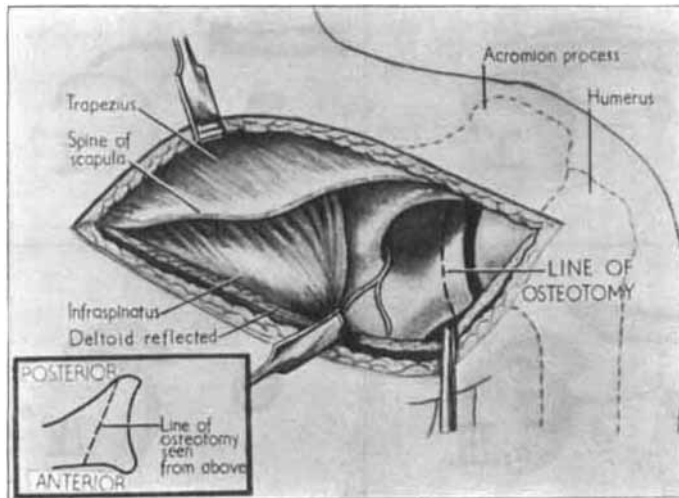


Fig. 1.

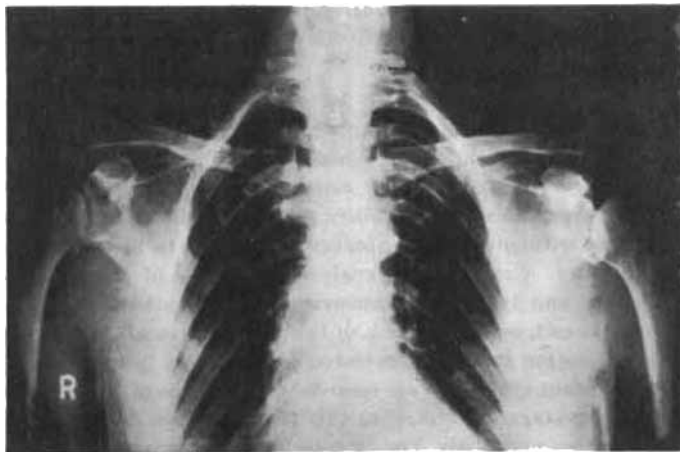


Fig. 2.

shoulder joint downwards away from the acromion after performing an osteotomy through the neck of the scapula.

Operative Technique.

With the patient lying prone and the arm in lateral rotation an incision is made along the spine of the scapula, the deltoid being detached and retracted downwards together with the infraspinatus so as to expose the back of the shoulder joint. An oblique osteotomy is now performed through the neck of the scapula so as to se-

parate the glenoid from the body of the bone. A bone spike is now inserted above the upper border of the glenoid which is then levered downwards by counter pressure against the spine of the scapula while downward traction is exerted on the arm.

No fixation or splinting is necessary, movements being encouraged from a few days after the operation.

The operation has proved uniformly successful for those cases where pain is due to friction between the head of the humerus and the acromion, and when movements of the shoulder joint are otherwise free.

Full function is usually regained within four weeks. Pain is relieved so rapidly by this operation that it has been suggested that in addition to its mechanical effect, the relief of pain may be analogous to that following a McMurray osteotomy. It has also been suggested that it might be helpful when the supraspinatus has been ruptured or paralysed, since the downward and medial displacement of the shoulder affords a better leverage for the deltoid.

FREE PAPERS

LESIONS OF THE INFRAPATELLAR FAT PAD AND SYNOVIAL FRINGES:

HOFFA'S DISEASE

by *I. S. Smillie* (Dundee, Scotland)

Internal derangement of the knee joint related to the infrapatellar fat pad exists in two distinct forms:

In which the joint is otherwise normal. In this variety the fat pad undergoes enlargement from oedema or haemorrhage as a result of a single incident of trauma (Fig. 1) or repeated minor incidents. Where hypertrophy is of idiopathic origin the condition is frequently bilateral, and affecting young females, may be of hormonal origin.

TABLE 1
Meniscectomies: Averages ages (1940-1962).

Years	Case number	Average age
1940-1943	1- 500	28
1943-1945	500-1000	29
1945-1951	1000-1500	30
1951-1953	1500-2000	33
1953-1955	2000-2500	34
1955-1957	2500-3000	35
1957-1958	3000-3500	35
1958-1959	3500-4000	36
1959-1961	4000-4500	36
1961-1962	4500-5000	36



Fig. 1.

Lesions of infrapatellar fat pad: etiology. In this case the direct injury which produced the scar over the patella was responsible also for hypertrophy of the fat pad.

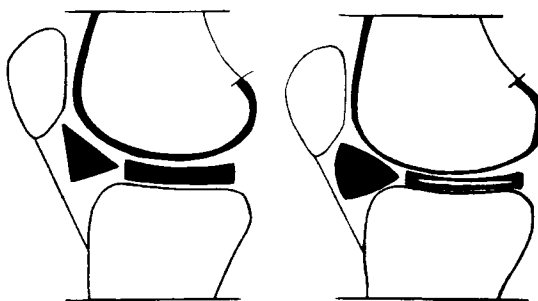


Fig. 2.

Lesions of infrapatellar fat pad: etiology. Diagrams to show effect of degenerative changes in the meniscus (in the form of horizontal cleavage) together with thinning of articular cartilage on the infrapatellar fat pad of the knee joint: the space available is reduced rendering the fat pad and particularly the synovial fringes vulnerable to injury.

In which the joint is the subject of degenerative changes. The pattern of internal derangements of the knee joint, and the age at which they are encountered, has changed in material degree in the past two decades (Table 1). This variety is secondary to other pathology in the joint. Degenerative changes in the menisci, in the form of horizontal cleavage, together with thinning of the articular cartilage, reduce the space available for the fat pad. The fat pad does not decrease in size as the space available to it decreases in size (Fig. 2). The liability to injury or to the trapping of synovial fringes is therefore increased.

Pathological anatomy.

The pathology encountered varies within wide limits. The fat pad may be the obvious subject of oedema or of hypertrophy, or of fibrosis from a previous haemorrhage of traumatic origin. It is assumed that fibrosis decreases mobility and renders the fat pad liable to compression. If it is enlarged there are usually projections of synovial membrane into the joint; and these may show evidence of involvement in trapping incidents.

Clinical features.

The history is usually of long duration. The outstanding symptom is pain or ache in the anterior compartment directly related to physical activity and characteristically relieved by rest. It takes the form of vague retro-patellar, or retro-patellar tendon pain; occasionally of sudden stabbing pain which may cause the knee to give-way, and even of synovial effusions. Swelling from hypertrophy may be present, usually on both sides of the tendon. Forcible extension, which exerts pressure on the pad, may induce pain in the acute phase. There may be local tenderness to deep pressure.

The differential diagnosis includes the range of conditions affecting the anterior compartment of the knee, in particular, the space-occupying lesions.

Treatment.

If quadriceps insufficiency contributes in varying degree to the trapping of synovial fringes, quadriceps redevelopment is essential in the treatment of every case. In circumstances of acute pain, and as a temporary measure, raising of the heel will take pressure from off the fat pad. It is not, however, a method of treatment which should be maintained because walking on a knee which does not, and cannot, extend fully is undesirable.

In general, when the diagnosis has been established beyond reasonable doubt, the treatment to be recommended is operation. Relief is effected by excision of the tags of synovial membrane or reduction of the size and position of the fat pad as the occasion demands.

THE PICTURE OF THE FEMORO-PATELLAR JOINT IN RECURRENT DISLOCATION OF THE PATELLA

by *Håkan Brattström* (Lund, Sweden)

In the femoro-patellar joint the lateral condyle is normally more prominent than the medial one. Recurrent dislocation of the patella is by many authors ascribed to a hypoplasia of the lateral condyle.

In order to make these quantities measurable on the X-ray film. I have under standard conditions examined 100 men and 100 women with healthy knees and 30 women with recurrent dislocation of the patella. The patient sits on an X-ray table with a vertical iron-pole between the knees and ankles. One X-ray film is placed ventrally for the anterior plane of the condyles of both knees, and one film dorsally for the posterior plane (Fig. 1). On both films a wire indicates the horizontal line.

In this way I get two practically simultaneous films with the anterior plane of right and left knee on one film and the posterior plane on the other (Fig. 2, schematic).

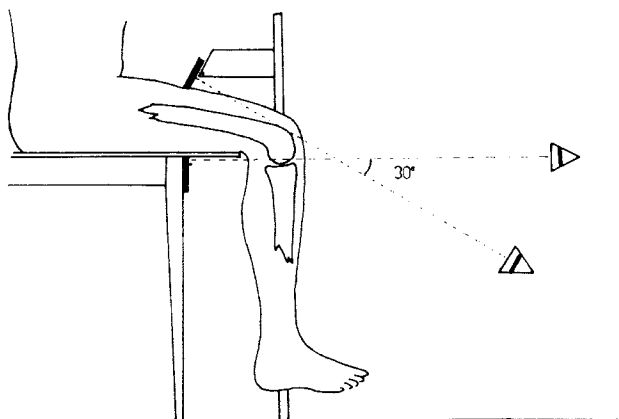


Fig. 1.

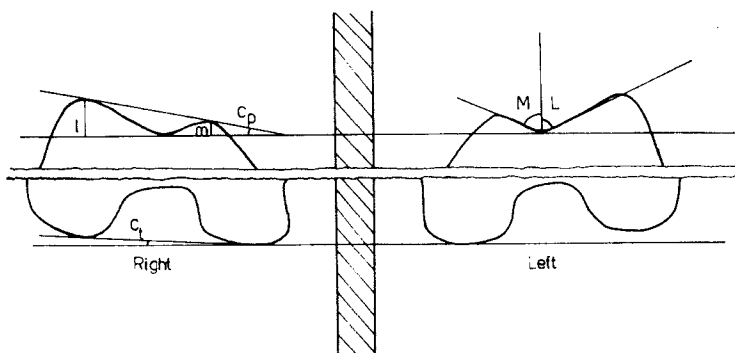


Fig. 2.

On the films I have measured and calculated the following facts:

1. The ratio between the heights of the lateral and medial condyles above the horizontal line through the bottom of the sulcus (Fig. 2: l/m).

Ratio l/m (right knee):

Healthy men	1.95 ± 0.07
Healthy women	1.98 ± 0.08
"Sick" women	2.90 ± 0.54

It seems as if the ratio of women with recurrent dislocation is a little higher than that of healthy women, as a sign of a *bigger* predominance of the lateral condyle, but the difference is not significant.

2. In order to see if rotation or torsion of distal end of femur is of any importance. I have measured the angles between the planes through the anterior resp. posterior border of the condyles and the horizontal plane (Fig. 2: C_p resp. C_t), and by this it is possible to calculate the angle C (not in Fig. 2) between these two planes.

Angle C (right knee):

Healthy men	2.86 ± 0.25
Healthy women	3.48 ± 0.25
"Sick" women	2.70 ± 0.68

There is no significant difference between these two female groups (0.78 ± 0.73).

3. I have measured the angles between a vertical line through the bottom of the sulcus and the lines from the tops of the condyles to the bottom (Fig. 2: L resp. M). I call them "condyle angles". They are independent of the varying photographic enlargement and give a better impression of the shape of the articulation than talking about the relative or absolute heights of the condyles. If the condyle is low, the angle is big and vice versa.

"Condyle angles" L resp. M (right knee):

	L	M	L+M
Healthy men	69.3 ± 0.4	73.5 ± 0.4	142.8 ± 0.5
Healthy women	69.4 ± 0.4	72.4 ± 0.4	141.8 ± 0.6
"Sick" women	75.2 ± 0.7	77.0 ± 1.1	152.1 ± 1.3

The difference between sick and healthy women is for L 5.8 ± 0.8 , for M 4.6 ± 1.2 and for L+M 10.3 ± 1.4 . This means that in a sick knee the lateral angle is bigger than normal as a sign that the lateral condyle is smaller, but at the same time the medial angle is bigger than normal, and the enlargement of the angle is of about the same size as the lateral one.

