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VIEWS ON THE GENERAL PRINCIPLES OF JOINTS AND MOVEMENTS[1]

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(by invitation)

In order to understand the special functions of our different joints, detailed knowledge is required of the general principles of joints and movements. In the following the above will be treated according to the method adopted for anatomy instruction in Lund.

As known, one can speak about two *basic forms of movement*, each of which demands a special and very exact definition.

Rotation comprises that basic form of movement occurring when a body rotates about one of its main axes (fig. 1). If the body is spheroidal and the axis of movement passes through its centre, the body will remain its original place in space. In this respect therefore the body does not undergo any change in position. On the other hand the body during the rotatory movement will constantly shift its orientation in space (fig. 2 a). If, however, this axis about which the rotation is performed lies outside the body the latter is displaced along a circular path the radius of which is of course equal to the distance from the body to the axis of movement. During this change in position or displacement from one point to another in space the body also continually alters its orientation in space (fig. 2 b). The same may be said of all the separate parts of a spheroidal body which lie outside the axis of movement passing through the centre of the body (fig. 2 c). A rotatory movement is, of course, measured in degrees of an angle. Moreover it should be added that the interpretation of a movement as a rotatory movement possesses practical value since then the size of the rotation can be compared from case to case without the need to take into consideration the absolute size of the joint mechanisms. If a 2 year old child and an adult both perform a flexion of 45° in a certain joint, the movement in principle is equally large in both cases.

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[1] This article forms the first section of the paper on the functional anatomy of the knee joint which opened the Congress of the Nordic Orthopaedic Association in Lund, 1958. All the illustrations in this article are based on original drawings by the author.

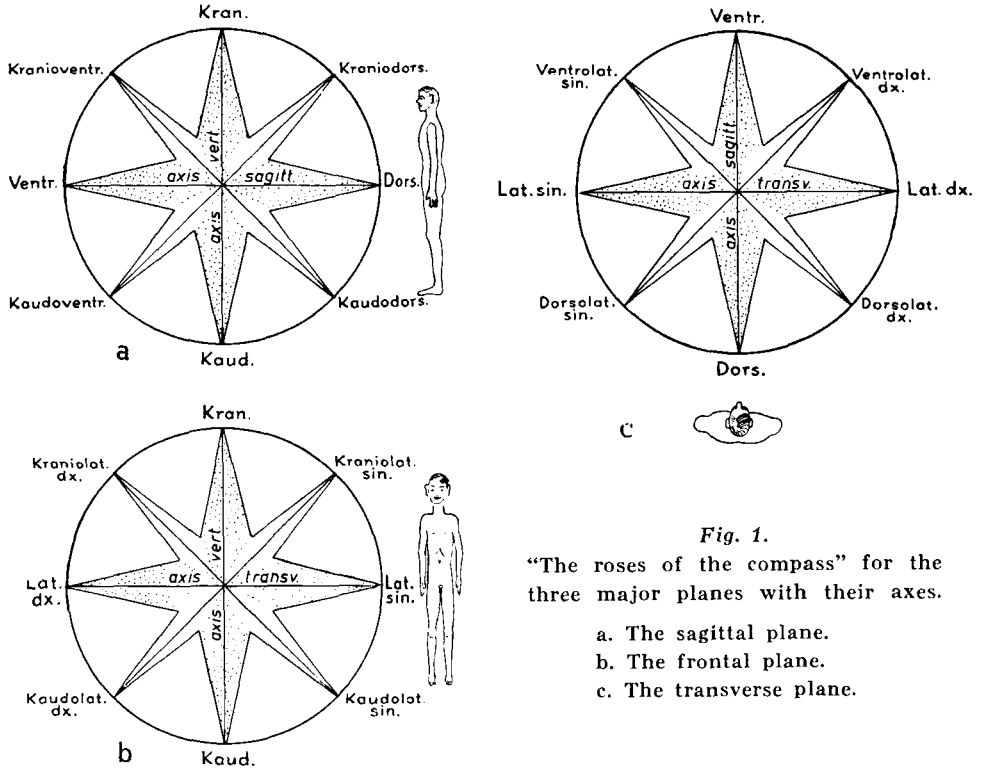


Fig. 1.
"The roses of the compass" for the three major planes with their axes.

a. The sagittal plane.
b. The frontal plane.
c. The transverse plane.

Translation comprises that basic form of movement occurring when a body is displaced along one of its main axes. The body is thus shifted from one point in space to another and therefore undergoes in this respect a change in position. This refers both to the body as a whole and to its individual parts. On the other hand, neither the body nor its individual parts undergo any change in orientation in space (fig. 3). A translatory movement is measured in linear units, which means that the absolute size of the joint mechanisms concerned must always be considered when comparing the effect of various translations. From the point of view of performance there is undeniably a difference when a 2 year old child lifts its foot 1 dm. and when the same movement is performed by an adult.

Since the main axes are 3 in number, corresponding to the 3 dimensions of space, a body which can utilize all its main axes for both rotation and translation has 6 possibilities of movement, or, as the relation is expressed, *6 degrees of freedom*. This latter conception has thus nothing to do with the amplitude of the movement, wether expressed in degrees of an angle or in linear units, and must not be confused with it. A body which possesses 6 degrees of freedom is completely mobile in space. In other words, by employing in turn now the one, now the other of its main axes for rotation and translation the body has absolute freedom of movement.

In this connection it must be noted that when a body performs rotation about one

of its main axes, the other two main axes always change their orientation in space since the body itself, as stated above, shifts its orientation in space in combination with a rotatory movement. On translation, however, the body itself does not alter its orientation in space and therefore none of its axes either.

