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THE OPERATIVE TREATMENT OF ARTHROSIS DEFORMANS COXAE

Speakers: *Carl Semb*, Oslo, *Gunnar Wiberg*, Lund, *Eivind Thomasen*, Aarhus

Carl Semb:

In operative treatment of hip joint arthrosis in Ullevål Hospital, Dept. III, and the Red Cross Clinic, the speaker employed from August 1946 until June 1954 as the normal method and the sole primary treatment, Smith-Petersen's arthroplasty with vitallium cup.

The material which is presented comprises those cases which underwent operation from August, 1946 to May, 1951, with an observation period of seven to three years. The series has been observed by a follow-up of Dr. Arnt Jakobsen. The results given are to be regarded as a summary of the experience gained from this work.

The series, which consists of 302 operated hips from 265 patients, has a minimum observation period of three years. Bilaterally operated patients totalled 44.

The distribution of the series into groups is as follows:—

Malum coxae senile:—35 hips operated on, including three bilaterally.
Average age: 62 years.

Dysplasia acetabuli:—51 hips operated on, including eight bilaterally.
Average age: 57 years.

Subluxatio coxae cong.:—51 hips operated on, including nine bilaterally.
Average age: 50 years.

Subluxatio coxae cong. rep.:—18 hips operated on, including three bilaterally.
Average age: 34 years.

Luxatio coxae cong. anterior:—40 hips operated on, including nine bilaterally.
Average age: 34 years.

Luxatio coxae cong. iliaca:—20 hips operated on—7 bilaterally.
Average age: 33 years.

Growth disturbances (Epiphysiolysis cap. fem., Legg-Calvé-Perthes etc.) 23 hips operated on—4 bilaterally. Average age: 38 years.

Traumatic arthritis: (Pseudarthrosis: 3, aseptic necrosis: 27). 30 hips operated on.
Average age: 58 years.

Infectious arthritis:—22 hips operated on—1 bilaterally.
Average age: 39 years.

The principles of Smith-Petersen's method are reviewed. The superiority of the vitallium cup is particularly pointed out where a new acetabulum is to be shaped, and also its ability to distribute the pressure over a larger surface of the joint head than normal. In addition it is stressed that a revascularisation of previously degenerated bone tissue may occur under the protective covering of the cup, and its rôle was described in fairly large transplantations of spongy bone tissue to replace cysts and necrotic tissue.

Complications in 302 operations:

2 post-operative deaths, both from pulmonary embolism ...	(0.7 %)
2 cases of deep infection	(0.7 %)
40 cases of thrombosis-embolism	(13 %)

Results of after-examination 3–7 years after the operation.

With few exceptions the results are based on personal examinations by the speaker and Dr. Arnt Jakobsen.

The classification was based on the function of the normal hip, estimating the defects in the operated joints—pain, reduced mobility, reduced stability and muscle strength from this.

For the *surgeon's judgement:* the international classification—excellent, good, fair and poor—was employed.

The *patients' judgement* of the results is given as follows: very satisfied, satisfied, not satisfied.

The total series comprised in all 290 hips in the follow-up examination (302 hips operated on, 12 patients died within three years).

188 observed for more than 5 years.

102 observed for more than 3 years.

Surgeon's evaluation:	Excellent	17–25 %
	Good	114–39 %
	Fair	66–23 %
	Poor	39–13 %
Patients' opinion:	Very satisfied	145–50 %
	Satisfied	97–33 %
	Not satisfied	48–17 %

The cause of the fair and the poor results is discussed.

New formation of bone which occurs in 25 % of the cases to a fair or strong degree is only the cause of 8.5 % of the fair and poor results.

Caput-collum atrophy was demonstrated roentgenologically in fully 30 cases, but 13 of these evinced no symptoms. In 5.2 % atrophy was assumed to be the cause of the fair and poor results.

Summarising, it may be said that Smith-Petersen's vitallium cup method makes it possible to create joints which preserve their structure throughout the duration of the observation period, (3–7 years). Continuous investigations have shown that in the overwhelming majority of the cases the results found to exist after 2½–3 years remain stationary.

Finally, important individual points of the operative technique were discussed:

1) The least possible detachment of the gluteal musculature and the suturing of the same to the ala ossis ilei with silk through drilled holes.

2) Caution with the resection of the joint capsule laterally where the arterial supply enters the joint head.

3) The least possible resection of the head with the possible replacement of necrotic parts and cysts by the transplantation of spongy bone tissue. In larger resections of the head transplantation of the trochanter major with the gluteus attachment distally.

4) Drainage for 24 hours. Anti-coagulation treatment from the 5th day post-operatively.

5) Intense after-treatment and routine mobilisation in narcosis 3 5 weeks post-operatively.

Gunnar Wiberg:

Among the surgical interventions in arthrosis deformans of the hip joint a number can be distinguished which are purely pain-relieving like, e.g. obturator exeresis, rhizotomy, Tavernier's op., chordotomy and drilling according to Graber Duvernier.

Other measures affect the joint itself more intimately. To these, for example, belong the shelf operation which may be of value in certain subluxation cases, and the capsulectomies. An intervention which must not be forgotten in this connexion is the subtrochanteric osteotomy.

The central features of our surgical therapy are the arthrodesis and the arthroplasty, and the order of precedence between them is difficult to decide. For many reasons it is hard to compare the results of arthroplasty and arthrodesis methods. The assortment of patients has some influence and in the hands of different surgeons the same operation produces different results. Even the follow-up results are not easy to compare in spite of the objective methods of evaluation which are proposed. The difficulties of determining which method is superior are demonstrated by the fact that leading orthopedic surgeons have changed their opinions over the passage of the years and from being protagonists of the arthroplasty several of them many years later expressed themselves in favour of arthrodesis.

As far as indications are concerned, regard must be paid to the patient's sex, general condition, age and mental outlook, to unilateral and bilateral conditions together with the occupation of the person in question.

With modern narcosis methods the general condition no longer plays such a great part, nor should the mental outlook be of decisive importance in the choice between an arthrodesis or an anthroplasty. With respect to age the general opinion seems to be that an arthrodesis is to be preferred for younger individuals but I personally consider that arthroplastics might also be discussed in these cases.

Much more important is the difference in indications between unilateral and bilateral cases. In my opinion a bilateral arthrosis deformans is suitable for arthroplasty in those cases where, taking into account the appearance of the healthy side, there is no need to fear subsequent deformans changes. In other cases an arthrodesis should be preferred.

A bilateral case with incipient changes on the one side is on the other hand suitable for arthrodesis, since this relieves weight-bearing for the least affected side.

I do not consider that the opinion often expressed abroad that a bilateral arthroplasty ought to be performed in advanced bilateral cases is correct, but prefer instead a combined operation with arthrodesis on the one side and arthroplasty on the other.

The patient's function in society must be taken into account and when work compels some to walk or stand the whole day, an arthrodesis ought to be preferred, while patients who have to sit at their work for the most part, are better served by an arthroplasty.

As far as the different operative methods in arthrodesis and arthroplasty are concerned one should realise that a good arthroplasty can be achieved in different ways, but fixation by nailing undoubtedly has a definite value in these cases. Amongst the arthroplasty methods Smith-Petersen's vitallium cup is less fashionable, even if follow-up examinations show that this seems to produce more lastingly good results in the long run than other more modern arthroplasty methods. These, which are carried out with acrylic and metal prostheses of very various types, are not yet stabilised methodologically. All that can be said so far is that the primary results seem to be better than what was achieved with earlier arthroplasty methods.

(To be published in full in Nordisk Medicin).

Eivind Thomasen, Aarhus.

DISCUSSION:

H. Støren (Stavern). In the Coast Hospital at Stavern 100 hip arthroplasties with the vitallium cup have been performed since 1947. We have used the acrylic prostheses since 1950. They number only 14 cases, since they were only used when the acetabulum showed small or no changes—as in caput necrosis after fractura colli femoris, or also in pseudarthrosis colli femoris when the caput showed changes or a fixation in the acetabulum. If the state of the caput was normal, we employed the method I presented in Aarhus 1948 (Acta orthoped. Scand. vol. XIX, p. 125). This and similar methods where the living caput can be preserved are undoubtedly to be preferred to all foreign body plastics, but owing to the qualifications mentioned the range of indication is narrow. We used the vitallium cup where there were acetabular changes. It follows from this that all dislocations and subluxations were treated by this method. Our observation period for vitallium cups extended up to 7 years, for the acrylic prostheses up to 3½ years. We have had no deaths, 4 thromboses, two of these in the same patient (vitallium cup).

There were no infections, although we had head necroses which however did not lead to other complications. The late results for the vitallium cup plastics show freedom from pain throughout. On reoperation a too deep cup was the cause of pain in one case—this disappeared at once when a shallower cup was used. Reduced mobility occurred relatively often after operation, but in part the patient did not notice this. With respect to the patients in these cases the result may be considered good, but for the plastics it is poor, on a level with arthrodesis. To give statistically 2 points for freedom from pain and 1 point for mobility shows therefore a false picture.

Some of our vitallium cup patients revealed over the years a caput atrophy, observed by the sinking of the hip into the cup. A considerable degree of this was seen, but with little or no subjective trouble. As could be expected, it arose particularly in those cases where the trochanter major and minor had been distally moved and a caput had been repaired by a collum stump and part of the trochanter. In our cases we have in part removed the capsule radically, but without injuring the inner envelope of the capsule which contains the vessels nourishing the caput. We did not observe increased pain in the cases where the capsule was not removed.

In higher dislocations where there was total atrophy of the caput and collum so that the trochanter had to be moved and the cup used along the longitudinal axis of the femur, we carried out simultaneously a medial osteotomy with the lower fragment in the adduction position. This prevented reluxation.