Conclusions:

The flattening of the lateral condyle, which has been described by many authors, is real, not depending on rotation or torsion, but it is accompanied by a flattening of the medial condyle of about the same size. Instead of talking about the relative or absolute heights of the condyles, it is better to describe the "condyle angles".

RESULTS OF THE PATELLARPLASTY IN SOME SEVERE CASES OF DEGENERATIVE ARTHRITIS OF THE KNEE JOINT

by *Henrik Stören* (Stavern, Norway)

In many cases of painful degenerative arthritis of the knee-joint, conservative measures are tried without success. We all know these short, obese individuals above 50 years of age, so commonly presenting genu varum caused by reduction of the cartilage of the median part of the joint. Rather commonly this painful condition leads to abuse of analgetics, and for many patients arthrodesis is the final outlook.

Because of its disadvantage, I feel that arthrodesis should be the very last treatment chosen. Especially in older individuals, an already impaired venous circulation may be further reduced by creating a stiff knee and thereby reduced activity of the muscles of the thigh.

The method of choice should aim at:

- a) reduction or riddance of pain, and
- b) preservation of joint mobility to the highest possible degree.

Such methods are:

- 1) Patellectomy (*von Rosen* and others).
- 2) Patellarplasty and debridement (*Magnusson*).
- 3) Debridement and synovectomy (*de Palma*).
- 4) Replacement of the patella with a Vitallium prosthesis (*McKeever*).
- 5) Complete arthroplasty. This method, however, is rarely useful in patients of age group mostly met with in this connection.

Von Rosen has reported good results from patellectomy, while others consider this operation an unfavourable treatment.

De Palma thus stated that "in the absence of patella—quadriceps works with a definite mechanical disadvantage".

At the *Coast Hospital of Stavern* we have for the last six years practised radical patellarplasty plus removal of marginal osteophytes.

We have restricted the operation to those cases where especially the patello-femoral part of the arthrosis is clearly demonstrated on roentgen diagrams, as shown on the following slides.

Technically, the operation is done by resection of patella, leaving only the anterior cortex in place. The cut surface from the resection is covered with a thick flap of fat from the abdominal wall.

3 days later quadriceps drill is started, and after 3 weeks passive movements are started.

In two cases with total dislocation of the patella, the operation was extended to include median transposition of the tibial tuberosity plus Krogius' operation.

12 cases have been followed-up after operation.

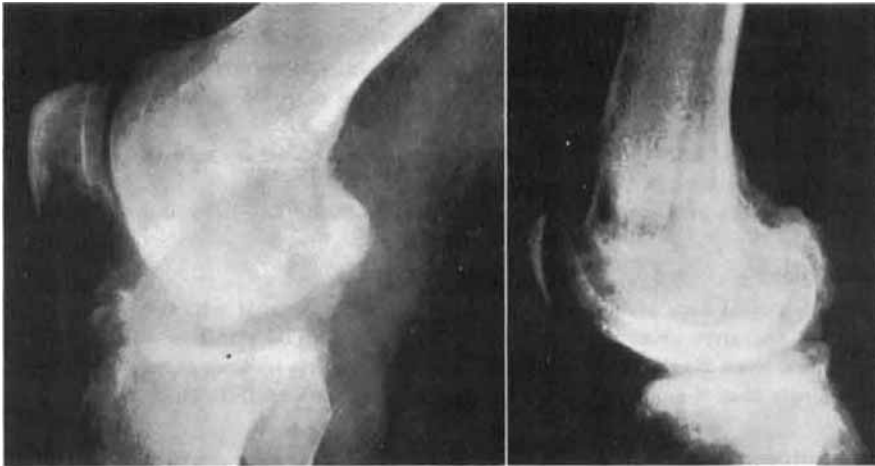
TABLE 1
Age distribution.

50-60 years	4 cases
60-70 years	6 cases
70-80 years	2 cases

TABLE 2
Results related to observation time.

Observation time	2-3 years	3-4 years	4-6 years
	12 cases	4 cases	2 cases
Results after	2-3 years	3-4 years	4-6 years
Excellent	6	3	2
Good	3	—	—
Fair	2	—	—
Poor	1*	1**	—

For notes see next page, please.



a.

b.



Fig. 3.

*This case for instance is called excellent.
Farmer—72 years old.*

- a. Before operation.
- b. Two years after operation.
- c. Ordinary photography: Three years after operation showing mobility and musculature at that time. He walks without a stick and has no pains.

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- * This patient demonstrated signs of emotional disturbances and should not have been operated upon. Her description of the pains appeared aggravated and evidently the thought of getting an invalid pension dominated her mind. After the one knee has been operated upon, however, she still wanted the other knee operated.
 - ** This patient was excellent for the first 3 years after the operation. He weighed 120 kilograms, however, and this, of course, was too much for his knees.

Comments on Table 2:

Excellent denotes ability to perform normal walking and movements without pain. Further the ability of 60 degrees or more flexion, and nearly complete extension.

Good denotes ability to walk without pain on an even floor, but not on stairs or rough ground. Flexion 45 degrees or more.

Fair denotes any definite improvement, but where moderate pain is still felt upon walking, and a cane is being used.

Poor denotes persistence of pain, whether mobility has been improved or not.

Conclusion:

The material here presented is fairly small, but I hope it will throw some light upon an operative procedure which may have a beneficial effect in otherwise hopeless cases. Even if the operation is of a palliative nature, its long lasting effect seems to indicate that it sometimes is able to break a vicious cycle in these patients.

QUADRICEPSPLASTY FOR STIFF KNEE FOLLOWING FRACTURES

by E. A. Nicoll (Sheffield, England)

PAUWELS' OSTEOTOMY IN COXARTHROSIS

by Sophus von Rosen (Malmö, Sweden)

Fredrich Pauwels, doctor of medicine and technology, gave a fuller report on his conception and experience of the genesis and the treatment of coxarthrosis in the report from the 48th German Orthopaedic Conference held in Berlin during 1960.

Pauwels states that coxarthrosis is a biomechanical problem and is due to the lack of accord between the mechanical demands placed on the hip joint and the resistance to these mechanical demands present in the cartilage and underlying bone tissues. The biological component in this lack of accord cannot be safely judged and cannot be influenced by our therapeutical measures. The other component, the mechanical forces acting on the hip joint, can be corrected by operative procedures in the form of "a causal therapy".

The three operative methods discussed by Pauwels are the "Voss operation", the "Mac Murrey displacement osteotomy" and the "Pauwels' varus adduction osteotomy".

According to Pauwels the effect of both the *Voss* operation and *Mac Murrey* osteotomy is a decreased pressure on the acetabular surfaces caused by a weakening of the action of the hip joint muscles. Pauwels thinks that these operations are not indicated in cases where the weightbearing surface is limited through subluxation or incongruence between the articular surfaces. The varus adduction osteotomy is justified in cases where greater contact between the articular surfaces is obtained when the leg is abducted.

Pauwels shows the results in a number of long-term cases showing beautiful and, I would say, fascinating structural improvements in the architecture of the joint.

My own experience of the Pauwels varus adduction is based on 17 patients on whom we have performed 20 Pauwels osteotomies since 1956. The sex distribution was 16 females and 1 male. It was around 30 years of age that the operation came into use as it was at this age that the patients began to be troubled and then again

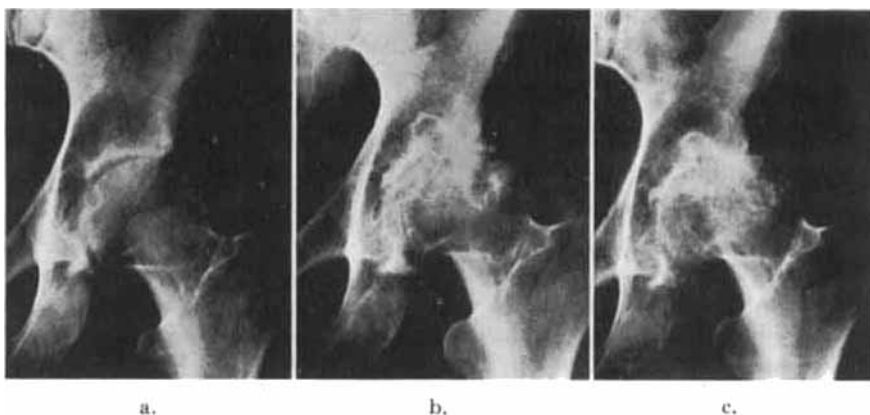


Fig. 1.

Female, born in 1901. From 1944 to 1958 a progressing osteoarthritis developed in the left hip joint. 1944 (a). 1954 (b). 1958 (c).



Fig. 2.

Same patient 3 years after varus adduction osteotomy.

later after the menopause. The two youngest were treated purely prophylactically owing to a valgus and subluxation position after late reduction of hip joint dislocation.

With a small modification we have followed the operative technique wich Pauwels recommended in 1955. Our results have been up to now very encouraging.

A short review of one case follows:

B.O. ♀, born in 1901. Quite severe trouble from the left hip joint in 1944. Had to use one cane for walking. Could drop the cane in 1946 after continuous gymnastic training. Some years later this patient suffered increasing pain which was impossible to endure in 1958. (Fig. 1 showing the X-ray changes during this period.) A

varus adduction osteotomy was performed in March, 1959. Present condition: The patient is very pleased. Mobility: 90° flexion, 15° abduction, 25° adduction. Practically no limp. The last X-ray is very satisfactory (Fig. 2).

"DELAYED EMERGENCY" TREATMENT OF OPEN LESIONS OF THE EXTREMITIES

by *Erin Madsen* (Sorø, Denmark)

A report is made on 84 open lesions (all but 5 were lesions of the hand) treated with delayed operation as recommended by Iselin. Primary treatment was as follows: surgical washing of skin, revision of wound, excision of dilacerated skin-edges, no suture, dressing moistened with cetaulon, chemotherapeutics. The dressing is changed daily. When acute reaction is decreasing a few days later, the final operation is done: excision of wound, repair of tendons, nerves and fractures, transplantation of skin, suture of the wound, dry dressing.

The motives for the delayed treatment are generally to operate under the best conditions. We can safely use an universal anesthesia, a skilled hand-surgeon is available. After the interval of a few days the limits of the necrosis are clearly to be seen, this means that the excision is safer. This method allows us to suture nerves and tendons nearly primarily on the fingers, also, the tendons in "no mans land" are repaired with the method of *Claude Verdan*, "suture bloquée". The conditions for skin-grafting are favourable. Last but not least: until now we have been able to avoid serious infections even in gravely contaminated wounds. *No tendons, bones or joints have been infected.*

Skilled experience and close observation during the interval are necessary to decide the optimal moment for operation. *The patient must be considered a case of urgency until the operation is done.*

Results: Of a total of 84 cases 79 healed without infection.

25 cases had skin grafts.

In 5 cases there was a slight superficial infection, but they all healed between 12 and 20 days. (1 suture on a finger burst without suppuration, 1 skin graft had a slight suppuration along the edges, 2 crushed finger ends had slight infections of the nail bed, 1 big wound on the leg was slightly infected a few days.)

Interval: 24 were operated after 18-24 hours, 38 between 1 and 2 days, 14 between 2 and 3 days, 8 between 4 and 7 days.

Suture of extensor tendons: 14 had very good results, 3 had fair results, 1 had result.

Suture of flexor tendons: 7 had very good results, 3 of them were sutured in "no mans land" with "suture bloquée". 3 had a fair result, 2 of them in "no mans land". No bad results.

(Fair: Finger $\frac{1}{2}$ -1 cm. from palm or ext. defect 10°-50°.)

We started this treatment with scepticism. Now we use it with confidence.

INDUCTIVE MECHANISMS IN BONE TRANSPLANTATION

by *R. Geoffrey Burwell* (Leeds, England)

The previous immunological studies of the writer have shown that homografts of fresh marrow-free iliac bone are only weakly, if at all, antigenic.