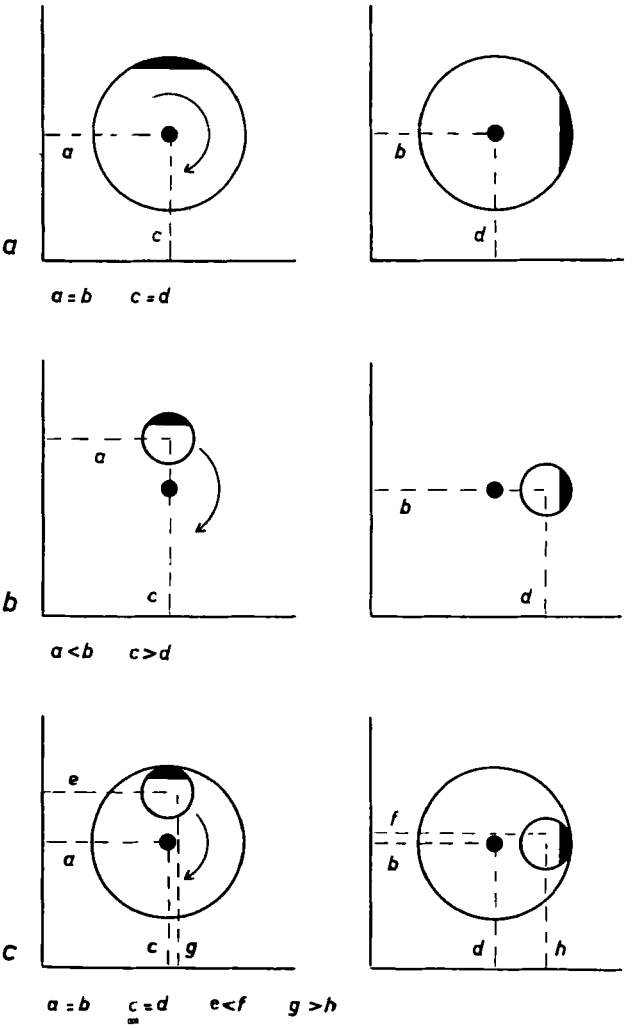


Fig. 2.
The rotatory movement.

a. The axis of movement passes through the centre of a spheroidal body.
b. The axis of movement lies outside the body.
c. The axis of movement passes through the centre of a spheroidal body, within which a part lying outside the axis of movement is marked.

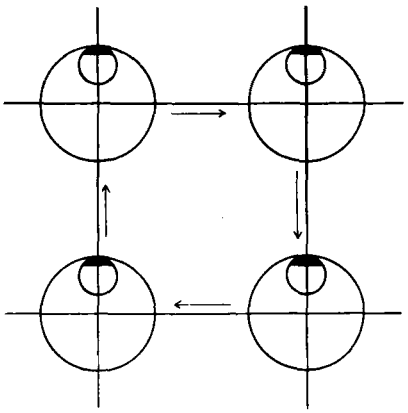


Fig. 3.
The translatory movement.

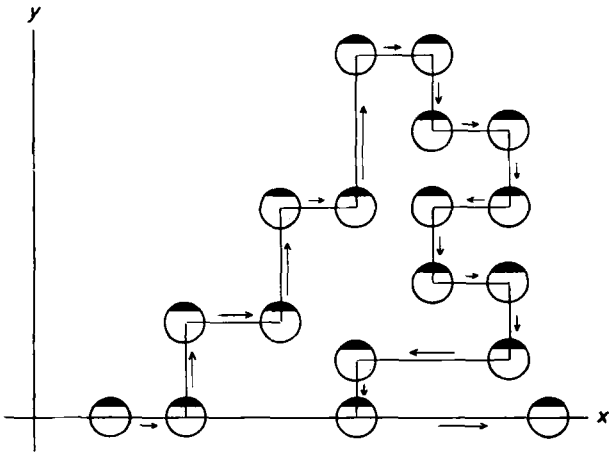


Fig. 4.
Translatory movements following alternating along the x- and y-axes in a coordinate system.

If a certain body is only capable of translatory movement, and if it can utilize two of its main axes, the movements of the body may be visualized in a 2-dimensional, right-angled coordinate system. Within this the body can move at right angles to the y-axis by translatory movement along the x-axis, and in the same way it can pass at right angles to the x-axis by translatory movement along the y-axis. By means of translation, for further small distances, alternating along the x- and y-axes the body can be displaced in any direction at all within the coordinate system (fig. 4) naturally also along curved paths. (Of course the body may also move in the third dimension, if it can also utilize the third main axis for a translatory movement). There is, however, a distinct difference between the movements performed by a body when it describes a circular path within the coordinate system resulting

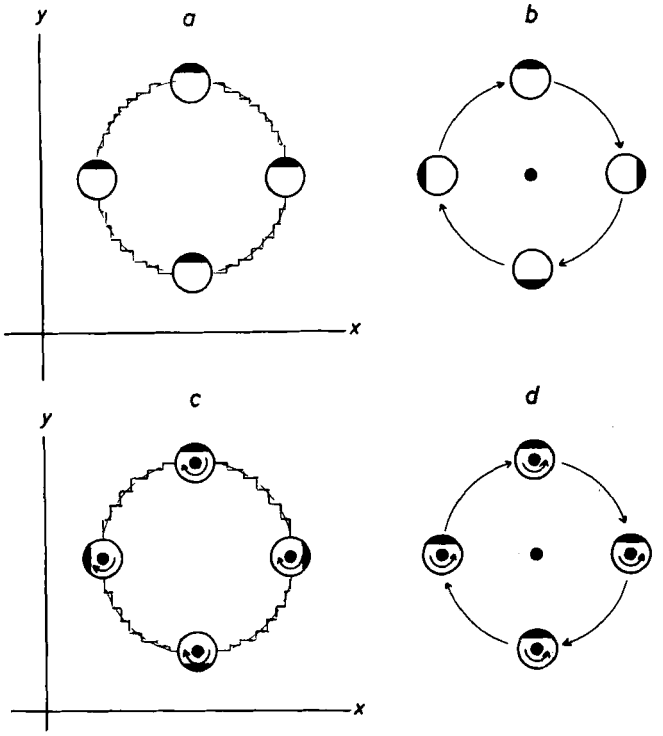


Fig. 5.