So far the acrylic prostheses have resulted in good mobility and freedom from pain, apart from one case where the pain persisted with weight-bearing. This case was the only one where the acetabulum had to be enlarged, as the prostheses available were too big.

In two cases of resorbtion of the collum femoris cylindrical acrylic prostheses were employed. After 2 years they show especially good results. It appears as if the prostheses are fixed by bone masses which grow up around the distal part of the prosthesis (roentgen pictures and normal photographs). A patient who had absolute freedom from pain, complete mobility and stability and who undertook heavy work, returned after 3½ years with slight pain and signs of limping. It proved that considerable resorbtion had arisen and in consequence the position of the prosthesis had altered. There were also signs of acetabular shifting. It seems as if on the whole the future can be met with greater confidence in those patients where the vitallium cup ad modum Smith Petersen is employed than for those to whom acrylic caput prostheses ad modum Judet are applied; the former method makes much greater demands on technical skill and is therefore scarcely so popular in general. In 2 cases of tuberculous coxitis with virulent bacteriae an arthroplasty with the vitallium cup was performed. In two others, where the caput contained a tbc. abscess, acrylic prostheses were used. Of course all the cases were accompanied by streptomycin treatment. The observation period was 2 years. For the acrylic prostheses this was 3 and 1½ years. As yet there is no sign of recurrence. The case observed for 3 years was re-operated on this spring owing to contractures. There were no longer signs of tbc. macroscopically, microscopically or bacteriologically.

G. Ulland (Sandnes). The operation was performed on 5 women aged between 65 and 70 years. Pseudoarthrosis was the indication for 3 and caput necrosis for 2. There were no post-operative complications. The result was good in each case. The observation period was from 1½ to 2½ years.

For the present the operation should only be used for elderly patients with pseudoarthrosis or caput necrosis, or for patients in a critical position after unsuccessful arthroplasty with the acrylic prosthesis. Continued observation will show if the range of indication should be widened.

(See figures on next page).

R. Movin (Copenhagen). With regard to hip arthroplasty department I in Copenhagen has passed through 2 phases—the cup method and the Judet method. At the moment we are going through a third, in which prostheses constructed according to other principles than Judet's are fitted and a different technique is used.

In the exhibition arranged in connection with the Congress an account is given of the results of the first two stages. The cup series comprises 35 patients kept under observation for 2–6 years, the Judet series 116 patients, as only those with an observation period of 1 year or more were included. In its arrangement at the exhibition the latter series is combined with that of department II.

The third stage really started 1 year ago, and the results are therefore not tabulated. It has been used in 65 cases.

Fig. 1.
A 70 year old woman, before operation.

Fig. 2.
2 years after operation.

There are two main reasons why we have had such an active phase of alloplasty in the last year: the one is, that we do not believe that hip alloplasty has found its final form yet, and the method ought not to be judged until many technical difficulties have been overcome. The other reason is that 1½ years ago, in co-operation with individual surgical departments we went about the task of discovering different principles of treatment for transcervical and intertrochanteric fractures of the femur and the conditions following such injuries.

During work on these fractures we altered our attitude on one decisive point. In the beginning we considered alloplasty as too much of a major operation for the weaker patients, but as the operative time for alloplasty was gradually reduced and as we saw that the patients managed relatively better after this intervention than after an osteosynthesis, we now employ alloplasty with the old, and osteosynthesis with the younger patients.

In this collum-fracture series, comprising 165 patients, alloplasty was undertaken in 55 cases, and the Judet prosthesis was used in only 10 of these.

The reason for this is that it was found unsuitable for all cases of defective or short collum, naturally enough since the prosthesis was intended for adjustment on the femoral head.

The nature of our series was therefore one of the reasons why we changed the type of prosthesis, but there were other reasons just as important. The two most fundamental were: first, that the Judet prosthesis required the spongy bone tissue to be enclosed in a narrow, deep groove, thus compromising the bone nourishment; secondly, that the prosthesis supported itself solely on cancellous bone.

It will appear from the following how we thought it possible to defeat these difficulties.

At this point it may be wise to look at the problems we are facing and consider them in relation to the possible solutions we propose.

The problems are numerous.

We have dislocations. In our series of 116 we have 4 with dislocation, 3 with subluxation. This may be reduced by using prostheses with sufficiently medially tilted heads. Furthermore by using prostheses which can be applied in retroversion in cases where we have to deal with a shallow acetabulum and anteverted collum, this complication will be likewise counteracted. This can be done, if the prosthesis has a medially tilted head, simply by rotating it backwards during its adjustment. In suitable cases cutting out of the acetabulum may be undertaken.

With regard to calcification in the surrounding muscles we believe that this can be reduced through repeated irrigation during the operation, so that the bone tissue released during the latter may be removed. This bone tissue buried in the musculature seems to us to be the main cause of the calcification--as in myositis ossificans. Others point to reaction owing to dust eroded from the prosthesis. This dust also presents a problem, and may be the cause of fibroses, through foreign body reaction.

It should be possible to combat reaction to this dust. On the basis of the research into erosion which we carried out in the National Research Institute, we thought that in nylon we possessed a strong, durable material. This is correct, too, as long as it is a question of rubbing against smooth surfaces. But simultaneously with our researches above, a patient with a nylon-acrylic prosthesis inserted in the hip, undertook a research of considerably higher value than our own. When his prosthesis was removed owing to shifting after half a year it showed wear amounting to a full 3 mms. which means, that even nylon cannot last in certain cases, like his, where the acetabulum is roughly formed. The prostheses are therefore now manufactured of acrylic resin with a vitallium cap covering the prosthesis head.

With regard to the post-operative positive Trendelenburg phenomenon, which exists in over half of the cases, such a number can be diminished through a more lenient approach to the joint, without breaking the insertion of the glutaeus medius in the trochanter or, if it is broken, by activation of the gluteal muscle.

We have experienced broken prosthesis stems. There have been no less than 5, 4 Judet prostheses and 1 prosthesis of a transitional type no longer used. The mechanism of the stem fracture was the same in all cases: the prostheses shifted owing to bone wastage under the collar, which means that the patient's weight bore down upon the stem alone: under the medial section of the stem an almost sclerotic part formed, above which the stem cracked. All our pins are now steeply placed and thus more resistant to weight-bearing, but in addition the V2A steel base is thickened and 100 % strengthened against bending and fracture. The "properties" of the material possibly also play a part in such fractures but if one can drive about on automobile axles for 30 40 years without sustaining any fracture it ought also to be possible to discover substances which can endure the life-time of the patient.

But this was only the technical side of the matter, for as described above, these prostheses were caused to break *first by the shifting*, and, now comes the most difficult point, *bone* wastage causing the prosthesis to shift.

All the other difficulties may be overcome in the future, but this point is much more serious. It turns upon one main problem: is it at all possible to introduce such a foreign body to the bone, so that it remains in position and resistant to weight many years after its application? -here grave doubt seems to be not unjustified.

There are two chief problems:

The first is—as stated above: can a prosthesis be expected to stay firmly in position after a number of years?

The second—if not,—for as far as can be estimated, nearly all the prostheses shift over a shorter or longer period; can the prosthesis be expected to give satisfaction, fulfilling the requirements for painlessness by weight bearing?

We are most disposed to answer the first question in the negative, adding the rider that the younger and the stronger the bone, the longer it will last.

As to the situation at present, we are clearly in an unfortunate position, since out of our total series of 290 Judet operated patients 32 have shifting prostheses beyond any doubt and no fewer than 44 are suspect, and one becomes not a little perturbed when meeting with such an experience as we had a short time previously: here we proceeded to trepan a bone cyst just under the prosthesis stem in a patient whose prosthesis was ideally placed roentgenologically, and where there was not the slightest sign of shifting in the form of bone wastage. In this case we discovered that the stem had shifted here and it indicates that the number of shifting prostheses amounts to considerably more than we suspect.

Thus we come to the answer of question no. 2: can the prosthesis give satisfaction in spite of loosening? In the series are to be found a few cases with notoriously shifting prostheses who manage excellently, within the observation period which these cases represent.

If the answer to this question is that shifting prostheses are not necessarily detrimental in an overwhelming number of cases, still greater stress, as far as I can see, must be placed on correct shaping of the prosthesis, i.e., the supporting surface must be as large as possible, and the prosthesis must base its support on several points, thus not only counterbalancing the under surface of the prosthesis head but also counterbalancing the stem, and standing not only on the cancellous bone, but also on the compact bone. With pressure distributed in such a way, the bone ought to have better biological conditions than with greater weight placed upon a more limited area.

This shifting of the prosthesis was one of the main reasons why we changed type.

We employ 2 models with one of which a reamer is used to shape the bone. This one is specially intended for fractures of the femoral neck, where the operation has to be completed rapidly, and the other is used, where a horizontal supporting surface is fashioned on the bone for the prosthesis to rest upon. This type locks itself against rotation as the supporting surface is not at right angles to the stem but requires more time for insertion. Both types are shown in the exhibition.

As announced recently in the Danish Medical Bulletin, similar researches into weight resistance have been undertaken on bone preparations applied to Judet's prosthesis and bone preparations applied to the new types described here.

The result was that the Judet prostheses withstood on average a pressure of 467 kgs., while the new prostheses withstood 1444 kgs. After this report a further 2 experiments were carried out in order to compare, with bones in position, the new Judet model with its oblique supporting surfaces and no collar. This withstood on average 605 kgs., our types 1600 kgs.