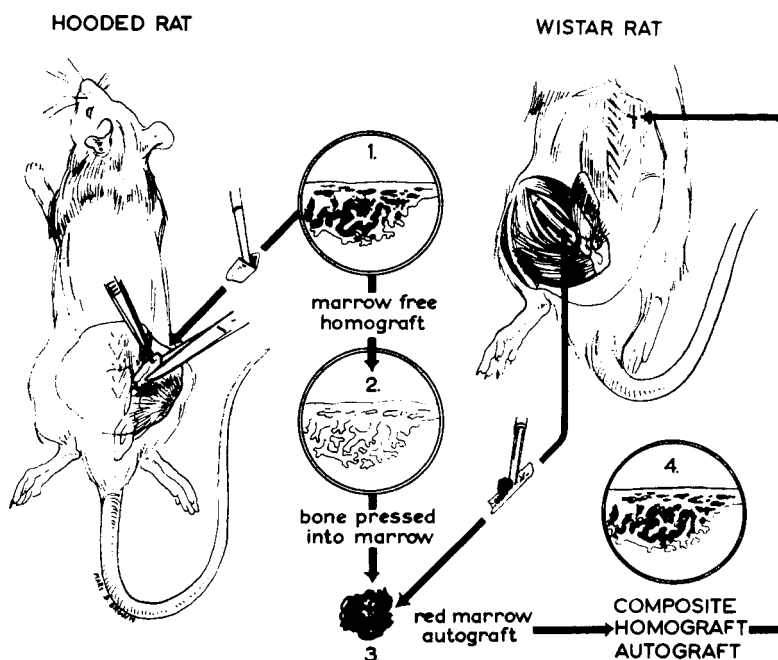


Fig. 1.

The method of preparation of a fresh composite homograft-autograft of cancellous bone.

In view of this finding an attempt has been made to produce a foreign bone graft capable of forming new bone as readily as an iliac autograft by the following method (Fig. 1). It was found that bone and marrow together as a fresh composite homograft-autograft (CHA) form considerably more new bone than do either of the components of the graft transplanted separately. Autografts of red marrow transplanted alone to a muscular site formed new bone in 13 of 30 experiments (43 per cent).

The effect of various physical and chemical treatments of the homologous bone before combining it with fresh autologous marrow has also been investigated. Using a quantitative method it was found that there is no statistical difference between the amount of new bone formed by fresh CHA's and CHA's prepared from bone treated by freezing (-20°C and -196°C). However, CHA's prepared from bone treated by freeze-drying, freeze-drying and irradiation, freeze-drying after sterilization with 1 per cent β -propiolactone and decalcification, form significantly less new bone than do fresh CHA's. Finally the CHA's prepared from bone treated by boiling, merthiolate solution, organic extraction, and ashing, show an even further impairment of new bone formation.

These observations were discussed briefly in relation to (a) mechanisms of osteogenesis, (b) the bone bank, (c) fracture healing and (d) the significance of the relation of bone and marrow.

MODIFIED PHEMISTER GRAFTING IN PSEUDARTHROSIS AND DELAYED UNION

by *Jan Roslund* (Stockholm)

TRANSPLANTATIONS OF BONE IN THE HIP JOINT SURGERY

by *Hans K. Dahl* (Oslo)

The author presented a material consisting of 122 vitallium cup arthroplasties combined with transplantation of cancellous bone. The operation were performed in special types of osteoarthritis of the hip joint, where a destruction of bone tissue would otherwise have necessitated a great resection of the femoral head, or replacement of the head with an endoprosthesis. The necrotic bone tissue was removed and replaced with cancellous bone chips or with solid transplants.

After gaining experience the same principle was extended to failures after prosthesis operations. In these cases a modified Whitman technique was used.

A follow-up examination of 96 patients with 101 arthroplasties presented an average observation time of 5.9 years.

Forty per cent of the patients were more than sixty years old.

The clinical result was compared with the results of the follow-up examination of the first 300 arthroplasties performed in our hospital and earlier published (*Jakobsen*, The Macmilian Company, New York, 1957).

TABLE 1

<i>Follow-up examination</i>	<i>Clinical result</i>	
	Transp. opr. (101)	Jakobsen (271)
Excellent:	43 %	25 %
Good:	37 %	40 %
Fair:	16.5 %	33 %
Poor:	3.5 %	12 %
Trendelenburg sign negative	57 %	42 %

The clinical result was supplemented with pathological-anatomical examination of specimens obtained during reoperations and post-mortem examinations in some cases.

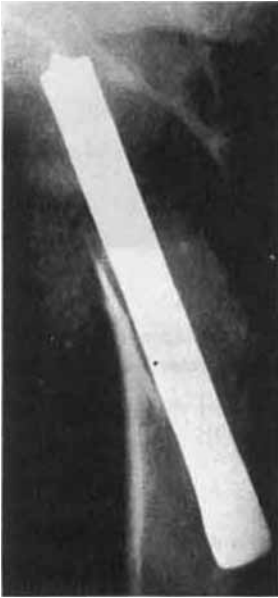
The clinical result and the pathological-anatomical examinations confirm that the grafts are healed.

Our opinion is therefore that the use of Smith-Petersen vitallium cup arthroplasty combined with transplantations of bone offers a better result than the use of an endoprosthesis.

ON THE USE OF MUSCLE-PEDICLE BONE GRAFTS IN FRESH SUBCAPITAL FRACTURES OF THE FEMUR

by *R. Movin* (Copenhagen)

45 patients demonstrating subcapital fractures of the neck of the femur have been operated on by a combined osteosynthesis and an osteoplasty.

*Fig. 1.*

X-ray 3 weeks after the operation.

*Fig. 2.*

5 weeks later callus formation is noticed around the graft, and the X-ray demonstrates the muscle pedicle bone graft as a living active structure.

After a normal osteosynthesis the lower extremity is rotated outward, the capsule of the hip joint incised and a groove made by a chisel in the neck of the femur and further into the head of the femur.

A cortical-cancellous bone graft measuring 4 by 1.5 by 1.5 cms. is taken from the anterior upper part of the major trochanter dealing gently with the attached glutæus minimus and medius muscle—the pedicle of the graft.

The graft is pressed firmly into the preformed groove and further into the hole in the head of the femur being placed across the fracture line.

The follow up study has not proved the method to be superior to other methods, but as the results are gradually improving, the work is being continued.

FRACER STUDIES OF SKELETAL DISEASE

by *Göran Bauer* (Malmö, Sweden)

PERTHES DISEASE—DYSPLASIA EPIPHYSIALIS CAPITIS FEMORIS

by *Johannes Meyer* (Refsnæs, Denmark)

Study of a material comprising 300 cases referred to the Seaside Sanatorium, Refsnæs, with the diagnosis Perthes Disease, revealed that this does not constitute a



Figs. 1, 2 and 3.

Dysplasia epiphysialis capitis femoris.

Fig. 1. 1 11/12 year old boy 11 months before the first roentgenological and clinical signs of Dysplasia. Ossification of the epiphysis retarded at least 1 year.

Fig. 2. The same Patient 11 months later. The nucleus of ossification appears dysplastic.

Fig. 3. The same Patient 5 months later than 2.

homogenous group. There is a minor group presenting a disease-picture—a syndrome—which is distinct, both roentgenographically and clinically, from the classic form of Perthes disease—not least as concerns prognosis.

This disease-picture is found in only about one tenth of all the patients, and mainly in *children under 4–5 years of age*. The epiphysial changes are not seen in normally developed epiphyses, as in typical cases of Perthes disease, but in *small, very strongly retarded epiphysial nuclei*. The roentgenogram shows no stage of condensation or fragmentation. From the very start, the small, retarded epiphysis shows a *diffuse, more or less coarse grainy bone structure*. This “grain of rice”-structure is most pronounced in the very earliest stages. Then without going through a stage of fragmentation, the structure becomes slowly and gradually more homogenous. The size and bone structure of the epiphysis become normal in the course of *three years*, and following suitable non-weight bearing treatment, healing ensues with no epiphysial flattening, so that the final result is a *completely normal epiphysis*.

In contrast to this, healing in Perthes disease takes about *5–7 years*, the disease leaving its trace in the form of a more or less *deformed epiphysis*—depending on the treatment. To distinguish it from the classic form of Perthes disease, a suitable designation for the above disease-picture would be *Dysplasia epiphysialis capitis femoris*. The fundamental difference between the two syndromes is presumably that while the dysplasia only is the expression of a *disturbance in ossification* of the young epiphysis, Perthes disease is the result of a *real necrosis* of the head of the femur.

The roentgenographic picture found in dysplasia of the head of the femur closely resembles the epiphysial changes so often found in *congenital dislocation of the hip*—before any attempt at reduction. None of the present cases of dysplasia of the head of the femur, however, showed luxation, subluxation or dysplasia of the acetabulum. Nevertheless, it seems likely that a *pathogenetic relationship exists between congenital dislocation of the hip and dysplasia of the head of the femur*.

Dysplasia of the head of the femur, *on the other hand*, is often associated with the classic form of Perthes disease; either in the same patient, in the same family, or in the form of transitional cases. The dysplasia also seems to predispose to classic Perthes disease later.

Dysplasia and Perthes disease are therefore undoubtedly not two different diseases, but merely an expression of the same cause resulting in different reactions in early and late childhood.

If the common pathogenesis of the two syndromes is disturbances of epiphysal circulation—and much tells in favour of this—*Trueta's studies* of vascularization of the epiphysis of the head of the femur in various age groups provides a natural explanation of the difference in the effect of circulatory disturbances before and after the age of 4-5 years.

DISCUSSION:

E. G. Herzog (Sheffield, England)

I was extremely interested in Dr. Meyer's paper.

Since, as we all know, it is so difficult to arrive at a definite prognosis in Perthes disease it seems very likely that we are in fact dealing with different types of cases; so that when we compare different forms of treatment our series are not strictly comparable. Now Dr. Meyer has taken a whole group of patients out of this disease complex under the name of dysplasia epiphysialis and presumably they have a different prognosis and possibly require different treatment. With a similar idea in mind, I have recently scrutinized more closely several cases which did unexpectedly badly with treatment by prolonged immobilization, which on the whole we consider the treatment of choice. We found that in two of them we had to revise the diagnosis to one of osteochondritis dissecans. We opened the joint in one of these cases and found a fragment which we freshened and pinned back with two Smillie pins.

THE MECHANICAL EFFECT OF THE CALCANEUM IN RELATION TO DEFORMITIES OF THE FOOT

by *F. G. Dwyer* (Liverpool, England)

Having noted the progressive improvement following plantar fasciotomy and correction of the varus of the heel in pes cavus, advantage has been taken of other deformities to study the effects on the forefoot of altering any abnormality in size or inclination in size or inclination of the calcaneum.

Attention is drawn to the line of action of the Achilles tendon (actuated as it is by the two most powerful muscles in the calf) in the normal. Any abnormality in the inclination of the calcaneum will shift the line of action of the tendon thus accentuating the deformity and affecting the balance and shape of the whole foot. Weakness or loss of power in the calf results in the calcaneum projecting distally like a post readily rolling into valgus or varus.

The principles underlying operative correction in all deformities including paralytic ones, are basically the same. They consist in correcting the abnormal inclination of the heel by removing or inserting a wedge of bone and increasing or decreasing the height of the heel where necessary.

Walking with the heel stable and fully corrected (or in some instances over-corrected) results in gradual correction of the forefoot deformity to such an extent that the following conclusions have been drawn:

1. No tendon transplantation should be performed before observing the full effect of altering the shape and inclination of the heel.
2. With the exception of paralytic drop foot mid-tarsal wedge resections can be avoided. Any equinus or supination of the forefoot which persists in spite of heel correction can be dealt with by removing a wedge at the tarso-metatarsal level leaving the mid-tarsal joint intact.

In pes cavus, in paralytic varus deformities and in club foot after division of the plantar fascia balance is achieved by either removing a lateral wedge from the calcaneum when the heel is large, or inserting a wedge into its medial aspect when it is small, as in club foot (the Achilles tendon being lengthened at the same time).