Comparisons between rotatory and translatory movements.

a. A body describes a circular path as a result of translatory movements, alternating along the x- and y-axes in a coordinate system. The body has 2 axes of movement and 2 degrees of freedom, both based on translatory movement.

b. A body describes a circular path as a result of a rotatory movement about an axis of movement lying outside the body. The body has 1 axis of movement and 1 degree of freedom, based on rotatory movement.

c. A body describes a circular path as a result of translatory movements, alternating along the x- and y-axes in a coordinate system. In addition the body can rotate about an axis of movement passing through its centre and perpendicular to the coordinate system. The body has 3 axes of movement and 3 degrees of freedom, 1 based on rotatory movement and 2 based on translatory movement.

d. A body describes a circular path as a result of a rotatory movement about an axis of movement lying outside the body. Moreover the body can rotate about an axis of movement passing through its centre and parallel with the previous axis. The body has 2 axes of movement and 2 degrees of freedom, both based on rotatory movement.

from translatory movements alternating along the x- and y-axes (fig. 5 a), and when the body describes a similar circular path but now as the result of a rotatory movement about an axis passing through the circle centre corresponding to this circular path (fig. 5 b). In the former instance the body does not alter its orientation in space; this does occur, however, in the latter instance. If, however, the body in fig. 5 a had been able to rotate about an axis passing through the centre of the body and at right angles to the coordinate system (fig. 5 c), the body could have moved in space in the same way as the body in fig. 5 b. Similarly if the body in fig. 5 b had been able in addition to rotate about a second axis of movement running parallel to the primary rotatory axis, but passing through the centre of the body (fig. 5 d), it could have moved in space in the same way as the body in fig. 5 a.

Finally, it ought to be said that the boundary between rotation and translation can be variable. For, if the distance between a body and the axis of rotation lying outside the body should approach infinity, and then be infinite, the body will move in space along an almost straight, then fully straight path, and the movement can then naturally be regarded as the result of a translatory movement.

When discussing joint movements in general terms we do not think perhaps so much of what happens in the individual instance in the respective axis of movement. Accordingly we do not make use in daily speech of the terms reserved for the two basic forms of movement, rotation and translation, to characterize these *general types of movement*. For this purpose we possess instead a special nomenclature for movement, comprising such terms as flexion, extension, abduction, adduction, circumduction, pronation and supination. As some examples below will show, however, this nomenclature is unfortunately not systematic, uniform or complete. The fact that we also lack well-defined, generally accepted *initial positions* in the posture of the extremities and parts of the body, from which positions the movements begin, tends to make it still more difficult to describe the normal type of movement and size of movement in a given case, not to mention the difficulties occurring when certificates have to be written out, including a clear, more detailed description of malformations, restricted movements, etc. This grave state of affairs must be remedied as soon as possible following mutual consultations between representatives of anatomy, radiology, orthopaedics, rheumatology, industrial medicine, industrial hygiene, insurance medicine, rehabilitation, physiotherapy and medical gymnastics.

It is generally considered that at least in the interphalangeal joints of the fingers the initial position is characterized by the fact that the long axes of the phalanges are in a straight line with each other. From this initial position, flexion can be performed by means of the flexors. Extension, i.e., the return movement to the initial position, is performed by means of the extensors.

In many cases, however, the situation is complicated by the fact that the movements from an understood or temporarily defined initial position may take place in two opposite directions. At times therefore, as in previous instances, a flexion from and an extension back to the initial positions may arise by means of flexors and extensors. But in addition the latter muscles may perform a movement which is the direct opposite of the first-named flexion movement, while a return to the initial position occurs with the aid of the flexors. Movements typical of this are found about the transverse axis of movement in the radiocarpal joint and about the transverse axis of movement in the talocrural joint, if one accepts that the initial

position in the radiocarpal joint is characterized by the long axes of the hand and the forearm being in a straight line with each other and in the talocrural joint by the long axis of the foot forming a right angle with the long axis of the lower leg. As known, we call the movements performed by the respective flexors from the initial position volar and plantar flexion, of which the latter movement is synonymous with the term used in common speech "stretching downward of the foot". The movements produced by the respective extensors from the initial position in the opposite direction are both called dorsal flexion, but in everyday language the term is "bending upward". The return movement to the understood initial position from volar flexion is indeed generally named extension, while we lack any designation for the return movement to the understood initial position from plantar flexion. And what are the suitable expressions for the return movements from dorsal flexion in the radiocarpal and talocrural joints?

In certain joints such as the knee joint, the hip joint, and the elbow joint, movements are possible normally and under special conditions in two opposite directions from the "initial position", but one of the movements in these cases is insignificant in extent. Therefore one is usually content to designate the larger of the movements flexion with extension as the name of the return movement, while the expression overstretching is reserved for the lesser of the movements, without, however, determining what the corresponding return movement ought to be called.

What is understood by outward rotation or supination and inward rotation or pronation in the radioulnar joints does not indeed require any explanation, even if no one can yet give a completely acceptable definition of the initial position to which the movements in question refer. But in the foot, where, as we know, analogous movements can be carried out, outward rotation is equivalent to "inward twisting" of the foot and inward rotation is equivalent to "outward twisting" of the foot.

The examples given above could be supplemented with many others of a similar nature, taken both from the joints of the extremities and from those of neck and trunk. All show how loose the ground is on which we must build our knowledge of the various movements in our body.

As known, the joints can be devided into anatomically simple and anatomically complicated joints, into grinding joints and rolling joints, into mechanically simple and mechanically complicated joints, and into tight and loose joints. Some of these *types of joint* will be discussed briefly here.

Even if there are other definitions, it is generally agreed that that joint is anatomically simple which has a simple joint cavity, while that joint is anatomically complicated whose joint cavity is completely, or partially divided by the presence of a disc, or meniscus. Without further reflection the majority have also been content to acknowledge this condition just as they have unreservedly accepted the continually recurring statement that the task of a disc and/or meniscus is to level out the incongruities between the articular surfaces. But if this apparently simple problem is observed more closely, it will be realized that this explanation is far too simple.