These researches naturally have only a limited value. They can give no indication at all whether the new types of prosthesis can fulfil their task after a number of years have passed. They were carried out however with this in mind, that the first requirement, if such an aid is to give satisfaction, is that the prostheses are resistant to weight-bearing, on the day they are applied.

In this account we only wish to point out the lines upon which we are working. The future will reveal if there is a landfall here.

S. Kiær, Copenhagen.

K. E. Kallio (Helsingfors). The operative treatment of arthrosis deformans Coxae in the Orthopaedic University Clinic of Helsingfors during 1950–54 was carried out as follows:

Arthroplasty: acrylic prosthesis 74, cup 19	93–52.2 %
Denervation	47–26.8 %
Ant. capsulectomy and post denerv.	10– 6.0 %
Acetabuloplasty	16– 8.9 %
Arthrodesis	5– 2.8 %
In all	175–100.0 %

From the table it will be seen that 6 different methods were employed. Nearly half of the cases underwent minor operations and rather more than half major operations. This fifty-fifty tendency is not only due to the lack of space at the clinic but also to our endeavour to decide in casu the most suitable operation, being fully aware that for arthrosis no method has yet been found which would be adequate in every case. The arthroplasties numbered 93. Judet's acrylic prosthesis was used 74 times i.e., in 43 % of the whole series. Primary arthroses and arthroses after coxa vara are considered to be the indications for acrylic plastics, but only in operative cases was the final choice made between acryl and cup. The patients' ages varied between 36–77 years, average age 55 years. The cases took their course without complications. Only the first case in the series, complicated by lues and a rhizotomy previously performed elsewhere, developed a fistula later. The results of the clinic justify the continued use of the acrylic method with the indications adopted so far. In two bilateral cases I applied acryl to the one joint and the cup to the other; but once I made use of acrylic plastics for both joints.—In 19 cases we used the vitallium cup instead of the acrylic prosthesis in cases of dysplasia acetabuli with subluxation. As a preparatory operation we at one time made use of obturator denervation in order to offset adduction and to keep the caput better in place in the acetabulum. There were no complications. A mobility as good as that with the acrylic technique was not achieved perhaps.

Arthrodesis was performed only in 5 cases, owing to lack of space for lengthy cases. But during recent years it has not been so easy to suggest this operation to the patients since the mobilising operations have been so popular. In 3 cases we successfully performed a so-called arthrodesis internofixata, i.e. the joint was nailed from the inside through the acetabulum and into the femoral head.

Capsulectomy was performed 4 times, but as the intervention is so extensive that an arthroplasty or other operation could be done at once we have given up the method.

Acetabuloplasty according to Smith-Petersen is on the other hand an operation which can be advised in certain cases. In our 16 cases mobility plainly improved.

Denervation was carried out 57 times and in our experience it is worth while in selected cases to attempt to relieve pain by the intervention.

Arnt Jakobsen (Oslo). Illustrated by a series of lantern slides a section is demonstrated of a 59 year old man who died 3½ years after a Smith-Petersen cup-plasty operation. The patient had an "excellent result".

The pictures showed a broad belt of 3 mm. thick homogeneous tissue running round the entire joint head; this tissue could not be distinguished macroscopically from normal joint cartilage. Microscopically the transitional stage between fibrous cartilage and hyaline cartilage was found. The bone tissue was found to be bare over an area approx. the size of a halfpenny, having the apex of the joint head as its centre. Cartilage formation had entered here what *Trueta* calls the "non-pressure area". A roentgen picture of the trabecular system in the joint head shows that to some extent this has a tendency towards a "pressure area", but this is far from being so marked as in an osteoarthritic joint head. The bone tissue underneath the "pressure area" was roentgenologically quite normal. It is assumed that a vitallium cup which moves in the joint will distribute the pressure over larger areas of the joint head than normal, and will shield the "pressure area" from unnecessary weight-bearing and collapse of the bone tissue below.

A number of cases of transplantation of large cysts in the joint head are demonstrated,—the one case with lantern slides of what seems to be a completely normal joint head, pictures taken during re-operation for bone growth. Here too *Trueta*'s work must be mentioned showing that the vascularisation around such cysts is extraordinarily rich and therefore particularly suitable for revascularising transplanted bone tissue.

Finally a number of examples are shown of how misleading the evaluation method of d'Aubigné may be in judging the results of hip plastics, especially in cases which do not have maximum invalidity.

Anders Westerborn (Gotenburg). It has been extremely interesting to listen to the discussion, which has principally concerned the question: which method should be preferred, cup-plasty or acrylic prosthesis.

At the Surgical Department II, Sahlgrenska sjukhuset, almost 200 hip-joint arthroplasties have been performed up to this date. About 70 of these were carried out according to Judet and the rest with cup-plasty according to Smith-Petersen, with some modifications in a number of cases. In our opinion, it is not a question of which method is to be used at a clinic, but rather which method is suitable for a given case, since both methods supplement each other.

When we started to use the Judet method in 1951, the very good primary results - both subjectively and objectively—were so impressive that in a few cases this method for a time predominated. Unfortunately we soon had a setback due to bending and even breaking of the stem of the prosthesis.

In some other cases we have seen resorption of the bone around the stem with loosening of the prosthesis leading to instability of the joint and pain. The steel stem of our prosthesis is now thicker than that of the original prosthesis and since we adopted this new design we have not seen any bending or stem fracture. A moderate valgus position of the prosthesis and two good cortical supports will decrease the risk of loosening. The cuff of the prosthesis should grip the firm residual part of the collum and the end of the stem should pass through the cortex of the diaphysis distally to the greater trochanter.

That we have returned to cup-plasty as the principal method is due to the difficulty we experienced in complete avoidance of the complications mentioned. Above all it is perhaps because we know now the final end results of cup-plasty

from a very great number of cases and these results as *Semb* and others have shown are very satisfactory. As for the Judet operation, on the other hand, we do not know sufficient about the end result. A poor result after a cup-plasty can often be improved by re-operation and this can possibly be done according to the Judet method. After a Judet-plasty, reoperation is frequently impossible. Even an arthrodesis presents very great difficulties here. According to our limited experience the best way to handle this problem is to insert a prosthesis consisting of head, neck and a medullary nail. This is a difficult procedure. In the two cases we have performed it, the results are very good.

The result of a cup-plasty depends very much on the growth of new exostoses. Unfortunately this risk is found perhaps to an equal extent in the Judet plasty. In some cases with excessive formation of exostosis (post-operatively) we have changed a cup plasty to a Judet plasty. However the tendency to the formation of exostosis has not been decreased.

Our attitude to the different methods is for the present that we prefer cup-plasty in cases where we can obtain equally good anatomic results by both methods. The Judet-plasty is reserved for cases with non-united or irreducible medial fractures of the femoral neck and caput necrosis of different origin.

Arne Bertelsen (Copenhagen). For the first year after operation the alloplasty results are better than those of the cup series. During the second to the third year the alloplasty results become steadily poorer, while the cup results do not change appreciably. There are grounds therefore for expecting the poorest late results after alloplasty.

The convalescence is by far the shortest with alloplasty, and it is reasonable to continue this procedure with old patients, while in my opinion one should choose between arthrodesis and cup plastics for younger and middle- aged people, at least so long as the alloplasty methods are not considerably improved.

J. Agerholm-Christensen (Oxford). The day's discussion has shown plainly that until there is agreement about a standard evaluation of cup and acrylic arthroplasties it will be difficult to produce decisive figures. But it seems to me that one may reliably declase that the cup arthroplasties require at least as many months as the acrylic arthroplasties need weeks to get going.

I myself have also enlisted the aid of arthrography, but have not hitherto discovered any fractured acrylic prosthesis. Finally, the thrombosis problem: this complication was found in about 15 % of Thomasen's series; in his time Judet had about 18 %. I have no doubt that this is due to the main vessel being mechanically affected in the anterior approach to the joint. This complication is reduced considerably by a posterior incision.

J. Hald, Sandvika.

S. Friberg (Stockholm). We have heard today that good results can be achieved with the old Smith-Petersen reconstructive operations and that the Judet plastic prostheses are sometimes very disappointing. When I visited a large number of American orthopaedic departments in 1948, we at the Orthopaedic Department of the Karolinska Institutet were not satisfied with the Smith-Petersen method, which had so far not come up to expectations. I was therefore eager to discover whether our experience was due to the method itself or to our technique. I found

that dissatisfaction with the Smith-Petersen operations was rather general—an important factor in the popularity of the Judet method.

When it was introduced, joint repair using Smith-Petersen cups represented an improvement on the fascia lata operations—less complicated procedure, fewer complications, shorter period of treatment, and better primary results—which meant that the indications could be expanded. For the same reasons, the introduction of plastic prostheses permitted still more generous indications. The fact that the latter operation has not proved the success that we at first anticipated must not cause us to reject the method as such. During the past five years, we have performed reconstructive operations using plastic prostheses in approximately 400 hip joints at "our" Department. Naturally, we have had some disappointments. Nevertheless, we continue to persevere, although we have become more restrictive regarding young patients, and we do not promise a manual laborer that he will be able to resume his former occupation, or an elderly patient that he will walk without a cane. But even so, it is progress to be able to relieve a patient of unbearable pain and from insomnia, at the same time retaining an acceptable range of motion, and to enable an old person to look after himself instead of living the life of an invalid.

With regard to technique, I should like to stress that we practically never touch the acetabulum, which is usually in better condition than appears from the roentgenograms, and that we make it a rule to try to spare the capsule, which is sutured after completion of the operation.