In all valgus deformities and particularly in cerebral palsy the insertion of a wedge of bone into the lateral aspect of the calcaneum tilts its plantar surface into varus and prevents it from rolling into valgus. The effect of control of the hindfoot by this means exerts a balancing effect upon the forefoot. In cerebral palsy the alteration in proprioceptive impulses is reflected higher up in the reduction of adductor and flexor spasm thus exerting a profound influence on balance and gait.

In calcanean deformities the height of the heel is reduced by removing as large a wedge as possible from the postero-superior aspect of the calcaneum at the same time correcting any valgus or varus inclination. When the calf is completely paralysed the wedge of bone which has been removed is inserted into the neck of the talus where it acts as a very effective bone block preventing excessive dorsi-flexion.

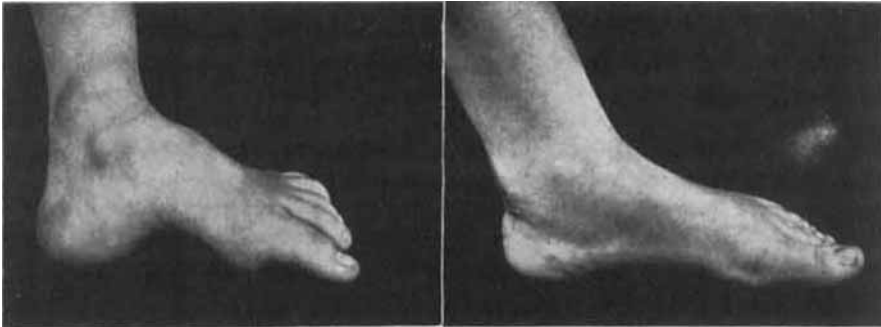
PARALYTIC CALCANEO CAVUS DEFORMITY OF THE FOOT

by *E. W. Somerville* (Oxford, England)

Paralytic calcaneus deformity of the foot can be divided into three types. In all three the gastrocnemius and soleus muscles are paralysed; the extent of the paralysis of the other muscles determines the degree and type of deformity that results.

Type 1.

The gastrocnemius and soleus are the only muscles which are paralysed, all the other muscles are acting strongly. As a result the heel assumes the vertical position because there is no upward pull, but the other muscles of the calf pull the forefoot down, producing the exaggerated cavus deformity. Whenever this muscle imbalance exists the deformity of calcaneo-cavus will always follow. It can be prevented or corrected by a suitable tendon transplant in which all the active muscles of the calf and the peroneal muscles are implanted into the end of the tuberosity of the calcaneus as tightly as possible, and the foot immobilized in plaster for one month. Of 13 such operations the result has been successful in correcting the deformity, and improving function in 12. 4 of these patients are able to walk on tip-toe.

*Fig. 1.*

A calcaneo cavus foot treated by tendon transplant.

Type 2.

In this type all the muscles of the calf are paralysed but the dorsi flexors are acting, and the tibialis anterior is often over-acting. With this muscle imbalance the calcaneus is as in Type 1, but the cavus deformity is less marked. However, the disability is greater because the forefoot cannot be got down to the ground. It is treated by transplantation of the tibialis anterior through the interosseus membrane into the calcaneus, again as tightly as possible, along with the peroneal muscles if they are acting. This operation has been done three times; all were successful in the first place, but in one at the end of one year the tendon of the tibialis anterior ruptured spontaneously.

Type 3.

Where all muscles below the knee are paralysed. The calcaneus is of moderate extent, and the cavus deformity is minimal. This foot can only be improved by stabilization operations, involving perhaps arthrodesis of the ankle, or bone block.

INDICATIONS FOR SURGERY IN SPASTIC PARALYSIS

by W. J. W. Sharrard (Sheffield, England)

Operative treatment has an important place in the management of children with spastic paralysis for the correction of fixed deformity and the redistribution of muscle forces at a joint. Reluctance to advise an operation often arises from fear of making a patient's condition worse or no better. An investigation was made among 420 spastic children to discover a reliable means of determining the indications for and the correct application of operative treatment.

The development of deformity in spite of adequate physiotherapy was found to be related not to the presence of spasticity in the shortened muscle but to relative weakness of voluntary action in the muscles opposing the deformity. Thus equinus was associated with relative weakness of the ankle dorsiflexors, independent of the level of spasticity in the calf muscle. Flexion and adduction deformity at the hip developed when the gluteal muscles were weak and flexion at the knee when the quadriceps was weak. A suggested mechanism for the development of deformity is

that the shortened muscle has failed to grow because of diminished tension exerted on it by its weaker opponents.

The rationale of surgical treatment should be to correct muscle length and, if possible, to obtain a better balance of forces at the affected joint. Tendon elongation or division weakens the stronger muscle and frequently achieves both aims; partial neurectomy or tendon transposition may also be used to obtain muscle balance. In addition to well known procedures, three operations new to the surgery of spastic paralysis have been found to be useful. These are psoas tendon elongation for hip flexion deformity, posterior ilio-psoas transposition for incipient dislocation of the hip and alternate anterior and posterior rhizotomy for spastic scoliosis.

TUBERCULOSIS OF THE SPINE TREATED WITH ANTITUBERCULOUS DRUGS AND RADICAL OPERATION WITHOUT ENFORCED RECUMBENCY, IMMOBILIZATION AND LONG HOSPITAL STAY

by *Bernhard Paus* (Oslo)

100 patients were given this treatment at the South Korean-Scandinavian Hospital in Seoul, Korea. INH and PAS were used, with addition of SM only during the in-patient treatment.

The patients were admitted and operated as soon as the bed capacity permitted. The operation aimed at as thorough eradication of the lesion as possible. No bone grafting was used. No tube was left for postoperative, local instillation of drugs.

The patients were permitted to get up as soon and as much as they wanted even if this meant the day after operation. Altogether 43 patients were completely up and about within 3 months.

Immobilization with plasterbeds, jackets and corsets was substituted by active exercises, starting from admission.

The in-patient treatment averaged 35 days, with a maximum of 30 days in 55 %, 40 days in 70 % and 60 days in 90 %. These figures include pre- and postoperative treatment, possible prolongations because of intercurrent diseases postponing operation, additional operation for tuberculosis of the hip, knee, sacro-iliacal joint, pubic bone, treatment for pulmonary tuberculosis etc.

The patients were included without any selection. The average number of vertebrae affected was 4.1. Paraplegia was present in 21 cases, sinus in 21, pulmonary tuberculosis in 31 etc.

80 patients became completely able to work. For adult males this mostly meant farm work or unskilled labour. For adult females it mostly meant housework. The interval from operation to resumption of work was less than 3 months in 15 cases, and less than 6 months in 47 cases. Roentgenological improvement was found in 80 %, and block in 60 %.

2 serious complications occurred, with operative damage of the cord. The operative mortality was 1 %.

The kyphosis amounted to the same degrees, and increased in the same way, as with other treatments.

CONGENITAL HIP DISLOCATION. A FOLLOW-UP STUDY

by *Ib Christensen* (Aarhus, Denmark)

THE RECOGNITION AND CURE OF CONGENITAL FLAT FOOT

by *Denis Wainwright* (Newcastle, England)

The distinguishing X-ray features of a true congenital flat foot are the vertical alignment of the long axis of the talus and the equinus deformity of the calcaneus. The forepart of the foot remains dorsiflexed, resulting in a subluxation of the talonavicular joint.

In this comparatively small series of cases, diagnosed in infancy, 8 in all, the deformity has been corrected by repeated manipulations of the forepart of the foot in a downwards and medial direction to bring it into line with the axis of the talus, and when this was accomplished the equinus of the hind foot was corrected by an elongation of the tendo Achilles and a posterior capsulotomy, restoring the longitudinal arch of the foot. In some cases this could only be achieved by placing a spike in the os calcis and levering the heel downwards and incorporating the spike in the plaster.

Fig. 1 a shows the X-rays of a child with bilateral congenital flat feet at the age of twelve weeks. They show a completely vertical position of the talus with equinus deformity of the os calcis and dorsiflexion of the forepart of the feet. The antero-posterior view illustrates the medial deviation of the talus. (Fig. 1 b).

Fig. 2 is a lateral X-ray of the right foot showing the extreme degree of equinus of the forefoot necessary to re-align it with the talus. Subsequent lengthening of the tendo Achilles and posterior capsulotomy corrects the equinus of the calcaneus and fully restores the longitudinal arches. (Fig. 3).

If the diagnosis can be established in infancy and provided the condition is not associated with a severe degree of generalized arthrogryposis or spina bifida careful



Fig. 1 a.

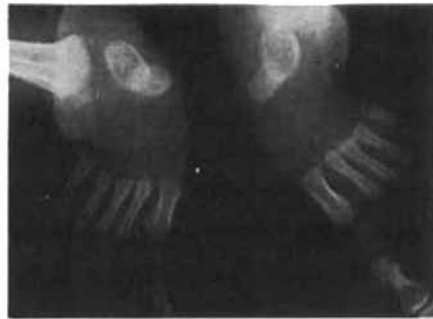


Fig. 1 b.

Fig. 1 a. A.P. view showing vertical talus and equinus deformity of the calcaneus.

Fig. 1 b. Lateral view showing the gross medial displacement of the talus.



Fig. 2.



Fig. 3.

Fig. 2. Lateral view showing the extreme degree of equinus necessary to re-align the forepart of the foot with the talus.

Fig. 3. Lateral view of both feet showing the full correction of the deformity of both feet with restoration of the longitudinal arch.

and intensive treatment on the lines suggested can result in a complete cure of this rare but troublesome and intractable deformity.

SCOLIOSIS SYMPOSIUM

THE PATHOGENESIS OF EXPERIMENTAL PROGRESSIVE SCOLIOSIS

by *A. Langenskiöld* and *J.-E. Michelsson* (Helsingfors)

In order to provoke progressive scoliosis, different operations on muscles, nerves and bones in the vicinity of the spine and on the spine itself were performed in young rabbits and pigs. It was found that progressive scoliosis always occurs when the posterior ends of 4-5 ribs are removed on one side. After hemilaminectomy of 4-5 thoracic or lumbar vertebrae of growing rabbits, scoliosis of 50-180 degrees developed in 2/3 of the animals (Figs. 1 and 2). The fact that both these operations cause severe scoliosis pointed to the existence of a common factor in these two apparently entirely different procedures.

It was found that the common factor in the two operations is the loss of function of the posterior costo-transverse ligament. One third of the animals subjected to section of five posterior costo-transverse ligaments developed progressive scoliosis. In the other two thirds of this group, scar formation prevented the deforming effect of the operation. The permanent loss of function of posterior costo-transverse



Fig. 1.

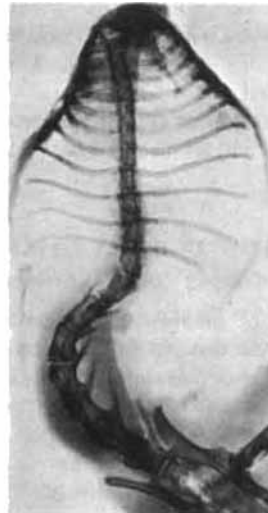


Fig. 2.

ligaments seems to be the scoliosis-provoking factor after hemilaminectomy and after rib resection.

We concluded that a protracted unilateral insufficiency of the function of the posterior costo-transverse ligament at several levels of the spine of a growing rabbit or pig causes progressive scoliosis of the same type as is seen in man. This ligament, in transmitting the effect of normal muscle tone to the spine, is of decisive importance to its equilibrium and symmetrical growth. Loss of function of the ligament on one side is followed by contracture of the corresponding ligament on the other side. This contracture is soon followed by contracture in other structures.

It is obvious from the anatomy of the posterior costo-transverse ligament that a contracture of it leads to a deformity composed of lateral flexion and rotation of the spine.