A disc is usually biconcave and its two surfaces represent in fact two joint sockets. This means that the bony parts articulating with the two joint sockets of the disc are both shaped like joint heads. This in turn permits at least one axis of movement on each side of the disc. In a joint mechanism the axes of rotation are always

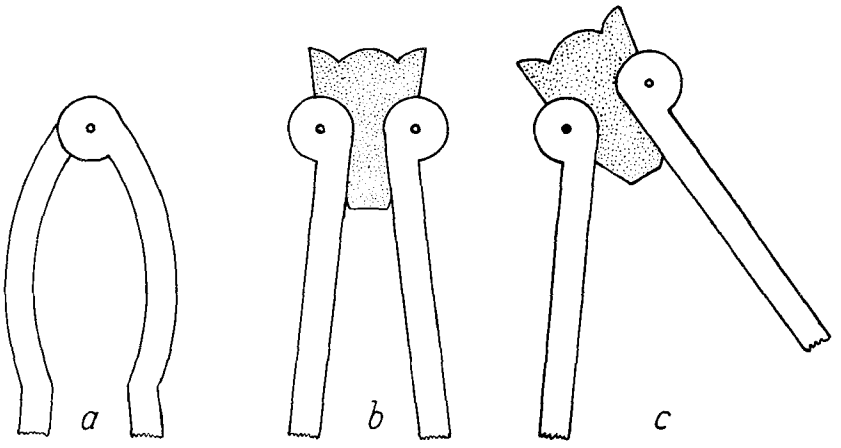


Fig. 6.

a. A hinge joint can be compared to a uniaxial nutcracker.
b. A hinge joint with inserted disc can be compared to a biaxial nutcracker.
c. Owing to the fact that the part inserted (the disc) into the biaxial nutcracker can be made to turn round either one of the axles, the other axle and the body through which it passes can be made to alter both position and orientation in space.

situated on the joint head side and never on the socket side of the joint fissure. It is only in the trochoid joint, e.g., the joint between the head of the rib and the vertebral body, and where this type of joint is included as part of another joint, i.e., in the restricted and complete ball and socket joint, that the axis of movement passes both through the joint head and the joint socket (perpendicular to the latter's centre).

If a normal hinge joint without a disc is compared with a uniaxial nutcracker (fig. 6 a), a hinge joint with a disc can be compared with a biaxial nutcracker (fig. 6 b). The middle part between the two limbs of the latter nutcracker corresponds of course to the disc. In the biaxial nutcracker the two limbs can be made to carry out the same movements as in the uniaxial nutcracker. The only differences is that in the uniaxial nutcracker the two limbs have a common axle, while in the biaxial nutcracker each limb possesses its own axle. In addition, however, another movement can be performed in the biaxial nutcracker which cannot be reproduced in the uniaxial one. Because the middle part in the biaxial nutcracker can be made to turn round either one of the axles of movement, the other axle and the body (joint head) through which it passes, can be brought to alter both position and orientation in space (fig. 6 c).

In the example given of the biaxial nutcracker the two axles run parallel with each other. But naturally one can also imagine other alternatives to the direction of the axles in relation to each other. They can thus form a right angle with each other (fig. 7), or the one division of the joint may perhaps be a hinge joint, the other a trochoid joint, etc.

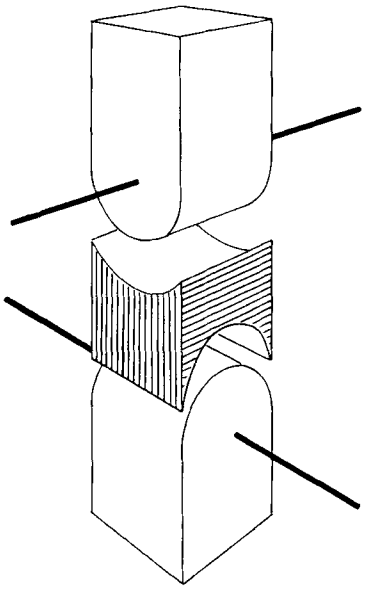


Fig. 7.
Diagram of a theoretical type of joint with disc. The axes of movement form a right angle with each other.

The definitions given of grinding joints and rolling joints have in general appeared free from objection; in a grinding joint the constantly identical parts of the one joint surface (cf. knife) grind against the constantly new parts of the other (cf. grindstone), while in the rolling joint the constantly new parts of the one joint surface come into contact with the constantly new parts of the other. It can be easily demonstrated, however, that the definition given of a rolling joint is not sufficiently searching.

Fig. 8 a presents a diagram of a rolling joint and here the joint heads move towards each other like the rollers of an ordinary wringer. In the example chosen the upper roller rotates clockwise, the lower roller anti-clockwise. Undoubtedly also the constantly new parts of the one articular surface come into contact with the constantly new parts of the other. However, this is also the case with that joint type illustrated by fig. 8 b, but here the upper roller also rotates anti-clockwise. According to the laws of friction there is insignificant friction, as long as the joint surfaces articulating with each other are completely even and moist. But it is a different matter if the articular surfaces, e.g., owing to pathological changes, no longer possess these characteristics, which are ideal for reducing wear and tear. It is probably inevitable that wear and tear under such circumstances is least in an ordinary rolling joint and somewhat greater in a grinding joint. But wear and tear is still greater in that joint type occurring in fig. 8 b and I have therefore designated this as the accentuated grinding joint. What I have mentioned can be illustrated by means of a car, whose wheels all the time rotate in such a way that they will try to

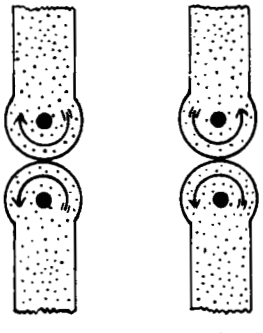


Fig. 8.

a. Diagram of a rolling joint. The joint heads rotate like the rollers of a wringer, the one clockwise, the other anti-clockwise.

b. Diagram of an accentuated grinding joint. The two joint heads rotate here anti-clockwise.

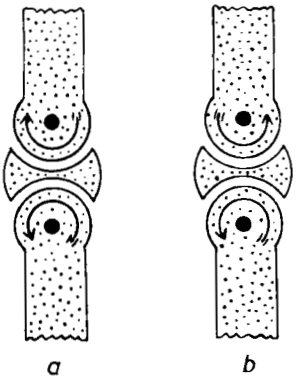


Fig. 9.

a. Diagram of a rolling joint (cf. fig. 8 a) with an inserted disc.

b. Diagram of an accentuated grinding joint (cf. fig. 8 b) with an inserted disc.

drive the car forward. If there is a free passage, the car moves forward (cf. rolling joint); if the car is attached at the rear to some object, it remains standing, and its wheels will skid against the ground (cf. grinding joint); finally, if the car is attached at the rear to a more powerful tractor moving in the opposite direction, the car is dragged backward in spite of its forward driving wheels (cf. accentuated grinding joint).