Carl Semb (Oslo). When the problem of the treatment of osteoarthritis in the hip joint is still the subject of so much discussion, and the opinion about Smith-Petersen's operation is so divergent—this may be attributed to: differences in material and indication, differences in operative technique and after-treatment—and differences in observation following the operation—especially the duration of the observation period.

When we have insisted so narrowly and strongly on Smith-Petersen's principles and methods it is first and foremost because the method represents a healthy *principle*—in that its aim is to create a joint with living tissue.

Our *series* is one-sided—but it has along with this the advantage that the series is not selectively prejudiced according to theoretical considerations. Our indications were strict-in that only severely troubled and completely or partially incapacitated patients were operated on.

It has astonished me that individual speakers have found bilateral suffering to be an indication for arthrodesis—unilateral, possibly also bilateral. We have adopted the opposite view and consider bilateral disease to be an indication *for* arthroplasty and *against* arthrodesis—because immobilisation of a hip joint makes great functional demands on the surrounding joints, and also on the other hip joint. In this series of 265 patients 44 were operated on bilaterally, i.e. 16.6 %.

No *prosthesis* operations according to Judet's principle were performed by us, as the problem of the use of such large foreign bodies remains unsolved. Our experiences have shown that large foreign bodies ,e.g. in thoracic surgery, tend to work loose sooner or later and often only after many years. Smith-Petersen's vitallium cup has in no case shown such a foreign body reaction and does not seem to provoke any reaction from its surroundings in an aseptic environment. Nor do we have any evidence that the cup produces bone reaction.

The classification of the series is of importance.

Our experiences have shown that the groups malum coxae, dystrofia acetabuli, subluxatio coxae, traumatic arthritis and infectious arthritis are the only ones which occasionally reveal nutritional disturbances of the joint head and the femoral neck after arthroplasty, surely because the nutrition has been previously reduced. They form about 65% of the series. We obtained improved results in these groups by the transplantation of spongy bone tissue. In these groups the use of the prosthesis to counteract shortenings of the head and the neck may be discussed theoretically as a possibility.

On the other hand, in the remaining groups of growth disturbance and different forms of luxatio coxae congenita which have a relatively low average age--well nourished bone tissue is found and there is enough living material for the development of a new joint. No cases of secondary atrophy were found in these groups either. Thus there would be no need for prosthesis operations here. They form 35 % of this series.

I was very interested to hear the results of the prosthesis operations performed by those who present investigated series. Only well investigated series with a long period of observation can produce evidence by which the true value of the method may be judged.

According to the series which are presented, it seems definite that the question of the firmness of the prosthesis is not solved-- and that, therefore, the foreign body reaction is not under control. For the present, therefore, we do not wish ourselves to adopt this method in the cases where poorly nourished bone tissue is present in the head and neck but will continue to use Smith-Petersen's principles and method.

Everything indicates that increased experience of selection, operative technique and after-treatment will further improve our results with the Smith-Petersen method.

G. Wiberg, Lund, *E. Thomasen*, Aarhus.

BONE GROWTH AND BONE REPAIR STUDIED WITH RADIO-ACTIVE ISOTOPES

by *G. Bauer* (Malmö).

The radio-active isotope technique has stimulated the study of the metabolism of bone salt. In the interpretation of data arrived at with this technique, there seems to be considerable divergence of opinions. According to the prevalent opinion, the bone salt of the skeleton is in a rapid equilibrium with the body fluids. The uptake of labelled bone seekers (e.g. Ca^{45}, P^{32}, Sr^{89}) administered to experimental animals would thus not permit a computation of new bone salt formation.

In conflict with this opinion, recent work has shown that bone salt, once deposited in the organic matrix of the skeleton, is relatively unavailable for the supposed exchange processes. The deposition rate of inorganic salt in the incisors and in the bones of rats has thus been determined from isotope data. Compared to earlier methods used to estimate the turn-over rate of bone salt, the isotope technique is easier and more accurate.

The author has used this technique for determinations of the rate of bone salt deposition and resorption in normal and in fractured bones in rats. Basic problems inherent in the isotope technique were briefly discussed. Experimental data on the

influence of trauma on the skeleton were submitted, and their importance for the understanding of bone repair were discussed.

Note: For references, see *Bauer, G. C. H.:* Bone Growth and Bone Repair Studied in Rats by Means of Ca^{45}, P^{32}, and Na^{22}, Acta Orthopaedica.

THE IMPORTANCE OF THE DISTRIBUTION OF THE ARTERIES IN THE LOCALISATION OF "ASEPTIC BONE NECROSIS".

by *P. G. K. Bentzon* (Aarhus)

he author has pursued his systematic investigations with the aid of stereoroentgen photography of sections—or amputation preparations injected with Zinnober—or red lead staining—over the approx. 30 years since his first publication on the subject. The paper gives an account of the knowledge thus gained of the more delicate branching of the arteries mostly in epiphysial—or apophysial regions, where the bone tissue reaction earlier designated as "aseptic necrosis" arises with varying frequency and with varying predilection as to age. If certain observable facts concerning 1) the stratification of the arteries—particularly with respect to the epi- or apophysis zones of growth, 2) the knowledge of or probability of "adequate traumatisation", 3) the frequency—in relation to the patient's age—of the occurrence of the reaction,—if these are compared with the clinical, roentgenological, histological observations and also those made in animal experiments, all these factors fall into a clear pattern which elucidates the special characteristic of each individual localisation in the way of the spread of the tissue reaction, the general incidence and the incidence in relation to the patient's age.

As far as the nature of the reaction is concerned, it must be regarded as a process of callus formation; but it is started in two ways differing in their cause: 1) where the arterial distribution ("terminal arteries"), makes it possible for infarcts to be formed with necrosis, the callus processes start (promptly) a *repair* reaction; but 2) where the distribution (numerous anastomoses) makes the formation of infarcts unlikely or unimaginable, hyperemisation must be reckoned with as the activating agent which sets the callus processes in motion. This hyperemisation is governed by a *vasomotor paresis* (analogous with that attainable by periarterial sympathectomy) caused by less powerful trauma to the arterial wall. The (sometimes extensive) bone necroses demonstrated at the autopsy then arise secondarily (but promptly) as the inevitable breaking down of the original bone tissue, which is "dislodged" by the callus proliferation processes. The author proposes that this well-known bone tissue reaction (previously recognised only by Leriche and himself) is designated as *fluction callus.*

The fact that the two processes—of callus and necrosis formation—run parallel and simultaneously (regardless of the activating agent) explains why the clinical and roentgenological courses—generally speaking—coincide so well whether it is ischemia or hyperemia which is the initial feature.

The author points out strongly that, even if it cannot be excluded (indeed, it is surely probable) that the tissue reaction is occasionally initiated on a purely traumatic basis in totally "normal" individuals, it must yet be taken into consideration that "constitutional" or local factors of weakness—of a widely differing type—which reduce the "resistance" of bone or cartilaginous tissue, are very often so strongly predisposing to the commencement of bone tissue changes that from a purely clinical and nosological point of view the predisposing anomaly is presented as the cause of the disease and with every reason is regarded as its "etiology".

It is clear then that the information which may be gained of the nature and course of bone tissue reaction in *clinical* histological autopsies, must always remain extremely problematical in value and that the significance of the findings must be influenced by the assumptions (previously formed) of the observer concerning the etiological and pathogenetical factors. This applies also to the research results gained by provoking this reaction during animal experiments.

On the other hand the author believes that a *comprehensive*, systematic, histological tissue examination of the diseases in animals who are affected spontaneously—e.g. swine (see E. Thomasen: Calvé-Perthes-like Changes in the Head of the Humerus in Swine. Acta orthop. scand. Vol. X, 1939, Page 331)—may give valuable information concerning the probability (or otherwise) of what is demonstrated by the author in purely anatomic investigations of man etc.

In order to be able to describe important anatomical details concerning the distribution of the arteries—in addition to his artery roentgenograms—Bentzon employed specially for the purpose manufactured models of the many regions to which these diseases can be localised. By standing with these models in his hands during his address and directly showing the audience what he was explaining the exposition became much more lucid, and the number of words spoken was reduced to a minimum.

DISCUSSION:

J. Agerholm-Christensen (Oxford). As is well known, the changes in Legg-Calvé-Perthes disease often include the collum as well, possibly the trochanter, and the acetabulum; this cannot be completely explained by Bentzon's hypothesis, however tempting it may be. Going through an Oxford series undertaken by Carlos Lima, it occurred to me that these changes were more frequent and more extensive than was generally assumed with pronounced calcium atrophy, perhaps of the same kind as we see in post-traumatic dystrophy. The well known caput changes may be secondary, possibly necrosis following compression fractures.

E, Thomasen, Aarhus, *P. G. K. Bentzen,* Aarhus, *C. Hirsch,* Stockholm, *H. Støren,* Stavern.

ON THE TECHNIQUE OF NAILING SLIPPED EPIPHYSIS IN THE HIP JOINT

by *E. Severin* (Gotenburg)

For naling in situ of slight slipping of the epiphysis in the hip joint the three-flanged nail originally constructed for the fixation of collum fractures is usually used in Scandinavia. Certain disadvantages and risks in using this clumsy nail are discussed. The author prefers the thin and easily guided *Nystrom* nail and describes the operative technique. To obtain accurate and clear pictures while the operation proceeds *Billing*'s technique is recommended.

(In complete form published in Acta Orthopaedica Scandinavica, Vol. XXIV, Fasc. 2, 1954).