Rabbits with a scoliosis of up to 70 degrees could be brought to grow straight in the course of some weeks by means of section of the costo-transverse ligaments and parts of the intercostal muscles on the concave side of the primary curve.

THE ROTATION IN IDIOPATHIC SCOLIOSIS

by *Olov Lindahl* (Stockholm)

In a study in collaboration with Raeder we have analysed the location of possible forces that—from a purely mechanical point of view—can produce the different deformities that characterize idiopathic scoliosis (*Acta Orth. Scand.* 32: 27, 1962).

As a result of this analysis, resection of the transversal processes on the concave side of the curve was assumed to be a method of obtaining regression of the curve.

This operation has been performed in 13 cases of idiopathic thoracic scoliosis and the patients have been observed for between 9 and 24 months. It was concluded that this operation did not thus far influence the natural course of the disease.

However, according to this mechanical theory, other structures might also produce the same deformity and the next most likely structure would be the thoracic wall, especially the posterior part. A unilateral restriction in vertical growth of the thoracic wall might be the cause of thoracic scoliosis.

An elongation of this structure on the concave side is now being tried as a new attempt to correct the scoliotic curve.

DISCOGRAPHY IN EARLY CASES OF IDIOPATHIC SCOLIOSIS

by *Olof Perey* (Örebro, Sweden)

In spite of considerable research the aetiology of idiopathic scoliosis is as yet unknown and hence it follows that the treatment is symptomatic. In the more recent literature many maintain that the scoliosis is consequent on changes in the vertebral development. Greatest attention has been focussed on the epiphyseal ring, but as recently described by *Stillwell Jr.* these changes are secondary. Prof. *James* has demonstrated that no changes were visible in the epiphyseal ring of an eleven months old child with scoliosis.

My opinion is, that idiopathic scoliosis has a congenital aetiology in spite of the fact that it sometimes appears quite late in life. This is supported by the fact that it appears in uniovular twins. *Murdoch* has published one case and I quote another.

The complicated development of the spinal column from several centres which ultimately units in the adult spine leads to the frequency of congenital deformity. Developmental abnormalities in the vertebrae are apperent roentgenologically but disc deformities cannot be visualized by normal straight X-ray films.

In idiopathic scoliosis there is no primary deformity of the vertebra and thus the disc must be examined for the presence of anomaly. In young individuals the moving centre lies in the nucleus pulposus which is under pressure and as the nucleus and annulus develop from different centres it may be suspected that the nucleus is abnormally placed in the disc. It is known that the nucleus can displace laterally due to changes in intradiscal pressure and consequent vertebral remodelling.

In a series of cases of newly developed scoliosis which have been sent to me by my colleagues in the children welfare service three cases were suitable for discography. The remainder were either thoracal or thoraco-lumbar in which it was technically difficult to perform discography without risk. The investigations were carried out according to the *Lindblom* method using the so called Antonineedle. The patients were 14, 12 and 2 years old respectively. Discography showed that at the apex of the scoliotic curve the nucleus was located asymmetrically. In two it was dislocated laterally to the convex side and in the other case to the concave side. The other discs examined had a centrally placed nucleus.

The three cases examined showed early scoliosis not exceeding 15° and all subsequently decreased—the oldest least and the youngest most. In the two year old girl a fenestration of the disc and removal of the nucleus was performed through an abdominal incision. Post-operatively the scoliosis decreased over the nine months after the operation.

I feel that it is necessary to operate in these cases as early as possible before secondary changes in the epiphyseal ring and deformities in the vertebral body and pedicles occur. Once these deformities have occurred, the balance is already lost and

thus epiphysiodesis or fusion on the same indication as previously must be performed with the subsequent greatly increased treatment period.

TRANSTHORACIC APPROACH FOR VERTEBRAL EPIPHYSEODESIS

by *Ulf Nilsson* (Stockholm)

(To be published later in the *Acta Orthopaedica Scandinavica*.)

THE LATE RESULTS OF UNILATERAL GROWTH ARREST OF THE SPINE FOR SCOLIOSIS

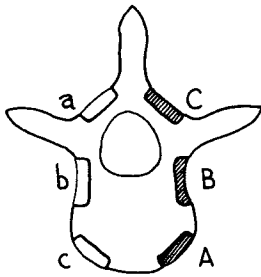
by *Robert Roaf* (Oswestry, England)

Whatever the primary cause of a spinal deformity, there is always a continuing or secondary cause—namely, the disturbance of growth leading to deformity both of the bones and intervertebral disks. The exact site of growth inhibition determines the type of curve. Fig. 1 shows that if the growth inhibition is anterior, a kyphosis results; if antero-lateral, a kypho-scoliosis; if lateral, a lateral flexion deformity without rotation; if postero-lateral, a lordo-scoliosis with varying degrees of rotation. There will be over-growth of bone opposite to—that is, at 180 degrees to the site of growth inhibition.

The logical treatment of growth disorders is to perform a growth arrest operation at the appropriate site—that is, opposite to the site of growth inhibition.

It has been found that an antero-lateral approach is the most flexible in enabling one to site the growth arrest either more anteriorly or more posteriorly according to the type of curve.

So far the results have been very encouraging—out of 189 patients, deterioration



- A. Growth inhibition here causes "kyphoscoliosis". Should be treated by growth ARREST at *a*
- B. Growth inhibition here causes "lateral curvature". Should be treated by growth ARREST at *b*
- C. Growth inhibition here causes "lordoscoliosis". Should be treated by growth ARREST at *c*

Fig. 1.

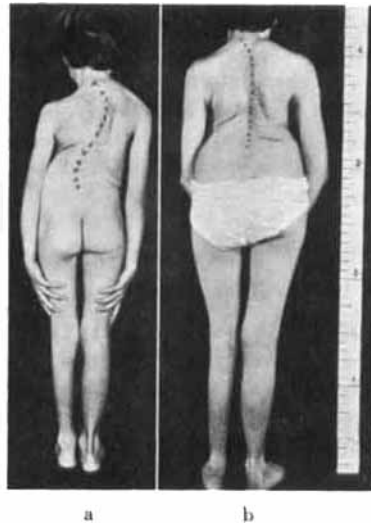


Fig. 2.

- a. Progressive paralytic curve.
- b. Six years after growth arrest.

in progressive curves has been stopped and in every case, and in approximately half there has been decrease in the curve with further growth.

In half the patients re-explorations have been performed and in only one has there been a pseudarthrosis at the site of the epiphyseodesis. Typical examples of improvement with growth are shown.

THE MANAGEMENT OF SCOLIOSIS

by *J. I. P. James* (Edinburgh, Scotland)

The only effective treatment of scoliosis is spinal fusion. By no means all curves are serious enough to require this and yet if we delay too long to see what happens the deformity becomes largely uncorrectible, particularly the rotation.

To resolve this dilemma it is necessary to know the natural course of the various aetiologies and types of curves. In those with a bad prognosis we undertake fusion at the earliest stage if the child is over ten. If under this age and therefore probably too young for fusion, the Milwaukee brace is most effective in preventing all further deterioration until the child is ready for fusion.

At all ages curves with an expected benign course are solely maintained under observation.

In a study of scolioses who were skeletally mature but who had never had effective treatment it was possible to analyse the behaviour of many types of curve.

In all aetiologies it was clear that high curves (thoracic) had a poor prognosis whereas those lower in the vertebral column, particularly the lumbar curves, were rarely serious. The age at which the curve appeared had a lesser but well marked influence. As is well known, paralytic curves and those arising in neurofibromatosis have a generally more serious outlook than idiopathic curves, though almost all thoracic curves in this aetiology were serious. The behaviour of congenital curves was hard to predict; many were slight; a few produced grotesque deformity.

Using bone-bank bone the pseudarthrosis rate on exploration of the graft was about 50 %. A change to the technique described by *Möe* had resulted in a fall 10 %-15 %. Routine exploration of the fusion five months after fusion allowed absolute certainty of fusion, or failure. If a pseudarthrosis existed it could then be repaired without loss of correction and adding only two months to the period of immobilization.

SURGICAL TREATMENT OF SCOLIOSIS

by *Ivar Albvik* (Oslo)

Because of the drawbacks of the long lasting immobilization in a heavy plaster jacket confined to bed for many months, and because of the inconvenience of performing the operation through a window in the jacket as is usually done in the ordinary methods of scoliotic fusion, we have developed our own method for fusion of the increasing scoliotic curve.

The main principles in this method are:

1. The curve is mobilized by means of physiotherapy. (Contracture therapy.)
2. After having obtained the best possible mobilization a plaster jacket is applied in a standing position in a gallow with suspension and side traction.
3. Further correction of the curve by means of ordinary wedging of the jacket.

4. The corrected plaster jacket is carried for several months, and is very often changed after another seance of mobilization.
5. Before the operation the plaster jacket is removed giving access to the operating field.
6. The fusion is performed in the socalled knee-elbow position to facilitate the operation and to minimize the bleeding. The fusion is done in one stage, and the whole curve is included in the fusion. A large amount of bone-bank bone is used as ships.
7. After the operation the patient is placed back in bed without any plasterjacket and without anye corrective spine support.
8. The patient is let out of bed in the course of the first three or four days after the operation without any spine support.
9. As soon as the patient is able to stand in the gallow for at least 20 min. (usually 14 days p.o.), he is replaced there and another plaster jacket is applied in the same way as before the operation, and corrected by wedging.
10. With this plaster jacket the patient is sent home, can walk around, attend school and maintain activity.
11. The plaster jacket is worn for 9 months.

From 1952 till 1960 152 patients were treated at Oslo University Orthopaedic Hospital with fusion of the scoliotic curve, and most of them according to the above described method. More or less correction is obtained in about 80 %. The average loss of correction after removal of the postoperative plaster jacket is 6.3 degrees included 9 cases (5.9 %) of pseudarthrosis. No death has occurred postoperatively.

CARDIO-PULMONARY FUNCTION IN SCOLIOTIC PATIENTS, TREATED WITH SPINAL FUSION

by *H. Erikson* and *M. Foss Hauge* (Oslo)

At the University Orthopaedic Hospital in Oslo rather extensive spinal fusion is used for the surgical treatment of scoliosis.

Since scoliosis deformity usually involves the thoracic cage, it was considered of interest to study the cardio-pulmonary function *before* and *after* the performed fusion.

41 patients from 8 to 17 years of age were examined at the University Institute of Respiratory Physiology in Oslo, pre-operatively and 9 months after the operation (a few days after removal of their plaster of Paris).

Besides the conventional determinations of vital capacity and maximal breathing capacity, a special test for determining the total cardio-pulmonary function, introduced by *Harald Erikson*, was used: By means of a spirometer, constructed by *Erikson and colleagues*, the CO₂-output was determined during rest, during a standard exercise and the recovery phase. The time required from the end of the exercise till the CO₂-output regains the resting level, is called *the CO₂-recovery time*. It is measured in minutes, and is an expression of the cardio-pulmonary function.

The pre-operative determinations of vital capacity and maximal breathing capacity show that almost all the patients had capacities below the normal mean values, and some only about 25 per cent of these (compared with mean values for healthy children on average height and weight in Oslo).

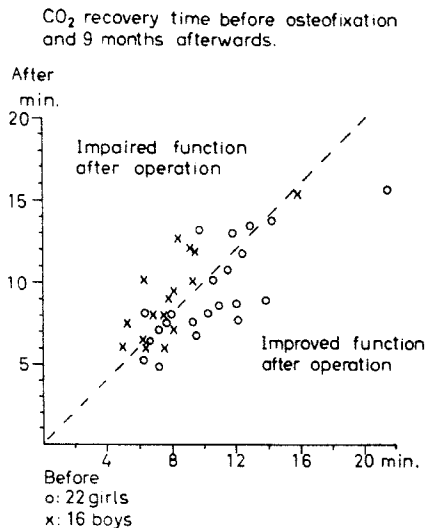


Fig. 1.

Vital capacity before operation and 9 months afterwards.