The accentuated grinding joint does not normally appear as a joint type in the human body, but let us nevertheless proceed a step further in our argument. If an articular disc is inserted into a rolling joint, then into an accentuated grinding joint as in fig. 9 a and 9 b, both the joint types are transformed into double grinding joints and from the point of view of wear and tear there is now no longer any difference between them. Here, then, one may point out another significant task of an articular disc, which is to equalize wear and tear. According to what I have been able to establish, the temporomandibular joint for example, represents an accentuated grinding joint but with an articular disc inserted to reduce wear and tear. It is especially valuable to bear this in mind when comtemplating extirpation of the disc of the temporomandibular joint. The indications for the removal of the disc may weigh heavy, but before the intervention is carried out, it must be clearly realized that the joint will be transformed into an accentuated grinding joint with increased wear and tear of the articular surfaces.

It has been pointed out above that in a joint with an inserted disc it is possible to place axes of movement on both sides of the disc. These axes may be parallel or form angles with each other(cf. fig. 7 above). It may then be of some interest to find that, apart from joints with discs, the rolling joint and the accentuated grinding joint, there is still another type of joint where an axis of movement is present on each side of the joint fissure and where these axes of movement form in this case

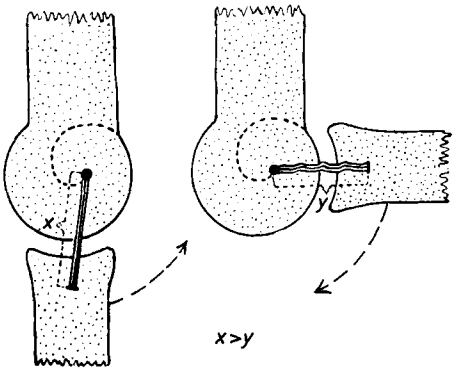


Fig. 10.
Diagram of a spiral joint.

a right angle with each other. The type referred to is the saddle joint. Each joint extremity is shaped in such a way that, considered in one plane, it forms the joint head and in the plane perpendicular to this it forms the joint socket for corresponding formations on the other joint extremity. But here, too, the principle holds good that the axis of movement passes through that bony part which forms the joint head in the actual movement.

One of the more interesting types of joint is undoubtedly the spiral joint. If a diagram of such a joint is viewed from the side (fig. 10) it will be found that its transverse axis of movement lies excentrically, so that the articular surface forms part of a spiral. When a rotatory movement occurs about this transverse axis of movement, the movable bone will approach and then retreat from this axis by being translated along its own long axis. When the movable bone comes into such a position that the distance to the transverse axis is greatest, the collateral ligaments tighten up and prevent lateral shifting. Gradually as the movable bone in connection with the rotation about the transverse axis is translated nearer and nearer this axis following its own long axis, the collateral ligaments relax successively. Lateral shifting becomes gradually possible therefore about an axis which in all positions is at right angles to both the transverse axis and the long axis of the movable bone, insofar as this lateral shifting is not prevented by other special arrangements. If these should be lacking, the joint in its entirety becomes limp when the collateral ligaments are completely relaxed, and theoretically both rotation and translation are possible about and along all the axes. Those of our joints which are spiral joints, however, possess precisely the joint stabilization arrangements of the kind indicated (e.g. the knee joint) which prevent this general limpness arising in the joint. Such a joint condition, although theoretical, is nevertheless worthy of observation, since it explains a number of the symptoms and other conditions which arise on damage to these special joint stabilizing arrangements.

Along with this account of the spiral joint principle another condition must be pointed out, which, to a certain extent, is also connected with this principle. The collateral ligaments found in the hinge joint have indeed as their main task the effective prevention of lateral shifting. But in doing so it can be established that

they also prevent a lateral displacement of the one leg in relation to the other. In the variant of the hinge joint, the transverse screw joint, the collateral ligaments prevent lateral shifting in a similar way, but in spite of this they permit here the lateral displacement so characteristic of precisely this type of joint. This can only happen, however, if the spiral joint principle operates at the same time, i.e., that the movable bone on rotation about and translation along the transverse axis (the screw) also possesses the ability to translate (following its own long axis) itself in the direction of the transverse axis.

In a number of joints the approximate *location and orientation of the axes of movement* are fairly well known, but many joints are still not sufficiently clarified in this respect. It was not until some years ago for example that it was realized that when the lower jaw is lowered and raised and moved forward and backward, in principle two transverse axes of movement are being utilized in the temporomandibular joint, the one passing through the tubercula articularia, the second through the capitula mandibulae, and that during lateral movement of the lower jaw the latter axis is utilized together with an oblique axis of movement which passes through the tuberculum articulare on the balancing side and through the capitulum mandibulae on the working side.

In this search for the axes of movement of a given joint a good guide may be obtained from certain circumstances, namely:

that the axis of a rotatory movement with one exception always lies upon the side of the joint head and never upon the side of the joint socket. It is only in the trochoid joint (and in those joints which include it as a part) that the axis of movement passes through both the joint head and the joint socket;

that if the joint is equipped with a biconcave disc or meniscus, at least one axis of movement must be present on each side of the disc;

that if it were possible to identify directly a given joint as belonging to the mechanically simple and mechanically complicated types of joint, one would also know directly where in principle the axes of movement were situated.

In order to determine more accurately the location and orientation of the axes of movement, and in referring to orientation this can alter its character in combination with movements about other axes of the joint, it is, however, necessary to undertake mathematical calculations of the curve radii of both the convex and the concave articular surfaces, possibly with the aid of x-ray tomograms or sections through fresh bones or castings of these. Finally, all findings must be considered against the background of the anatomic structure and the capsular and ligamental mechanism. Investigations of this nature are extremely exacting and moreover they have hitherto been carried out to a very modest extent.

THE DIAGNOSIS AND TREATMENT OF MENISCUS LESION IN NEARLY 700 KNEE JOINT OPERATIONS

by *J. Saugman-Jensen (Copenhagen)*

ON THE DIAGNOSIS OF THE MENISCUS LESION IN THE KNEE WITH SPECIAL REGARD TO THE VALUE OF ARTHROGRAPHY

by *Hans Bohr* (Aarhus, Denmark)

The present study is based on a series from the Orthopaedic Hospital in Aarhus an consists of patients who in the years 1953–58 were admitted to hospital or became out-patients for meniscus lesion of the knee.