DISCUSSION:

E. Thomasen, Aarhus, *P. G. K. Bentzen,* Aarhus, *S. Kiær,* Copenhagen, *G. Wiberg,* Lund.

OPEN REDUCTION OF CONGENITAL HIP DISLOCATION (FILM)

by *F. Langenskiöld* (Helsingfors)

THE TREATMENT OF PSEUDARTHROSIS

Speaker: *Arne Bertelsen, Copenhagen.*

A. Bertelsen:

After a short historical introduction and the perusal of fairly extensive statistical data relating to treatment after 1949 the attempt is made to draw up a survey of pseudarthrosis treatment in Denmark during the period 1944 1953 inclusive. Inquiries were answered by 79 % of the respective hospital departments in the country with regard to the number of treated fractures of the long bones and also concerning the presence of pseudarthroses, their treatment and the results of this treatment.

Out of the 32,500 fractures of the long bones a pseudarthrosis incidence of 1.2 % was found (restricted to adult patients the incidence must be almost doubled, since the child fractures make up 45 %, while the traumatic child pseudarthroses only amount to a small percentage of the pseudarthrosis series).

The definition delayed union/pseudarthrosis is made clear, and cases designated as pseudarthrosis within 12 months after the fracture are only accepted as pseudarthrosis when either a defect exists, a sclerosis with closure of the medullary cavity, or an interposition verified at operation.

The results of treating 276 operated cases are recorded according to the final treatment, while previous attempts at treatment are only briefly recounted; the percentage of healing was 87 % and, summarising, the following conclusions are reached.

Bone graft plastics with autologous material, either as an onlay or sliding graft or as medullary bone—peg—graft under compression proved itself superior to other methods in our series. For *crus pseudarthroses* one must continue to recommend the *autological graft* (96 % union) even after comparison with recent non-Danish series.

Phemister's and Matti's methods may be employed in cases with a satisfactory position without much shifting.

My own material can contribute but little towards defining the place of the medullary nailing in pseudarthrosis treatment. Both the literature and my own experience indicate, however, that the method is superfluous in crus pseudarthroses and of doubtful value for the forearm. On the other hand it seems as if the method must be preferred in *femur pseudarthroses* and perhaps in *humerus pseudarthroses.*

If in a given case it is decided to nail a pseudarthrosis it is advisable to omit resection of the pseudarthrosis, as *Küntscher* himself does, or combine the suturing with transplantation according to *d'Aubigné, Westerborn* or *Palmer.*

The antebrachium pseudarthroses present continually the greatest problem in the treatment of pseudarthrosis. For pseudarthrosis in the upper third of the ulnar diaphysis and in the lower third of the radial diaphysis we prefer marrow nailing with such shortening that the second bone can be telescoped. For the middle third and in pseudarthrosis of a single bone we habitually employ onlay or sliding graft.

THE INCIDENCE OF PSEUDARTHROSIS IN THE VARIOUS FORMS OF TREATMENT OF A FAIRLY LARGE FRACTURE SERIES

by *G. Støren* (Drammen)

The series comprises 1468 diaphysis fractures treated in Drammen Hospital during the 10 years 1954–52. In all, 8 certain pseudarthroses were discovered, i.e. a pseudarthrosis incidence of 0.7 %. For pseudarthrosis to be diagnosed in this series clear roentgenological signs, sclerosis of the medullary cavity, and indications of rounding of the fracture ends were required.

4 crus pseudoarthroses, 3 humerus pseudoarthroses and 1 radius pseudoarthrosis were found.

In the crus pseudoarthroses a predominating number of fractures which had been treated by operation were found, with transverse fractures prevailing, and with a localisation predominantly in the lower third of the leg.

In the humerus pseudoarthroses there was also a predominance of open-treated fractures; all were localised to the lower third of the humerus.

The one radius pseudoarthrosis was treated by operation.

The operative methods of treatment employed in those cases which developed into pseudarthroses are distributed thus (crus-, humerus- and radiuspseudoarthroses combined):

Open reduction without osteosynthesis	1
Küntscher's intramedullary nailing	2
Parham's band	1
Steel wire cerclage	2

On examining the course of treatment for each individual pseudoarthrosis all cases were found to possess one or more treatment conditions which in themselves may be assumed to have strongly favoured the development of pseudoarthrosis.

It was especially noticed that in several of the cases there were characteristics of the fractures themselves or complicating factors which compelled the adoption of the actual methods of treatment.

One may finally conclude that in this series of shaft fractures it was more the execution and the pursuance of the treatment than the actual choice of method which led to the development of pseudoarthroses where they occurred, for owing to the above-mentioned reasons too much weight must not be placed upon the predominance of operative treated fractures found amongst this small number of pseudoarthroses.

This contribution will be published in its complete form as an article in Acta Orthop. Scand.

ON THE TREATMENT OF PSEUDARTHROSIS AND RETARDED CONSOLIDATION

by *O. Bistrom* (Helsingfors)

During the years 1951–53 at the Orthopedic Clinic in Helsingfors 39 patients were operated on with pseudarthrosis of the long bones. In each case the pseudarthroses in question arose after fractures incurred in peace-time conditions. In 18 cases the fracture was sustained in traffic accidents. In 5 cases the operation was performed according to Lexer's method with good result, although the consolidation period was relatively long. Later two methods were chiefly employed. If no

considerable dislocation or defect was present a spongy bone graft was transplanted from the iliac crest. The graft was inserted into the bone above the pseudarthrosis; no metal attachment was employed for this. Moreover spongy "chips" were packed around the pseudarthrosis joint, which was not moved away more than was necessary for the insertion of the transplant. This method was employed in 18 cases and 14 cases were of tibial pseudarthrosis. This method seems to lead the most rapidly to consolidation. If a fairly large defect or dislocation existed it was very often necessary to free the pseudarthrosis ends. Because a certain inner stability must be regarded as an advantage at least during the beginning of union, in these a cortical graft from the tibia was transplanted and the transplant was made fast with vitallium screws. Spongy "chips" were used as additional material. Only a humerus pseudarthrosis which had twice previously been operated on elsewhere without any result was unsuccessful. A femur pseudarthrosis was infected but united just the same. In one other case a quite insignificant infection occurred after evacuation of a post-operative haematoma. Since the risk of infection is now so much less and operative technique has been simplified, the indications for bone transplantion could now be extended to cover certain cases of retarded consolidation, where the development of pseudarthrosis seems probable. In this way months of working time may certainly be saved and function-restricting malpositions, muscle atrophy and joint shrinkage may in many a case be avoided.

(To be published in Acta Orthop. Scand.)

ON PSEUDARTHROSIS TREATMENT AT THE INVALID INSTITUTE'S HOSPITAL IN HELSINGFORS

by *L. Nyberg* (Helsingfors)

The pseudarthroses from the period 1945–52 are reported. 12 of these were humerus pseudarthroses which were all treated with Z resection and Parham-fixation; all united. Most of 20 forearm pseudarthroses were treated with free bone transplantation and Parham fixation; 2 were unsuccessful owing to infection. 4 out of 13 femur pseudarthroses were treated with Z resection and Parham fixation. The shortening could be compensated in these cases by operation on both legs in the one case, while in the 2 remaining cases the other leg had been previously amputated. Consolidation was obtained in all these cases. 36 lower leg pseudarthroses were operated upon, the majority of these with free transplantation and Parham fixation. 7 were treated according to Hahn with fibula transplantation and 5 of these 7 recovered well. Out of the total number of lower leg pseudarthroses 9 were unsuccessful, the majority of these owing to infection.

The marrow cavity was opened up as a rule and pseudarthrosis connective tissue was very often removed. An erosion of the transplant after cerclage and steel wire was observed in one case only. No complication was perceived with the Parham band. In 3 cases of lower leg pseudarthroses, older than 3 years, consolidation was achieved after good immobilisation and weight bearing.

In fairly hopeless cases it seems wrong to have doubts of amputation and to think instead of very long and perhaps ineffective hospitalisation. 1 humerus and 2 crus pseudarthroses were amputated owing to very large bone defects, severe skin lesions, and nerve injuries with trophic ulcerations.

According to these results a Z resection with steel wire fixation seems to be a good method in those cases which permit shortening, but the results of free bone transplantation and steel wire fixation are also quite satisfactory.

DISCUSSION:

F. Langenskiöld, Helsingfors.

E. Madsen (Sorö). The principles of the treatment we have adopted are as follows:

1. Resection of the pseudarthrosis only if the position requires it.
2. Transplantation of solid tibia grafts, long, and fixed with 4 vitallium screws.
3. Bone chips are packed around, possibly in the pseudarthrosis.
4. On the femur simultaneous internal fixation with vitallium plates on a plane at right angles to the plane of the graft.

Finally I should like to say that the most important part of the pseudarthrosis treatment is the prophylaxis. Many days of illness and much invalidity could be avoided if one were everywhere ready for quick and active intervention as soon as retarded union were suspected—and in such a case operation with bone transplantation.

Arne Bertelsen (Copenhagen).—To *Støren:*

The incidence of pseudarthrosis after osteosynthesis can be calculated from 8982 fractures:

335 Lane osteosyntheses resulted in 19 pseudarthroses (6 %).
265 Küntscher osteosyntheses resulted in 9 pseudarthroses (3.4 %).
68 Parham osteosyntheses resulted in 2 pseudarthroses (3 %).
45 von Magnus osteosyntheses resulted in 0 pseudarthroses (0 %).

In our series therefore the pseudarthrosis incidence is *not* independent of the treatment, on the contrary it is 3–4 times as great in the operated cases as in the non-operated.

To Ddr. *Biström, Nyberg* and *Erin Madsen:*

Our treatment of retarded healing has been lengthy immobilisation and Beck's drilling. A more active attitude is however justified.

To *Langenskiöld:*

Our humerus series is only small—37 pseudarthroses were operated on, 3 of which could not be followed up. Some of the cases had to be operated on several times before healing was obtained. In these cases osteoplastic nailing with split fibula and the application of compression achieved our purpose.