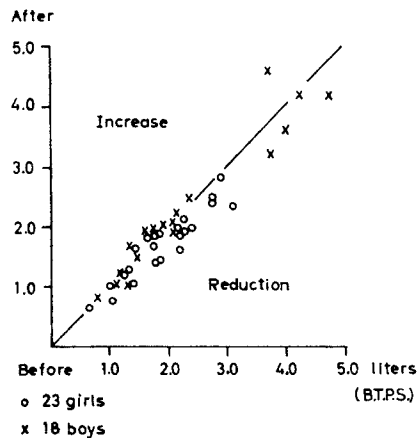


Fig. 2.

The CO₂-recovery times are prolonged for the majority of patients, indicating a decreased cardio-pulmonary function. Two patients with recovery times of more than 15 minutes were—according to this test, and also according to clinical evaluation—cardio-pulmonary cripples.

In general, the preoperative examinations showed that the bellows function of the lungs and the total cardio-pulmonary function in these patients varied from normal to very poor, with mean function values approximately one half of normal.

A comparison of the values obtained before and after the operation is made. Fig. 1 shows the data on vital capacity, which demonstrates only small or no changes. The same is the case for the data on maximal breathing capacity, and for the CO₂-recovery time, shown on Fig. 2. On the graphs, observations showing no change after operation fall on a line at an angle of 45 degrees.

In conclusion, we have found that surgical correction of scoliosis *in the first instance*, has *not* led to an improvement in cardio-pulmonary function, as we had hoped. But neither has it led to further impairment, as we feared.

The investigations will be continued, and the patients followed for many years with the same cardio-pulmonary tests—and perhaps this will throw some light on to the important clinical problems concerning pulmonary heart disease.

SCOLIOSIS TREATED WITH SPINAL FUSION

by Erik B. Riska (Helsinki)

The treatment of progressive structural scoliosis in the Orthopaedic Hospital of the Invalid Foundation in Helsinki was reviewed on the basis of 197 patients operated on during the period 1945 to 1961. In this series of patients, 86 had idiopathic scoliosis, 99 had paralytic scoliosis, and 12 were miscellaneous cases.

The majority of the patients underwent operation between the ages of 13 and 15. The turnbuckle cast of Risser was used from 1947 to 1954 in 42 cases, the Milwaukee

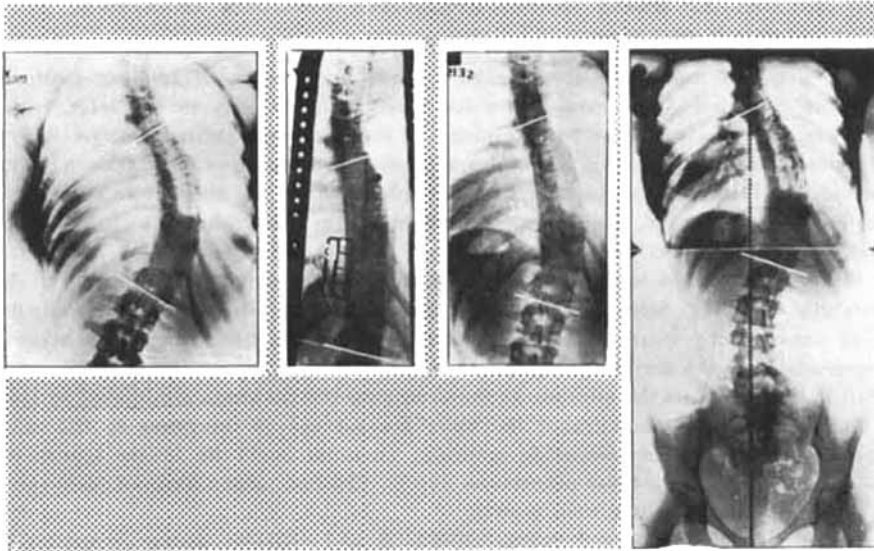
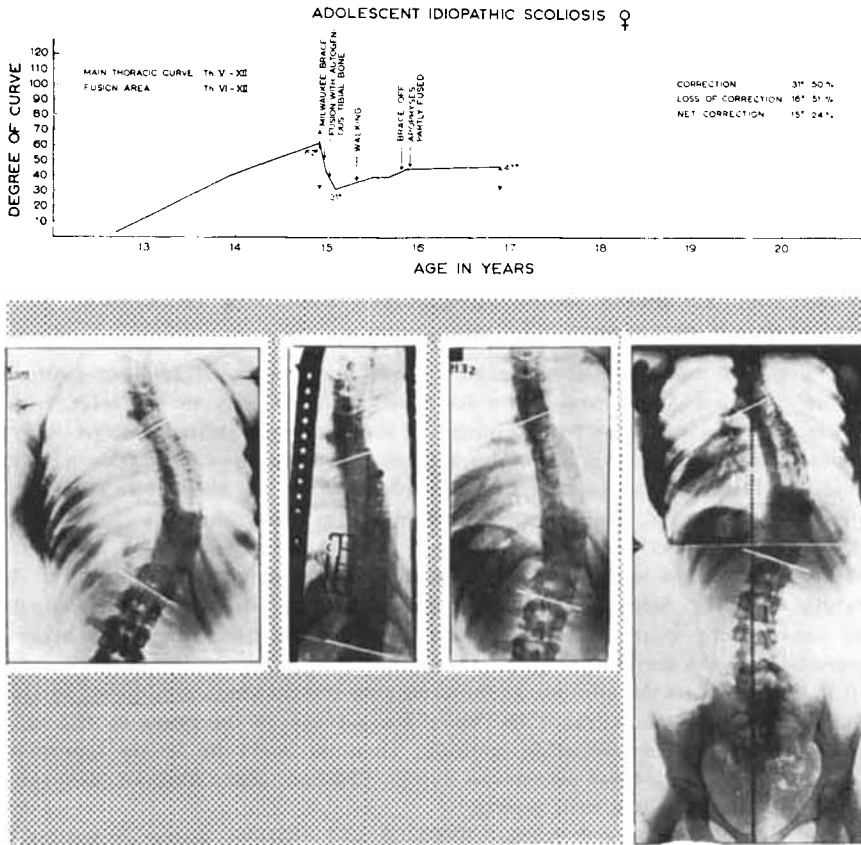


Fig. 1.

brace of *Blount & Schmidt* from 1954 in 155 cases. Three general types of fusion have been employed by about 20 different surgeons: first, the original *Hibbs'* method in 23 cases; secondly, in 24 cases, a method of fusion similar to this but not involving destruction of the articular facets. Thirdly, since 1954, the fusion has been done by means of the *Cobb* method, for 96 patients with the addition of homogenous bone-bank bone, for 40 patients with autogenous bone, and for 14 patients with both together. The mean duration of the follow-up period was 3 years and 11 months.

The results of treatment between 1945 and 1954 were poor when compared with the results achieved since 1957 and by present-day treatment. It was observed that autogenous bone was superior to bone-bank bone as a grafting material. There were 57 patients with pseudarthroses, but it is obvious that more patients suffered from unverified pseudarthroses. *Only 5 patients of the 40 treated with fusion involving autogenous bone had a pseudarthrosis in the grafts.*

Figure 1 illustrates our current treatment. This case is an adolescent idiopathic scoliosis treated with spinal fusion utilizing additional autogenous bone. The pro-

gression of the deformity was interrupted by the treatment and a net correction of 24 per cent was achieved. In our clinic today, we try to get the patient under early treatment. We fuse the spine if the deforming curvature attains an angle of 40-50°, and mainly with additional autogenous bone.

RESULTS OF SPINAL FUSION IN SCOLIOSIS

by *E. Thomassen* (Aarhus, Denmark)

THE MILWAUKEE BRACE IN NON-OPERATIVE SCOLIOSIS TREATMENT

by *Walter P. Blount* (Milwaukee, Wisconsin)

The pages of medical history record a great many ways of treating scoliosis without operation. Some have shown temporary promise only to fail later. Until recently none has succeeded in obtaining and maintaining significant correction in a series of cases. Braces that allowed ambulation were removed during sleep. They provided either lateral pressure or distraction but usually not both. If an occasional scoliosis was improved, support was abandoned from the weakened torso too soon and the correction was lost.

From 1947 to 1956 we used the Milwaukee brace occasionally to correct early paralytic scolioses. Acceptable idiopathic curves in girls who were near maturity were improved by wearing the brace with only a single pad. The curves became compensated as the major one decreased in length and degree while the lower curve shifted farther across the midline. At the same time the rib hump diminished in size.

For ten years we discouraged the more general use of the brace in the non-operative treatment of idiopathic scoliosis. Then we could no longer ignore its potential in correcting these progressive curves. Crooked spines have an inexorable tendency to become worse with growth.

If the forces are reversed during childhood and efficient active correction is maintained long enough, these spines will grow straight again. The growth zones on the concave side must be decompressed while those on the convex side are compressed. This reversal has been noted in our X-ray studies confirming the original clinical observations of *Hueter & Volkmann*. *Stillwell* demonstrated these phenomena experimentally in monkeys in June 1962.

The effectiveness of the brace is well demonstrated by a girl with a chronologic age of 13 years plus 6 months. The photographs show well compensated curves but with rotation and a high left shoulder that are not acceptable. In the X-ray the curves measure 45° and 35° (Fig. 1).

She wore the brace for three years with good correction, and then began removing

Figs. 1-2.

A. Female aged thirteen years, six months.

B. Three and one-half years later. She wears the Milwaukee brace only at night.

A. December 24, 1958. Rapidly progressive idiopathic scoliosis. Age, thirteen years, six months.

B. July 3, 1962. Three and one-half years later at completion of treatment.

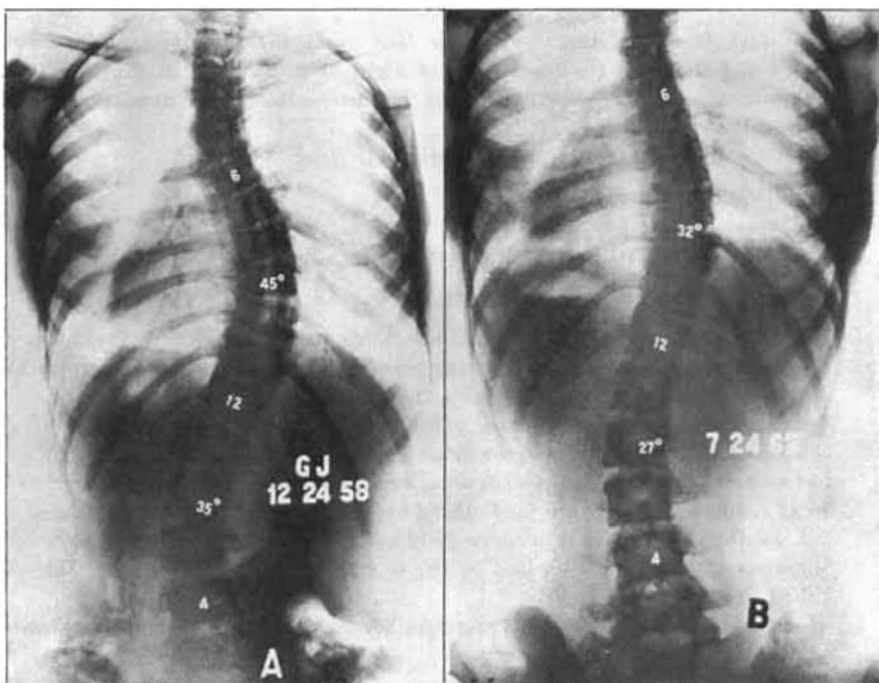


Fig. 1.