In the first stage of the investigation I assembled the cases of pure meniscus lesion in which diagnosis was confirmed at operation. In all, 188 patients were involved, 139 with medial meniscus lesions, 39 with lateral meniscus lesions, and another 10 patients where lesion of both medial and lateral meniscus was found.

TABLE 1

Data and subj. symp.	Med. meniscl. 139 pt.	Lat. meniscl. 39 pt.
Right-sided	45 %	59 %
Men	81 %	75 %
Average age	38 years	34 years
Average duration of symp.	13 months (20 > 5 years)	18 months (5 > 5 years)
Trauma or wrenching	78 % (86 %)	75 % (81 %)
Swelling	74 % (83 %)	75 % (85 %)
Pain	98 % (99 %)	90 % (92 %)
Locking (impingement with fix.)	47 % (55 %)	44 % (52 %)
Locking or instability	67 % (75 %)	59 % (67 %)

In table 1 data and subjective symptoms of medial and lateral meniscus lesions are reviewed. The percentage refers to the number of patients in relation to the total of patients. In brackets the percentage is given of those who put positive or negative information on record. It will be seen that pain and swelling are the dominating symptoms while locking only occurs in about half the cases.

TABLE 2

Objective symptoms	Med. meniscl. 139 pt.	Lat. meniscl. 39 pt.
Atrophy $\geqq$ 1 cm.	50 % (57 %)	49 % (54 %)
Uncentration in the joint	40 % (44 %)	31 % (32 %)
Tenderness on joint line	86 % (88 %)	85 % (89 %)
Ext. defect	35 % (37 %)	49 % (50 %)
Flex. defect	19 % (21 %)	31 % (34 %)
Ext. or flex. defect	42 % (44 %)	59 % (61 %)
Bragard's sympt.	41 % (69 %)	13 % (33 %)
McMurray's sympt.	20 % (56 %)	18 % (70 %)
Bragard's or McMurray's sympt.	55 % (76 %)	31 % (57 %)

There is no fundamental difference between the medial and lateral meniscus lesions. In table 2 information is provided on the most frequent objective symptoms. It is noteworthy that atrophy of more than 1 cm. only appears in half the patients. Tenderness around the joint line occurs in 85 % and reduced mobility from the medial lesion in 42 % and from the lateral in 60 %. By Bragard's symptom increased tenderness of the meniscus is meant during rotation with the knee half flexed: this symptom was found in about half the patients with medial meniscus lesions and rather more rarely in those with lateral lesions. By McMurray's symptoms is understood a click, emerging when the maximally flexed knee is extended during simultaneous rotation outward or inward: this symptom is found in only 20 % of all patients with medial or lateral meniscus lesion, but in a little over half of the patients whom the record makes clear were examined.

The second stage of the investigation was a review of the results of air arthrography. This was performed at Aarhus Hospital in Doctor Wagener's department in those cases in which the clinical investigation gave no completely reliable diagnosis but where meniscus lesion was suspected. The indication for arthrography has been quite wide and this is shown by the large number of meniscus lesions demonstrated by the arthrography.

TABLE 3

Comparison between operative findings and arthrography.

Operative findinds		Arthrography (A.)		Op. = A.
Type	No.	+lesion	−lesion	
Buckle handle	31	31	0	30
Forward lesion	15	13	2	13
Backward lesion	42	40	2	38
Transverse rupture	10	8	2	8
Tear in middle	7	5	2	4
Peripheral tear	6	6	0	6
Horizontal tear	5	4	1	3
Degen. or atrophy	17	14	3	11
Total of meniscus lesion	133	121	12	113

In all 171 arthrographies were performed. 127 of these showed signs of meniscus lesion. Table 3 shows that the diagnosis could be verified at operation in 121, i.e., 95 %, while in the remaining 6 cases no meniscus lesion was found at operation. It will be seen from the table how the meniscus lesions are distributed and simultaneously how many arthrographies showed positive or negative findings in the individual groups. It appears that there are a relatively large number of errors of judgement in transverse ruptures, longitudinal tears of horizontal tears. In the group atrophy or degeneration, meniscus lesions are assembled which show clear changes but without breaks in continuity: here there is also naturally a relatively large number in which arthrography could not demonstrate any lesion. It will be seen, however, that on the whole there is good correspondence between operative findings and the arthrography report. Amongst 133 meniscus lesions in 123 knees

there were only 12 where arthrography could not demonstrate any lesion and it can be seen moreover that in 85 % there was complete agreement between operative findings and the arthrography report with respect to localization and type.

In all there were 47 cases where the arthrography showed no sign of meniscus lesion, 15 of which underwent operation on the basis of the clinical picture. In 12 of these meniscus lesion was found, which means that negative arthrography is by no means a guarantee that no meniscus lesion exists. In 32 cases the clinical symptoms were so vague that operation was rejected. In a personal follow-up of 29 of these patients I found that 13 patients now showed clear signs of meniscus lesion, since the symptoms were either unchanged or worse, while in 16 patients there was now no clinical sign of meniscus lesion.

It was stated earlier that amongst the 188 patients there were 10 in whom lesion of both the medial and lateral meniscus were found in the same knee. General clinical examination caused suspicion of this in one case only. In the remaining 9 cases the double lesion was revealed through arthrography.

In concluding this study I may point out that it is the complete clinical investigation which is decisive in the diagnosis of meniscus lesion and that the possibility of a lesion of both the medial and lateral meniscus must be considered. Arthrography is a considerable aid when brought into diagnostic deliberations combined with the objective symptoms. With positive arthrography findings there is 95 % probability that a meniscus lesion really exists. In cases of negative arthrography, if the remaining clinical examination does not strongly favour a meniscus lesion it would be reasonable to await the future course. One may expect that half of these patients may have a meniscus lesion.

DISCUSSION:

U. Zakrisson-Ferm (Linköping, Sweden):

In December, 1956, H. Brodin and S. Ribbing announced before the Swedish Orthopaedic Association their experiences with the meniscography method which was put forward in 1951 by van de Berg (Liege). Since then the method has been improved, above all by direct enlargement with microfocus tubes 0.3 × 0.3 mm. which has increased the diagnostic reliability, since it makes possible a double size picture with satisfactory sharpness.