For the antebrachium pseudarthroses the results do not seem to me to be at all too good. There was only 75 % healing of both bones out of 83 operated cases.

TREATMENT OF PSEUDARTHROSES OF THE OS NAVICULARE CARPI

by *Åge Randløv-Madsen* (Odense)

The clinical nature and treatment of the disease are described on the basis of 57 cases of pseudarthrosis following fractures of the os naviculare carpi, treated at 3 Danish orthopedic departments.

The fracture occurs most frequently in accidents at work, but sport and traffic accidents also cause a considerable number of fractures. 7 patients suffered

repeated trauma to the wrist which in each instance could have caused fracturing. Here it was clearly a question of re-fracturing old lesions with poor or no union, which only evinced rare symptoms. On the whole these scarce initial symptoms must be blamed for the fact that this form of fracture is so often not recognised early enough and is treated inadequately. The importance of the early radiographic examination is stressed.

An examination of the patients' radiographs shows both that the fracture often leads to nutritional disturbances, even if it is situated in the middle of the bone, and that considerable displacements occur amongst the fragments during movement. In consequence the fractures ought to be treated with lengthy and rigorous immobilisation in plaster. As an example of this it may be mentioned that a 9 months old pseudarthrosis healed after 7 months in a plaster bandage.

The long duration of immobilisation demands an evaluation of the operative methods however. Of 41 patients who were operated on for pseudarthrosis sited in the middle of the bone, 5 underwent drilling according to Beck, 3 with non-union and continued trouble. 20 patients were treated by the interposition-operation according to Bentzon. The observation period was between 1 and 15 years. All the patients excepting one are at work. 16 patients indicate the result as excellent, since they are working in their customary jobs without inconvenience. In 3 the result is fairly good, for they are at work in their occupatiens, but feel pain with particularly large loads. In one patient the result was poor owing to arthrosis in the radio-carpal joint. 13 patients underwent osteosynthesis; in most cases a bone graft was knocked through a hole drilled in the fragments. In 12 cases the osteosynthesis led to the healing of the pseudarthrosis. In 9 the result was excellent, in 3 poor, since these 3 had to give up their normal occupation and take lighter work. The cause of the poor results seems to lie partly in a previously existing arthrosis, and partly in technical conditions. Finally an arthrodesis was performed on the wrists of 2. The one achieved healing with a good result, in the other case there was non-union with a poor result.

The following indications are proposed for the methods of treatment mentioned; in cases where the requisite time can be given for the treatment and where the pseudarthrosis is not definite with sharply drawn, sclerotic fracture surfaces, immobilisation in plaster ought to be attempted, if necessary of long duration. If this treatment fails or rapid treatment is desirable, osteosynthesis is indicated, always provided that the cases in question are relatively recent with possibilities of union. For older cases without reasonable prospects of union Bentzon's interposition method is to be preferred. It may be supposed that alloplastics with prostheses of vitallium or acryl in particular will be given their full significance where severe changes in the form of the os naviculare or severe arthrosis are found.

DISCUSSION:

E. Madsen, Sorö.

H. Novotny Oslo). Of 34 pseudarthroses of the carpal scaphoid, observed from 1949 to 53 at the legevakten in Oslo, only about one third knew about their fracture. Some of the patients who were unaware of their injury remembered dimly, however, an accident in childhood. Fractures of the scaphoid in children often give very small symptoms and are therefore easily overlooked. Those pseud-

arthroses which give relatively little trouble in later life are probably mostly acquired in childhood. As, however, in these early pseudarthroses there is also a lowered resistance of the hand to trauma, one should be very much aware of the possibility of scaphoid fractures in children in order to avoid the development of pseudarthroses.

Arne Bertelsen (Copenhagen). We prefer extirpation when dealing with proximal fragments which cover less than 1/5 of the size of the bone, Bentzon's method by broader pseudarthrosis fissures through the middle of the bone, and extirpation of the 3 proximal bones (a.m. Smith-Petersen) in complicating radiocarpal arthrosis.

Age Randløv-Madsen, Odense.

J. Agerholm-Christensen (Oxford). I have also had good results with Bentzon's operation. Before one embarks upon excision of the proximal carpal row, I should much advise use of an acrylic prosthesis.

PREVENTIVE AND STABILIZING TENDON TRANSPLANTATION IN POLIO-FEET

by *Johs. Mortens* (Copenhagen)

I had an opportunity this winter at the Royal National Orthopaedic Hospital, London, together with an English colleague *Michael Pilcher* to investigate 147 feet in children treated by tendon transplantation *without arthrodesis* for deformities following poliomyelitis. We have concluded our analysis of these cases, reexamined personally by us, but we have not yet decided upon the final shape in which to present the results. In due time however we hope to have them published together with adequate documentation.

TABLE 1

Principles of Preventive, Stabilizing Tendon Transplantation in Polio-Feet.

I. At least one year's conservative treatment before the decision to operate is taken.
II. Operation should be delayed, if possible to the age of 5 years.
   a) because of correct muscle-charting.
   b) in younger ages the danger of overcorrection is probably greater.
   Exception: rapidly progressive deformity (calcaneus, plano-valgus).
III. Accurate muscle charting and recognition of the deforming muscles are essential.
IV. The other foot may be a useful guide to prognosis. A natural tendency to plano-valgus indicates early tendon transplantation in case of Invertor-weakness.
V. Consideration of possible hazards of operation: overcorrection, sec. deformity, instability, loss of a function.
VI. Preoperative correction of deformities (NB: a tight T.A.)
VII. Subcutaneous rerouting, and fixation to bone.
VIII. Postoperative protection of the transplant.

TABLE 2

Suggestions for Preventive, Stabilizing Tendon Transplantation in Various Paralytic Foot Deformities.

	Deformity	Paralysis	Suggestion for Transplants
WEAK CALF	Calcaneo-cavus	Triceps surae	Principle: try to preserve sidestability by preserving one set of Invertors/Evertors. 1) When Triceps has maintained some function: Peron. brev. + Tib. post. and available Toe flexors to T.A. 2) When Triceps is totally paralytic: Peron. long + Toe flexors to T.A. Tib. ant. simultaneously moved towards mid dorsum or to T.A. also, if Toe extensors are good.
	Calcaneo-cavo-valgus	Triceps surae and Invertors	1) Peronaei to T.A., also available Toe flex. 2) With weak Dorsiflexors: Peronaei to dorsum, available Toe flex. to T.A. (*Cave:* Equino-(plano-)valgus with transplantation to T.A. alone).
	Calcaneo-cavo-varus	Triceps surae and Evertors	1) Tib. ant. to T.A. 2) To avoid drop foot, if Toe extensors are weak: Tib. ant. towards mid dorsum. Available Toe flex. and Tib. post. to T.A. (If Tib. post. is to be regarded as main deforming factor, Tib. post. is naturally moved to T.A. and Tib. ant. balanced dorsally) .
STRONG CALF	Medial cavus	Tib. ant.	Ext. hall. long. to 1st. metarsal. If proved insufficient: Peron. long. to dorsum (or to Peron. brev. if varus of the heel).
		Tib. ant. and post.	Both Peronaei to Dorsum.
	Plano-valgus	Tib. ant.	Peron. long. to dorsum.
		Tib. ant. and post.	Both Peronaei to dorsum.
	Equino-varus Varus,	Peronaei	Tib. ant. moved laterally on dorsum.
	Equino-cavo-varus	Peronaei and Dorsiflex.	Tib. post. laterally on dorsum.

Recent publications from America on treatment of polio feet in children are concerned mainly with tendon transplantation *combined with arthrodesis (Irwin, Reidy, Broderick and Barr, Kuhlmann and Bell). Tendon transplantation alone* has been practised for many years at the R.N.O.H. and we were fortunate to have seen two cases operated over 50 years ago by *Tubby* and *Murhead Little*. The staff at the hospital have been increasingly conscious of the role of muscle imbalance and deforming muscle pull in the production of paralytic foot deformities and there has been a gradual shift towards early tendon transplantation; operation however was seldom undertaken before some degree of deformity occurred.

The preoperative condition in the material was not always ideal for obtaining a good result and a wide variation of types of transplants was used. However, there was sufficient information obtained from the analysis to give a sound basis for an opinion of the value of the method.

I have become convinced that it is possible in a large proportion of cases to prevent increasing deformity or to correct a deformity and increase stability by early transplantation, by careful preliminary correction (particularly of a tight T.A.) and by using the types of transplants which have proved to be the best and which I have indicated in Table 2.

The method involves certain risks in respect to overcorrection or secondary deformities due to the removal of the transplant, and in respect to increased instability by the operation. These hazards however, I feel, can largely be overcome by careful planning and execution of the operation. (The principles of tendon transplantation we follow are summarised in Table 1).—It was mainly in the group of Invertor-weakness with associated Medial cavus or Plano-valgus deformity that overcorrection had taken place, when one—or both—Peronaei were transplanted towards the inner border of the foot. In many such cases, however, the function of Tibialis posticus had been underestimated preoperatively. Tibialis posticus in a plano-valgus foot may appear to be very weak; after manipulation and plastering and a period of bed rest it may increase in power to a remarkable degree.

Overcorrection had taken place in cases of calcaneo-cavo-valgus also. A contracture of the Achilles tendon was established by the reinforcement of the calf and an unstable equino-cavo-valgus or an equino-plano-valgus deformity was the result. In all these cases, however, the Tibialis anticus was weak, and in such cases I feel it is better to abstain from correction of the calcaneus element of the deformity and instead of transplanting the Peronaei to T.A., transplant them dorsally in order to establish side-stability (see Table 2).