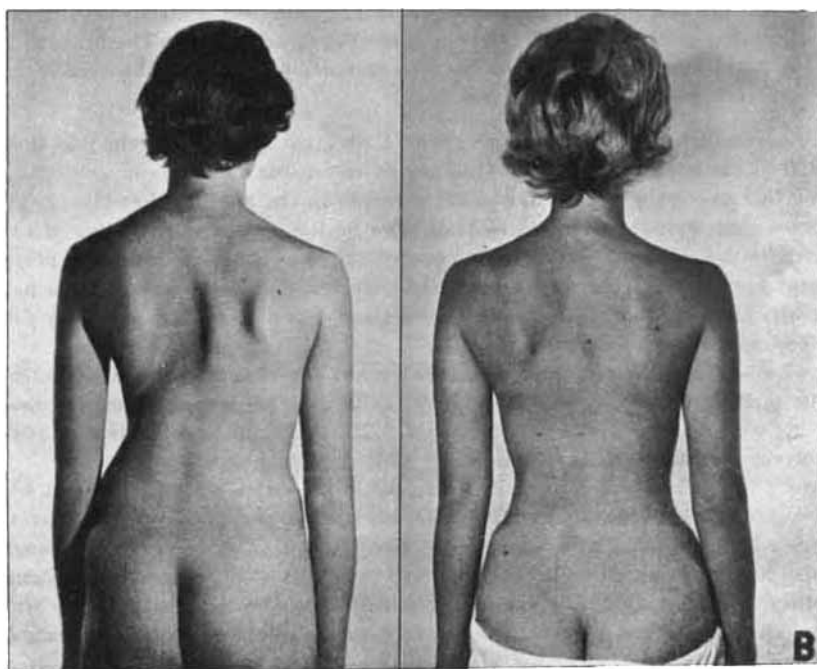


Fig. 2.

it once a week for social functions. After four years the improvement was well maintained and she wore the brace only at night (Fig. 2). Most of the correction was maintained and there was a pleasing cosmetic effect with almost complete reduction of the rib hump.

Ambulatory non-operative treatment requires:

1. An efficient brace.
2. An experienced orthopaedic surgeon.
3. The closest cooperation from the patient.

The more important components are:

1. Efficient distraction. This means comfortable but inconspicuous inclusion of the head and an efficient grip on the pelvis. The patient can always raise his chin from the support while he takes the weight on the occiput.
2. Two to four adjustable pressure pads must be properly placed under X-ray control. The orthopaedic surgeon must check the progress at intervals of one to two months and shift the pads as active correction progresses.
3. Brief removal of the brace for bathing or swimming is greatly appreciated in hot weather. Otherwise it is worn constantly.
4. Vigorous activity is encouraged in the brace. Volley ball, tennis, and bicycle riding are common place.
5. Specific breathing and posture exercises become meaningful when done in the brace.
6. Rest periods must alternate with exercise. Total recumbency may be advisable during the first two or three weeks of treatment.
7. The brace is worn until the curvature no longer has any tendency to progression.
8. Weaning must be gradual after the corrected spine is stable. The brace is worn at night only for the last six months or more to maintain the over-corrected position while flexibility is regained.

Pressure of the pads is made in a cephalad direction against only the ribs that are caudad to the apex of the curve. This avoids increasing the superior compensatory curve. In overcoming the rib hump, the pressure in the anterior direction must not accentuate an existing thoracic lordosis. The major pad is placed lower than one would think. Frequently the strap that controls the pad is passed behind the posterior upright instead of in front of it so as to develop straight lateral pressure. The patient can shift his body away from the pad at all times. Special pads are necessary for the less common types of scoliosis.

Jaws do not become deformed if one avoids the cup-shaped chin piece. Protrusion of the incisors occurs in about half of the children. This troublesome complication is being well handled by the orthodontists. With their appliances it is now possible to correct crooked teeth simultaneously with crooked backs.

Progressive structural curves in young children merit a thorough trial of the Milwaukee brace without operation. We know that the brace will correct these curves when combined with recumbency after fusion. If we keep these youngsters in bed in the brace without fusion for a few weeks their curves develop enough stability to permit gradually increasing ambulation. We have successfully weaned young children before puberty. They have grown straight as they once grew more and more crooked.

Early paralytic scolioses can be corrected and kept from worsening while the muscles become stronger and the fascial contractures subside. The brace may be worn while we do release operations and fascial transfers. In a significant number of cases the temporary use of the brace from one to six years has been most rewarding.

CONFERENCE ON "BASIC STUDIES IN RELATION TO OSTEOPOROSIS"

ACCRETION RATES IN OSTEOPENIA STUDIED WITH Ca^{47} AND Sr^{85}

by J.-F. Dymling (Malmö, Sweden)

Albright & Reifstein (1) postulated a humorally effected decrease of bone matrix anabolism as the cause of osteoporosis. However, they did not have any means to measure bone formation. Their concept has lately been challenged (2, 3, 4).

The accretion rate, which can be estimated with bone-seeking isotopes (5), is directly proportional to the bone formation rate in normally mineralized bone. The accretion rate has been estimated in 56 individuals with osteopenia ("too little calcified bone") and compared to 24 normals (Fig. 1). The results are expressed in liters of plasma, which can be converted to grams of calcium by dividing with a factor of ten, since these individuals are all normocalcemic (1 gram of calcium in 10 liters of plasma).

The normal 24 individuals had a mean accretion rate of 4.6 ± 0.2 liters of plasma

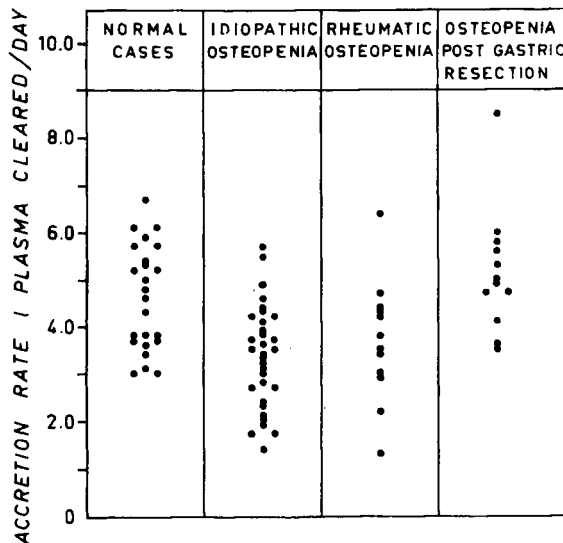


Fig. 1.

Accretion rates in normal and osteopenic subjects.

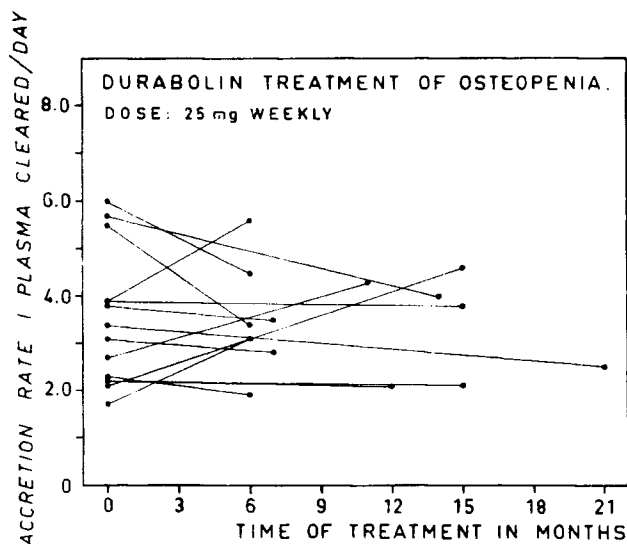


Fig. 2.

The effect of long-term treatment with Durabolin® on accretion rates in osteopenic subjects.

cleared per day. In the cases of osteopenia associated with rheumatoid diseases, and the idiopathic group the mean accretion rates were 3.7 ± 0.35 and 3.4 ± 0.19 liters of plasma cleared per day. This decrease, which approximates 30 %, is significant. In the gastrectomized patients with osteopenia the accretion rate did not differ significantly from the normal group, the mean value being 5.1 ± 0.37 .

The diagnosis of osteopenia was made on X-ray. It is established that the loss of skeletal mass under these circumstances exceeds 30 %. The accretion rates per unit skeletal mass were thus found not to be lowered in osteopenia. In the gastrectomized patients it was even found to be increased.

Treatment of osteopenia with anabolic steroids is based on the *Albright-Reifenstein* concept. It has been shown that anabolic steroids can reduce calcium loss, but it is not established that this effect continues during long-term treatment. 14 patients with idiopathic osteopenia were studied before and during treatment with 19-nortestosterone-phenyl-propionate 25 mg. weekly for 6-21 months. 12 improved subjectively. All the females developed hirsutism. The accretion rates showed no change (Fig. 2), nor did the exchangeable calcium spaces. This has been interpreted to mean that this anabolic steroid does not alter the bone formation rate.

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THE USE OF TETRACYCLINES AS MICROSCOPIC BONE MARKERS IN THE QUANTITATIVE STUDY OF BONE FORMATION

by *W. R. Lee* (London)

The tetracycline series of antibiotics have the property of forming a fluorescent complex on growing surfaces of bone. If bone formation continues, the complex is built into the bone and remains there: its localization can be demonstrated by the microscopic examination of undecalcified sections in ultraviolet light.

If single doses are given at known time intervals a series of fluorescent "markers" are deposited and can be used to determine: a) the Appositional Growth Rate, and b) the Total New Bone Formation Rate.

a) The Appositional Growth Rate, usually expressed in microns per day, is the rate at which bone is laid down on individual surfaces. It is determined by measuring the linear distance between the markers, using a calibrated eyepiece micrometer scale.

b) The Total New Bone Formation Rate is the rate at which new bone is added to the total mass and it is usually expressed as the percentage of this mass added each day. When apposition and resorption are in equilibrium, the Total New Bone Formation Rate is described as "Turnover". Actual determination of the Total New Bone Formation Rate involves measurement, in a thin section, of the area of bone formed in the period between two marker doses (i.e. the area of bone circumscribed by the two markers) and the total area of bone present. This can be carried out: 1) by a photographic method, or 2) by random sampling methods using either an eyepiece grid of the Chalkley type or the Leitz Integrating Eyepiece Micrometer.

Some results obtained with this technique in the study of human bone, both normal and in Paget's disease, were given. An experimental comparison in the dog, of calcium accretion as indicated by the uptake of Ca^{45} , and total new bone formation rate, was described and discussed.

THE EFFECT OF IMMOBILIZATION ON THE RATE OF UPTAKE OF PHOSPHORUS IN MICROSCOPIC BONE STRUCTURES

by *J. Strandh and A. Bengtsson* (Uppsala, Sweden)

Changes in bone tissue produced by immobilization have been studied by a number of investigators in various ways using for instance radiology, histological or microradiographic techniques, chemical analyses, gravimetric determinations or rigidity measurements.

The aim of the present investigation was to study the influence of immobilization with plaster of Paris on the rate of uptake of phosphorus in bone tissue.

The subject were an old adult dog and a young growing dog of different breeds. One of the forelegs of each animal was immobilized in plaster of Paris, ranging from just above the elbow joint and downwards over the lower portion of the extremity and over the foot. The immobilization period was 11 days for the older and 21 days for the younger dog. Four days before the plaster was removed both dogs were given intravenously 0.5 mC P^{32} /kg. body weight. The phosphorus activity of the inorganic fraction in serum was followed by repeated blood sampling during the experimental period. Both dogs were relatively unaffected by the experimental procedure. On removal of the plaster a portion of the third metatarsal was resected from both forelegs in each case.

Cross sections of the mid-portion of the diaphyses were cut and ground down to a thickness of about 330 μ , after which the ground sections were microradiographed. Guided by enlarged microradiograms, selected portions of the periosteal and endosteal lamellar bone as well as Haversian systems with high X-ray absorption were dissected out of the cross sections.

The activity measurements of blood and bone samples were performed with a Philips low level beta counting arrangement which gave a background of about 1 count per minute.

The phosphorus amount in blood and bone samples were determined according to *Youngburg & Youngburg* (3).

Using an expression derived in an earlier paper (2) the rate of uptake for phosphorus was determined for the different types of bone structures.

For further details of the dissection technique, the chemical procedures and the treatment of data the reader is referred to *Strandh* (1) and *Strandh & Bengtsson* (2).