From January, 1957, to July, 1958, 62 cases were operated on at the Orthopaedic Clinic in Linköping; these were examined in accordance with the meniscography method under discussion. In 61 cases there was complete agreement between the arthrography and the operative findings.

A detailed account of both method and results will be published in Acta Radiologica.

Lars Andrén and *Lennart Wehlin* (Malmö, Sweden):

At the X-ray department in Malmö all knee joint arthrographies since 1956 have been made with double contrast medium, but using a different, partly new technique. 1. The course of the tibial articular surfaces is drawn on the skin under fluoroscopy. 2. Air and ca. 10 ml. of water-soluble contrast medium are injected until the joint capsule feels moderately extended. 3. The patient gets up, walks about,

bends the knees. 4. The patient is placed in a side position on the examination table with the meniscus to be examined facing upwards. The joint space is widened with the aid of a firm pillow underneath the distal end of the femur and a sandbag on the foot. 5. With a horizontal projection and film-focus-distance of 1 metre or more X-ray, pictures are then taken. Between exposures the knee is rotated 10–15° so that the whole of the meniscus circumference is examined. 6. The examination is completed by lateral pictures with vertical projection and possibly a picture in the abdominal position with flexed knee.

The basic difference in this technique is the horizontal projection. Its advantage is that disturbing overprojection of contrast medium with sediment deposit is avoided.

In order to obtain optimal contrast covering of the menisci the mingling of contrast medium and synovial fluid should be avoided. Passive or active movements lying down should be avoided therefore. In a standing position the heavier contrast medium manifests sediment and surrounds the menisci and synovial fluid is pressed out from possible ruptures and is replaced by contrast medium, when the patient walks or flexes the knees.

In order to obtain a high degree of sharpness in the pictures a long film-focus-distance is used. Other advantages of the method: easy to perform and not wasteful of time, no traction apparatus or assistant, flouroscopy only once.

H. Støren (Stavern, Norway):

In the material I possess of meniscus ruptures there seldom occurs in the case history true instances of one trauma alone. On the other hand on closer examination it often occurs that the patient has been kneeling of squatting with the leg rotated outward. An engineer who had a habit of crawling with his legs and feet outward-rotated when inspecting oil tanks on whaling boileries had longitudinal ruptures of the menisci on both knees. At operation there was bloodstained exudate in the joints although he did not acknowledge any trauma. The same is true of many cases. Mercer in Edinborough declares that he sees meniscus ruptures particularly often amongst coal miners and believes that this is due to the fact that the miners stand with their feet planted firmly on the ground and twist their thighs and body to the side when they shovel coal.

Even if the joint has bloodstained content this does not signify an acute trauma.

The chronic state of irritation which arises in the joint provokes a hyperemia with easy tendency towards bleeding.

When it appears that a rupture has arisen directly after one adequate trauma alone,—then there is much possibility that this trauma has only provided the opportunity for the meniscus, in reality already ruptured or pathologically changed, to make its appearance through locking.

C. Hirsch (Upsala), *H. Nilsonne* (Stockholm), *J. Palmer* (Stockholm), *E. Hj. Larsen* (Copenhagen), *H. Wahren* (Eskilstuna), *H. Novotny* (Oslo), *J. Saugman-Jensen* (Copenhagen), *H. Bohr* (Aarhus).

PRIMARY OPERATION ON LIGAMENT LESIONS IN THE KNEE

by *P. Windfeld* (Sønderborg, Denmark)

CRUCIATE LIGAMENT PLASTICS WITH MENISCUS

by *N. Lindström* (Härnösand, Sweden)

While primary operation is generally prescribed for fresh cruciate ligament injuries the treatment is still to a large extent conservative in the case of the older injuries. This is certainly due to the fact that discouraging results have been obtained in the main with the methods so far in use.

Three different transplants have been employed: 1. Silk sutures (Lange's method), 2. fascia transplant (Hey Grove's method) and 3. tendon-transplant. The disadvantage of these methods is that a dead material can never replace a ligament in the long run, the fascia transplant stretches and the tendons become necrotic. The attempt has also been made to restore the stability of the knee by operations on the lateral ligaments, but since these are only tensed during a part of the movement phase, the results can never be completely satisfactory.

As methods have thus not proved adequate, conservative treatment is generally recommended with muscle exercise, through which astonishingly good active stability can be achieved. Recently attempts have been made to increase this stabilising muscular effect through the "dynamic approach" operations according to Helfet and Augustine.

With greater tensions, however, passive stability is also required, and this can be achieved only through reconstruction of the ligaments. It is therefore necessary to find a transplant which does not stretch and does not become necrotic. I considered that I had found such a material in the menisci, which lack a blood supply and are completely nourished from the synovial fluid. Since I had previously had discouraging results with fascia transplant I tried at the beginning of the forties to employ meniscus as a transplant and the results proved encouraging. On studying the literature I later found that Wittek had employed the meniscus in 7 cases and Zur Werth in 1 case.

In a number of cases of injury to the forward cruciate ligament I retained from the beginning the anterior attachment of the meniscus and sutured the meniscus to the condyle with silk or wire througt drill holes. However, the anterior meniscus attachment does not correspond with the origin of the cruciate ligament so that I was compelled to re-operate on 2 cases and bring down the meniscus via drill holes from the eminentia to the forward aspect of the tibia. In the great majority of the cases, however, I brought down the meniscus into drill holes both in the condyle and the tibia. The drill holes are Y-shaped so that an intervening piece of bone is secured, around which are knotted the wire threads by which the meniscus is tied at both ends. However, as far as the rear cruciate ligament is concerned, I believe that one can retain the rear attachment of the lateral meniscus which corresponds quite well with the origin of the rear cruciate ligament. The operation is performed using a prolonged Payer incision and the knee is put in plaster in a slightly flexed position. Exercise is begun after 4 weeks and the patients are allowed to put weight on the leg after 8 weeks.

I have had the opportunity of seeing the meniscus uniting thoroughly in the two cases mentioned before, which were re-operated on because I retained the anterior meniscus attachment and the stability was not satisfactory. In both cases a well-developed, apparently normal cruciate ligament was present.