The method of preventive tendon transplantation has its limitations:

1. In some cases of severe plano-valgus a transplant of both Peronaei to the inner border is not able to hold the foot. In such cases it might be worth while to try also to reinforce Tibialis posticus by one of the Toe flexors. However, I feel that here is a field for other stabilizing procedures.

2. In some cases of calcaneus deformity a preventive tendon transplantation cannot be done without running the risk of either producing an equinus (as mentioned above) or a drop foot, namely in calcaneo-cavo-varus deformities with weak Toe extensors. As will be seen from Table 2, I prefer in such cases to move the Tibialis anticus towards mid dorsum instead of to the T.A.

My reasons for this are: 1) A stable calcaneus foot needs no orthopedic appliance whilst a drop foot in most cases does. 2) *Elmslie*'s arthrodesis for a calcaneus foot, I think, gives a better functional result and probably also a better lasting result than a *Lambrinudi*'s arthrodesis for a drop foot.

READING APPARATUS FOR RECUMBENT PATIENTS

by *E. Severin* (Gotenburg)

Together with an engineer the speaker has constructed a reading apparatus (Biblioscope) for patients lying in bed. The apparatus has been demonstrated. It uses book film, which is projected against a slide. The patient reads at normal reading distance. The room does not need to be darkened. Proposals have been presented for organising the distribution of apparatus and films through public libraries and with the aid of the Red Cross.

TREATMENT OF CAPSULAR CHONDROMATOSIS OF THE KNEE JOINT

by *H. Støren* (Drammen)

The pathology of the disease is reviewed briefly.

In the treatment the following must be taken into consideration:

1. That the disease advances steadily.
2. That over a shorter or longer period it may proceed without especial inconvenience to the patient;
3. That afterwards it passes more often than not to a painful, strongly invalidising stage with considerable limitation of mobility and contractures.

It is important in the treatment to know that malignant transformation of this growth has never been seen, but that on incomplete removal it always recurs.

Up to now the different methods of treatment have varied without any clear orientation—from conservative operation to resection with arthrodesis. The lecturer, bearing in mind the treatment, divides the disease clinically into an initial stage and a more advanced stage. The initial stage covers the period when subjective trouble is relatively minor. Treatment is then expectant. Some times X-ray treatment is an aid against the troublesome pain, which arises. If locking due to loose bodies is present, the operation is restricted to the removal of free bodies and chondromatous masses—but an incomplete synovectomy ought not to be undertaken as it makes a later radical operation more difficult because of scar tissue and adhesions.

This initial stage may be of short or long duration—sometimes it lasts years or through the whole life of the patient, but very often it advances to an extremely troublesome, second stage which makes an invalid of the patient. This stage requires radical intervention. The synovial membrane must be totally removed, if recurrence is to be prevented. It cannot be decided macroscopically with any reliability if parts of this are normal, since the enchondromas cannot always be seen with the naked eye. Apart from the menisci one must also remove the cruciate ligaments. The chondromatous growths arise especially in the menisco-tibial joint and in intimate contact with the attachments of the cruciate lig. By degrees they arrode the borders of the joint by means of tightly packed, chipped-off, partially necrotic masses formed by synovial bodies and create a marginal usure. This promotes a roentgen finding not previously described in this disease—which may be compared with the marginal usure seen in synovial forms of tuberculosis and in destructive polyarthritis.

The true total synovectomy and meniscectomy can only be undertaken when the joint is completely opened up. For this purpose the author employs Lexer's incision, temporarily severing the tibial tuberosity. But in addition the bony

origins of the Lig. collat. on the femur are also temporarily severed. They are joined again after operation by vitallium nails. If the chondromatous growths arrode the bone, which is soon seen from the roentgen picture, resection as well as the total synovectomy is performed, but instead of combining this with arthrodesis, the speaker undertakes arthroplasty.

The address is accompanied by casuistics, roentgen pictures and anatomical preparations are photographed.

(To be published in complete form).

THE OPERATIVE TREATMENT OF HALLUX VALGUS

by *O. Nygård Jespersen* (Copenhagen)

At the orthopedic department of St. Joseph's hospital in Copenhagen 552 patients with hallux valgus, 2 men and 550 women, were operated on from 1946 to 1953. 170 patients were under 35 years, 176 between 35 and 50, and 206 older than 50 years. The cases thus comprise many middle-aged and elderly patients, and this circumstance influenced to some extent the choice of surgical methods. The following methods were employed:

1) Arthroplasty a.m. Keller or a.m. Mayo was performed on 47 patients. Most of these patients also suffered from hallux rigidus, besides hallux valgus.

2) Simple chiselling away of the exostosis a.m. Schede was carried out on 64 patients. This palliative operation was used only in treating elderly patients.

3) Chiselling away of the exostosis together with transference of the tendon of the m. abductor hallucis was carried out on 243 patients. In this operation the abductor hallucis tendon is freed along its whole length and resutured to the base of the first phalanx, the great toe being kept dorsally flexed. Thereby the abductor tendon partly regains its abducting function, and the dorsal flexion of the great toe is preserved, thus facilitating the natural movement of the foot when walking. This method of operation was employed particularly in the case of middle-aged patients with slight osteoarthritis in the metatarsophalangeal joint.

4) Osteotomy a.m. Ludloff, chiselling away of the exostosis together with the transference of the abductor tendon was carried out on 198 patients, especially on younger patients (average age 33 years).

The best functional and cosmetic results were obtained with the osteotomy method which leads me to describe briefly the technique used, together with the results of a follow-up examination of 40 cases.

Technique: 1) curved incision above the exostosis, 2) freeing of the abductor tendon, 3) chiselling away of the exostosis, 4) subperiosteal oblique osteotomy on the medial side of the first metatarsal close to the capitulum, 5) straightening of the first metatarsal by traction on the pulp with the aid of a towel clip, 6) suturing the periost at the osteotomy site, 7) the tendon of the m. abductor hallucis is sutured to the base of the first phalanx, the great toe being dorsally flexed, 8) skin suture, 9) a plaster cast is applied, simultaneously the first metatarsal is straightened on the osteotomy site by traction on the pulp and the great toe is dorsally flexed. After-treatment: the plaster cast remains in position for 3 weeks, and then the patient stays in bed for a further 2 weeks with a tight bandage around the foot.

This method of operation fulfils the most fundamental requirements of an appropriate operative treatment of hallux valgus: 1) the chiselling away of the exostosis results in the foot becoming narrower, 2) the varus position of the

first metatarsal is diminished by the displacement at the osteotomy site, 3) the subluxation of the great toe is prevented and consequently the flexibility of the great toe is increased, 4) the subluxation of the sesamoid bones is often completely reduced, 5) by bandaging the great toe in dorsal flexion this movement is preserved so that the foot can move normally when walking, 6) the shortening which is necessary to correct the subluxation of the great toe is less than 1 cm. Thus the capitulum of the first metatarsal is preserved as a supporting point of the foot and one avoids a painful prominence of the capitula of the second and third metatarsals.

The follow-up examination of 40 patients operated on with the osteotomy method gave the following results:

35 patients experienced no trouble. The result was satisfactory on clinical and X-ray examination. The gait was natural. The shortening of the first metatarsal was, on an average, only about ½ cm. The result in the case of 4 patients was fairly good. The position of the great toes was clinically good, but walking continued to be somewhat troublesome, because of reduced plantar flexion of the first toe. On the other hand the dorsal flexion was good, and after the footwear of these patients had been provided with special soles they experienced little trouble. In the case of these patients the shortening of the first metatarsal was about 1 cm. In the case of one patient the result was poor. A painful prominence of the capitulum of the second metatarsal remained and flexion of the great toe was reduced. The shortening of the first metatarsal was about 2 cm. This patient has since been reoperated on.

The most fundamental drawback to the osteotomy operation described is the long stay necessary in hospital (5 weeks). This drawback is offset to some extent, however, because most of the patients are able to put weight on their feet without inconvenience a few days after getting up, and so are saved a longer convalescence. The method has given such good functional and cosmetic results that it can be recommended in the treatment of younger patients.

DISCUSSION:

E. Thomasen, Aarhus.

H. Støren (Stavern). With reference to Thomasen's demonstration of his method for the fixation of the caput's position in Hohmann's operation, I should like to say that Thomasen's method is good—but that nevertheless my method is better. I showed the procedure at the Congress in Oslo of 1952. The caput which has been moved, is fixed and is laterally displaced to the suture which tautens the capsule on the medial side. This last is often necessary to prevent a recurrence of the valgus position. Even the best displacement in the lateral direction is not *always* sufficient to prevent this. But the most important point is perhaps that the patient, with my method, can already begin to move some days after the operation. With Thomasen's operation, as with Hohmann's own procedure, the toe must be completely kept in plaster.

H. Novotny (Oslo). H. Novotny remarks on the fact that hallux valgus in a pes cavus and a pes planus have a completely different etiology. Operative treatment should therefore also be different in both types. Generally speaking the evaluation of the constitutional factor of the foot and the choice of the type of intervention

according to this judgement is perhaps the most difficult part in the treatment of hallux valgus.

A. Monberg, Copenhagen.

THE POLIO EPIDEMIC IN COPENHAGEN IN 1952

by *A. Monberg* (Copenhagen)

I shall give some explanatory information about the polio epidemic in 1952 and at the same time discuss some orthopedic problems from the acute stage.