In the table are recorded the results of the immobilization investigation. Except for highly mineralized Haversian systems, where no differences could be detected, the rate of uptake was found to be considerably lower in bone structures taken from the immobilized legs.

TABLE

Comparison of the rates of uptake of phosphorus in different types of bone structures from metatarsal diaphyses in immobilized and control legs of two dogs of different ages. Degrees of X-ray absorption: high = H; low = L; Rates of uptake: %/hour 10^3 .

Experimental animal	Extremity	Haversian systems	Periosteal lamellar bone	Endosteal lamellar bone	
		H	H	H	L
Old adult	Immob.	0.56	1.06	1.11	2.1
	Control	0.61	1.65	1.61	5.7
Young growing	Immob.	12.4	22	20	142
	Control	12.1	38	39	323

References:

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Acknowledgement.

This investigation was supported in part by a grant from the Swedish Medical Research Council, in part by a P S H research grant (D-1652) from the United States Public Health Service.

CHEMICAL ANALYSIS AND MICRORADIOGRAPHIC INVESTIGATIONS FROM
BONE SPECIMEN FROM CASES OF OSTEOPOROSIS AND NORMALS

by *E. Dollerup and Hans Bohr* (Aarhus and Copenhagen)

Bone specimens from the iliac crest in 58 cases of idiopathic osteoporosis have been analysed for the content of nitrogen, calcium and phosphorus, and the results compared with a similar analysis of normal bone from different age groups. The dia-

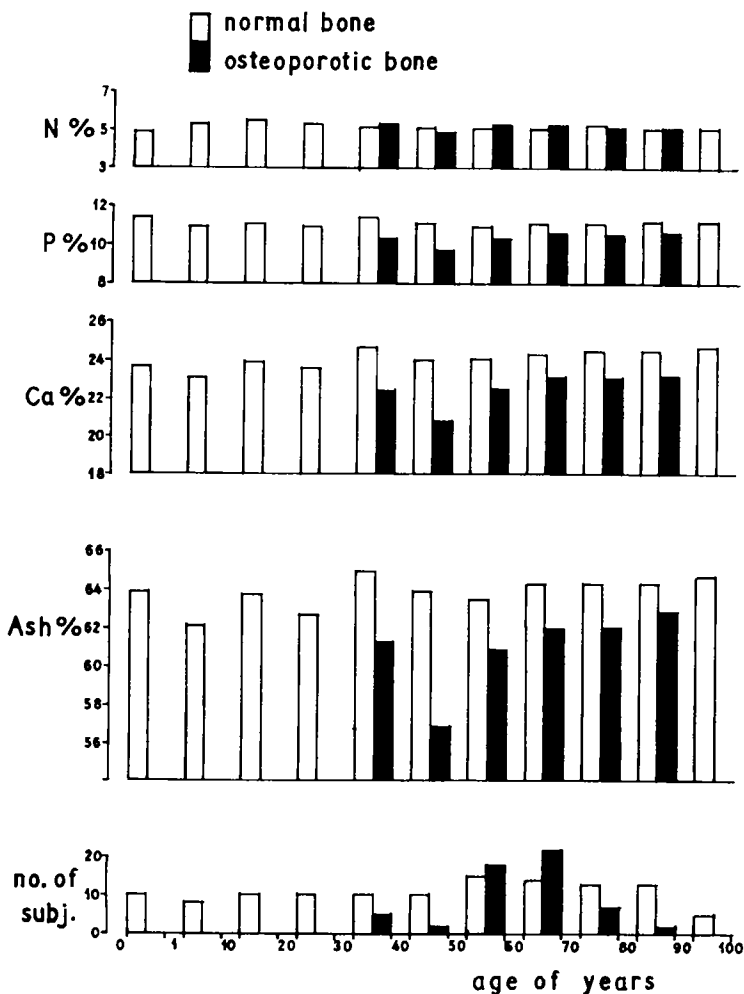


Fig. 1.

gnosis of idiopathic osteoporosis was made when X-ray photos of the lumbar spine showed the characteristic signs of osteoporosis and other diseases could be excluded at the examination in the Municipal Hospital or the Orthopaedic Hospital of Aarhus. The normal cases were chosen at post mortem examination among cases of fatal accidents or sudden death, when there had not been any prolonged bed rest or any known disease, which could have influenced the calcium metabolism of the skeleton.

The bone specimens divided into compact and cancellous bone and by a thorough rinsing in running water the marrow was removed. Fat was further extracted by ether and the bone dried at 100° C. to constant weight. Determinations of nitrogen were made by the method of *Kjeldahl* and determinations of calcium and phosphorus after ashing at 600° C. by the method of *Biedermann & Schwartzback* and the method of *Fiske & Subbarow* respectively.

A summary of the results for cancellous bone is given in Fig. 1, where the amounts of nitrogen, phosphorus, calcium and ash are given in percentage of dry bone. It is seen that while the nitrogen content is nearly the same in normal and osteoporotic bone, the amount of phosphorus and calcium is definitely lower in osteoporotic bone. Consequently the relation of Ca/N and P/N is below normal in osteoporosis indicating a lesser degree of mineralization.

Microradiographic investigations have showed a normal bone structure in idiopathic osteoporosis. An attempt to evaluate the rate of new building of bone by calculating the number of less mineralized Havershen systems as compared with the fully mineralized Havershen systems failed to show any decisive difference between normals and cases of idiopathic osteoporosis. As this study was only on a semi-quantitative scale it does not contradict the results of the chemical analyses mentioned above.

OSTEOPOROSIS AND MALABSORPTION OF CALCIUM—SUCCESSFUL TREATMENT WITH LARGE DOSES OF VITAMIN D IN A 24-YEAR OLD WOMAN WITH TOO LITTLE CALCIFIED BONE WITHOUT EXCESS OF OSTEOID TISSUE by Ole Munck (Copenhagen)

The patient was a 24-year old woman with symptoms of generalized bone disease during the last six years. X-ray showed fractures of the spine and pronounced decrease of the bone density throughout the skeleton. Lamina dura of the teeth was intact, and there were no erosive changes of the phalanges. The serum concentrations of calcium, phosphorus and alkaline phosphatase were normal. Calcium and nitrogen contents in bone was normal. Renal function was normal. Corticoidmetabolites and estrogen excretion in urine normal. Fecal fat excretion was normal in four 4-day periods: 2.5, 5.5, 7.5 and 5.0 g./hours on a daily intake of 80 g. fat. A biopsy from the iliac crest is shown in Fig. 2.

The left part is an ordinary photo, the right part a microradiograph. The trabeculae are mince, there is no defect in mineralization, and there is not an excessive amount of uncalcified, osteoid tissue. This sum of observation points unequivocally to the diagnosis osteoporosis.

Fig. 2 shows the calcium balance during 80 4-day periods. Food, feces and urine were analysed for calcium, phosphorous and nitrogen in each period. The data was charted according to *Albright*, so that positive balance is indicated by white areas under the zeroline. In the 5 control periods the average balance was negative with

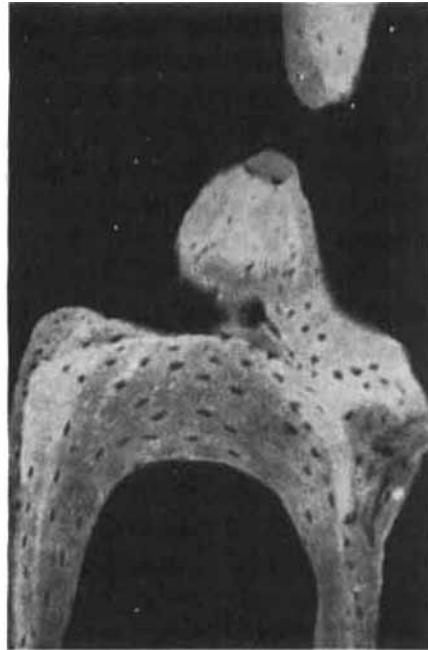


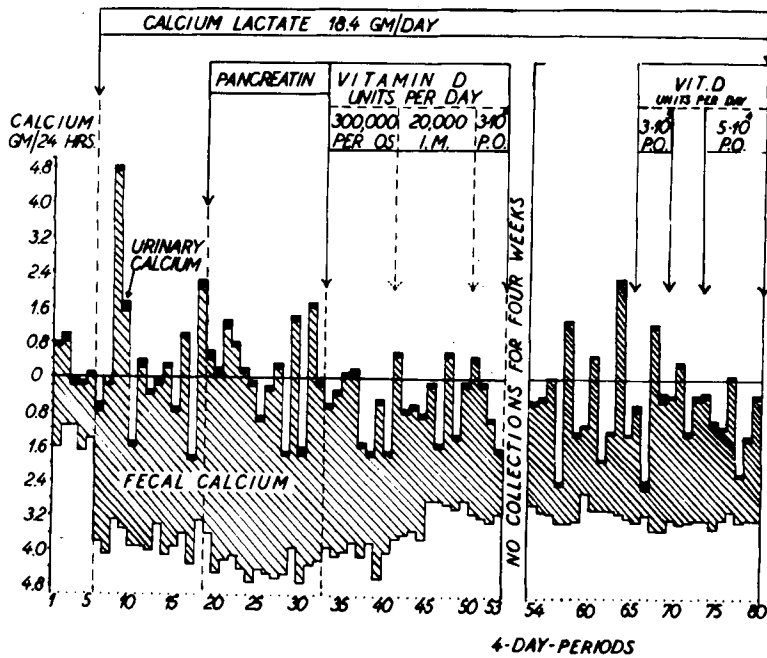
Fig. 1.

Microradiograph of biopsy from iliac crest.

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Fig. 2.

Calcium balance during 320 days.



367 mg./24 hrs. due to fecal loss. An extra supply of 2.4 g. calcium per day did not result in positive balance (13 periods). Addition of pancreatic enzymes was also without significant effect (14 periods). Then 300,000 i.u. of vitamin D was given daily during 12 periods interrupted by 9 periods when 20,000 i.u. was given daily intramuscularly. This treatment resulted in a positive calcium balance, on average +572 mg./24 hrs., this being a highly significant difference ($p < 0.001$) from the average of -248 mg./24 hrs. in all the 32 periods where no vitamin D was given. During the last 27 periods the balance remained positive with an average of +574 mg./hrs. The total gain of calcium during vitamin D treatment was 110 g. X-ray showed an increase in bone density.

This combination of observations has not been reported previously and may therefore contribute to the questions of etiology and treatment of osteoporosis.

Thanks are due to Dr. *H. Bohr* for performing the microradiograph and to Dr. *E. Dollerup* for the chemical analyses of bone.

CORTICAL OSTEOPOROSIS

by *Olov Lindahl* and *Ake G. H. Lindgren* (Stockholm)

It is a common concept that there is a reduction of the amount of cortical bone in osteoporosis. No systematic investigations seem to have been published regarding this.

We have collected one femur and one humerus from each of 64 autopsy cases, with an equal distribution between the sexes and with ages between 15 and 90 years. The weight, the volume and the average outer diameter of these specimens were determined. From this data the true density and the average cross section area were calculated. We think that the average cross section area gives a good conception of the amount of cortical bone in the body.

The average outer diameter of the femur was 33 mm. in men and 30 mm. in women, and of the humerus 26 mm. in men and 23 mm. in women. The diameter showed a slight increase with age.

The average density of the femur in men and women was 1.92 and 1.78 and of humerus 1.79 and 1.71 g./ml. respectively. In men there was a slight increase of the density with age, but this was not found in women.

The mean of the average cross section areas of the femur in men and women was 4.37 and 3.36, and of the humerus 2.33 and 1.52 sq.cm. respectively. There was a slight decrease of the area with age in men but not in women.

The following conclusions seem to be indicated from the collected data: The amount of bone mineral is higher in the femur than in the humerus and also higher in men than women. The density of cortical bone varies as much as 100 per cent. The changes of the average cross section areas with age do not correlate with the changes of the apparent density occurring in spongy bone with age (*Lindahl & Lindgren, Acta Orth. Scand. 32: 85, 1962*).