The question affects a series of patients from Copenhagen and neighbouring districts whose total of inhabitants is 1,200.000. From here patients are admitted to Blegdams Hospital, where since 1937 there has been very close co-operation between the epidemiologist, the expert on physical treatment, and the orthopedist, so that treatment was pursued with the co-operation of the various specialist doctors from the acute stage,—which is not always the case in very many places.

During this epidemic the very young children were moved after the elapse of some weeks to the Child Hospital on Fuglebakken and to Dr. Louise's Child Hospital, where there was also physical—orthopedic care. For many patients the physical orthopedic treatment was carried out for 1–2 years at Blegdams Hospital. Now, scarcely 2 years afterwards, there are 50 patients, who are regular patients and who could hardly manage for themselves outside the specialist hospital, not least because a number of them have difficulties with respiration, and about 15 must constantly be submitted to respirator treatment. At present it is being deliberated whether to send some of the patients home with respirator.

Since the incorporation of the convalescent home here (Hornbæk) under the Society and Institute for Cripples, many, and especially the severely affected patients, have been transferred here, while patients who require special surgical orthopedical treatment are transferred to the orthopedic departments.

Ambulatory patients are treated at the infantile paralysis Institute in Hellerup and in Thorvaldsensvej and also at the physical department of the Orthopedical Hospital and at the Kommune Hospital.

Since Copenhagen was particularly badly hit by the epidemic, it was necessary to take the financial aspect into consideration, as expenditure was very considerable, 5–6 million crowns, and the problem was settled so that all patients during the period from 7. 52–30. 6. 53. were included in the special provisions under which all expenses of treatment, orthopedic aids and maintenance of family were defrayed by the state.

During the epidemic 3000 patients were treated here in Copenhagen of which ⅓ had pareses to a greater or lesser degree and of these ⅓ again had respiratory trouble, about 350; 270 tracheotomies were undertaken to positive pressure.

I shall not discuss this in more detail but will refer you to H. C. R. Lassen's account in the August issue of Nordisk Medicin, 1953.

In connexion with this information I shall exhibit a chart drawn up by the Sundhed Committee concerning the number of polio patients, the pareses and mortality during the years 1932 to 1953, covering the whole country. From this it will be seen that the 1952 epidemic is by far the gravest even in degree of malignity. In all there were 5676 cases with 2450 pareses. The latter were distributed in such a way that little over half of the patients were under 10 years, with

a quite equal division between boys and girls, while, otherwise, women, particularly after the years between 25–30, predominated.

Very soon after the beginning of the epidemic it was clear that we were faced with a very serious outbreak, for the cases were very extreme; of the 34 patients first admitted with respiratory pareses 28 died. Later, however, this mortality was reduced to about 30 % with the aid of tracheotomy. Patients were conveyed to us in considerable numbers and the admissions rose steeply from week to week.

Very soon after the acute phase we recorded the extent and degree of the pareses —in the same way as it is done in most places—on the chart. Our attention was especially directed to the cases where the pareses were so situated that one would expect the development of back deformity, and by no means least to the degree of paresis of the abdominal muscles. If symmetrical or asymmetrical pareses existed we noted this so as to obtain information whether it had any particular significance in the development of back deformity.

Bearing in mind the severe cases of scoliosis from earlier epidemics we considered very closely whether we could not counteract this tendency with longer periods in bed than before.

Then it became a question of how long a patient should remain recumbent. We thought that half a year would be necessary, from the standpoint that the regeneration of the partially paretic muscles would proceed before the end of this period; secondly, it was assumed that there would be a deterioration in the general condition of patients, part of whose mobility apparatus was not functioning, if a very long period in bed was required, and finally, kidney complications occurred in a number of patients owing to stone formation, and this too was an indication against the very long stay in bed.

During recumbency patients were placed in different positions in order to counteract contractures and were instructed by the physiotherapist in active and passive movements. Taking everything into consideration we found it a justifiable decision to allow patients to sit up after the elapse of half a year and we let the patient lean on a lumbar pillow which both prevented any slipping forward and supported the back. The patients were provided with supporting corsets and in bed were supported by an aid for the back (Denis-Browne) with arm supports for the axilla. Furthermore we also tried to train the patient in balancing exercises, partly with the aid of trestles and partly with the aid of the physiotherapist, and in walking exercises between long rails. At the same time exercises were performed in the pool and there were also crawling and mattress exercises.

We employed to a large extent fashion belts to counteract protrusion of the abdomen. The patients were submitted very frequently to a roentgen check, so that we obtained an idea of the development of the condition. Naturally we did not carry through the rule of half a year in bed categorically, but adjusted it to the individual according to the development of deformity and the signs of the disease progressing.

To obtain an idea whether the bed rest adopted hindered or counteracted the development of back deformity I went through the series. In all cases where positional or back deformity was recorded in the acute stage or shortly afterwards I studied the patients' condition 2 years later.

In 154 patients out of 243 no change in position and no scoliosis were found almost 2 years later. In 47 patients the condition was stationary, i.e., rather slight deviation in position or scoliosis unchanged and initial compensation showing no progress within 2 years. In 42 cases the deformity seemed to be progressive.

When the figures are scanned and back deformity is found corrected in 154 cases, one is tempted to conclude that bed rest is of great importance in counteracting the development of back deformity but it is dangerous to compare this with earlier epidemics since then attention was not drawn to such a large extent as in this epidemic to the slighter changes of position in the acute stage.

The symmetrical or asymmetrical pareses of the abdominal muscles seem to be significant in the development of the back deformity. Of the 42 patients with progressive deformity I examined 35 and found:

asymmetrical paresis in 18 cases
symmetrical paresis in 17 cases

This deforming muscle pull between the thorax and the pelvis exerted by no means least by the obl. ext. and the quadratus lumborum is of great importance in the development of change in the column's position, and therefore it is necessary to carry on with long bed rest and very slowly to train the patient to reach the sitting position.

In 40 patients minor, and indeed fairly severe, pareses of the abdominal muscles were found without back deformity.

I also made a study of the series with regard to the duration of bandaging for pareses of the lower extremities where it was necessary to supply the patient with splint bandages.

228 out of 276 patients had to be provided with splint bandages, mainly with ischial bearing and fixation in the heel of the shoe. Out of these 228 patients the bandaging was permanent 2 years afterwards in 155 cases and temporary in 73; it obviously has to do with the problem of temperament how early one removes these. 48 patients who themselves had quite severe pareses of the muscles of the quadriceps, crus and foot walked without bandages but this may occur on condition that a good glut. max. exists; however a number of these patients must certainly be supplied with bandages later if the recurvature of the knee increases, or must be provided with splint bandages to compensate defective side balance of the foot. In 18 cases the splints were changed from the quite static type to crus splints or footwear.

Finally I wish to draw the following conclusions, that bed rest from half a year to a whole year must be considered necessary, where pareses are concerned which will promote changes in the position of the back; this however must be naturally adjusted to the individual depending on the stage of development of the deformity and it will only be after some years when the patient has been putting weight on the limb that it will be possible to express an opinion about the development of the deformity.

As for the treatment of the lower extremities somewhat over half of the prescribed bandages proved to be permanent. How many of these bandages can be removed later by operative treatment can only be decided after the elapse of 4–5 years.

Copenhagen and neighbouring districts: 1,200,000 inhabitants.

2998 patients treated at Blegdams Hospital.

About 1000 patients had pareses and of these 350 had respiratory pareses.

270 patients treated by tracheotomy for positive pressure.

Scolioses and changes in the position of the column: 243 patients examined two years afterwards.

143 patients corrected.
47 patients stationary.
42 patients progressive.

228 patients out of 276 with pareses were treated with splint bandages. Re-examin two years later.

155 patients permanent.
73 patients temporary.
48 patients, bandaging not required.

DISCUSSION:

O. Remvig, Hornbeck, *K. Jansen,* Copenhagen, *P. G. K. Bentzon,* Aarhus, *E. Thomasen,* Aarhus.

R. Movin (Copenhagen). In the report of Dr. Remvig the treatment of polio-scolioses naturally took a prominent place, and during the discussion of how these scolioses occur, asymmetrical paralyses were mentioned several times as the cause, and rightly so. Occasionally, however, one is surprised to find that the scoliosis moves in the opposite direction to what one would expect from the muscular status and it is certainly wise when examining the scoliosis not to fix one's eyes upon asymmetrical paralyses and contractures alone, but also to take into consideration other possibilities such as symmetrical contractures of the muscles of the back.

According to Sommerville scoliosis is to be regarded as a "rotational lordosis". What we perceive on the X-ray as an extreme form of scoliosis is in reality the vertebral column seen from the side, and the curve is a lordosis of the section of the column in question. Observe that the bodies describe a larger arc, the processus spinosi a lesser one, i.e., follow the shortest route. By burning away the rearmost arc and inserting strings between the processus spinosi, thus blocking these up, Sommerville was able to produce experimentally typical scolioses.

In considering the impression made on me by Sommerville's work and the fact that we often see severe fascia-plantar shrinkage and thickening in polio cases the thought came to me that Sommerville's theory might possibly cover the pathogenesis of some of our polio-scolioses.

If one supposes that during the polio illness shrinkages occur in the supra- and intraspinous ligaments or that symmetrical contractures arise in the long, extensor muscles of the back, we then have a rearward tightening band of muscle, resembling what Sommerville artificially produced in his rats. This will not in itself result in scolioses, but if the polio-patient passes through a period of rapid growth lordosis will arise because the vertebral bodies must have room. However this would bring about a grotesque lordosis and this does not occur. Instead the patient obtains compensation by turning the vertebral bodies out towards the side in order to find room, and we have what is called scoliosis or "rotational lordosis".

F. Langenskiöld, Helsingfors, *J. Mortens,* Copenhagen.