Up to and including 1955 I operated on 26 men and 8 women that is 34 cases of

cruciate ligament injury, and used this method. The anterior cruciate ligament was injured in 31 cases, the rear in 2 cases and both ligaments in 1 case. 27 cases had simultaneous meniscus injury and in 2 cases lateral ligament reconstruction had to be carried out; the great majority of injuries were suffered in sport and the patients complained about the feeling of instability; only in 5 cases did locking occur. 14 cases achieved full stability in the knee joint and only a slight "drawer" symptom remained in 13 cases, so that the operation gave satisfactory results in 27 out of 34 cases operated on. In 7 cases, however, the operation was a complete failure with residual pronounced "drawer" symptom, certainly as a result of unsatisfactory technique. Thus, of the 22 cases in which the meniscus was drawn through drill holes in both femur and tibia, only 4 have pronounced residual "drawer" symptom and this is probably due to incorrect placing of the drill holes.

Thus the menisci are well suited as a plastic material for old cruciate ligament injuries and with increased experience and technique the results ought well to be further improved.

DISCUSSION:

W. Otnes (Fredrikstad, Norway):

Stabilizing knee operationss come under consideration for freshly torn ligaments and in chronic cases of unstable knees.

The unstable knee joint in acute injuries is often due to tibial condyle fractures, sometimes accompanied by ruptured ligaments. The fracture case is often best treated by operative reduction and bone transplantation, with or without plaster immobilization, according to the degree of injury. I have had occasion to carry out primary suture on purely ligamental injuries, and have found it beneficial. Anterior ligament ruptures where the intercondyloid eminences are torn and broken, can be easily sutured in place and maintained if the thread holds above the bone fragment of the eminences. If such a fragment is lacking in thread easily cuts through and other methods must then be used. Roden has described a method of fixing the posterior ligaments.

When unstable joints follow old injuries reconstruction comes under discussion. In extreme cases arthrodesis must be used. A good substitute for anterior ligaments can be obtained by drawing the semitendinosus tendon through the joint from the rear and attaching it to the bone canal of the tuberositas. This "ligament", thanks to the connection with the muscle, is given an active function and should not atrophy.

In 1947 Emil Hauser, Chicago, published an account of ligament plastics where he made use of a strip of the tendon for the rectus femoris, see: Surgery, Gynecology and Obstetrics, page 339, 1947. He had then performed the operation 15 times with "lasting effect". The point of the method is that the newly constructed ligament receives an active function. The method can be supplemented by taking part of the patellar ligament also and suturing up to the side of the femoral condyle.

I have had cause to perform Hauser's operation 5 times and the results have been so good that the method is recommended.

I operated on the first three cases in 1947–1948 for disabling, unstable joints. All three became stable and free from pain, and are now symptom-free. I did not put the first case in plaster as Hauser considered that it could be omitted. The patient wrenched the knee some weeks after the intervention and this somewhat stretched

the ligament but the patient recovered well after a period in plaster. In this first case the transplant was placed outside the knee joint capsule as Hauser states. Afterwards I altered the technique and placed the transplant between the fibrous capsule and the synovial capsule since I expected more certain healing and substitution at this site. I continued to perform the intervention in this way and have kept the knees in plaster for 6 to 8 weeks. It seems natural to lay the transplant as stated since an arthrotomy must often be performed and loose meniscus removed. This was so in two of the cases. The incision in the fibrous capsule is sutured above the strip of tendon. In one case ligament substitution was also carried out with the semitendinosus tendon. This patient had a marked unstable joint in the valgus direction with positive drawer symptom owing to injury to the anterior ligaments. She was tormented by recurring hydrops; sword bone position occurred when the knee went into hyperextension—the knee gave way easily. I examined her some days ago and she had a pain-free stable joint. The last two cases were operated on ¾ yars ago. They have become stable. The importance of the required quadriceps drill must be stressed in the after-care.

The Hauser plastics replaces lateral ligaments and takes over to a considerable degree ligament function of the anterior cruciate ligament. The method can also, and this is important, be employed primarily in acute capsular ligament injuries.

H. Støren (Stavern, Norway):

Lindström frees the meniscus completely. I saw this method used in 1935 in Payr's clinic in Leipzig.

Then the attachment of the medial meniscus to the tibia was not removed.—Nor was this done by Wittek either (who was the first to employ this method). It would also be a more rational procedure to retain the attachment. Instead of an intra-articular cruciate ligament plastics, I employed an extraarticular, stabilizing plastics with a broad strip of tractus tibialis ligament carried through the femoral condyles to the inner aspect and again back through the tibial condyles to the point of origin where it was firmly and tightly fixed.

In two cases where this method was tried the results were subjectively and objectively satisfactory.

N. Lindström (Härnösand, Sweden):

Regarding the question of retaining the anterior meniscus attachment, then I may point out that I did this from the beginning, but since the attachment does not correspond with the origin of the anterior cruciate ligament, the ligament cannot be extended through the whole phase of movement. Docent Palmer has passed on to reconstructing the lateral ligament, which others have also attempted. As we heard from Professor Hjortsjö, however, these are only stretched when the knee is extended and cannot replace the cruciate ligament's function with the knee flexed. I cannot understand why Docent Palmer considers that cruciate ligament plastics is such a large intervention or why he considers himself morally unjustified in performing this operation. I would only point out that I have operated on 34 cases of meniscus plastics, including a number of other ligament plastics, without the slightest complication and with good mobility in the knee. 2 cases, however, did not return for examination but had 90° flexion of the knee joint at the last visit.

J. Palmer (Stockholm), *P. Windfeld* (Sønderborg, Denmark).

LUXATIO PATELLÆ OPERATED ON AD MOD. MAC CARROLL SCHWARTZMAN

by *P. Thestrup-Andersen* (Copenhagen)

DISCUSSION:

P. Lütken (Aalborg, Denmark).

GENER RECURVATUM POSTTRAUMATICA TREATED WITH OSTEOTOMIA CRURIS AD MOD. IRWIN

by *P. Lütken* (Aalborg, Denmark)

DISCUSSION:

J. Agerholm-Christensen (Oxford), *P. Windfeld* (Sønderborg, Denmark).

KNEE JOINT ARTHROSIS COMBINED WITH FRACTURES ADJACENT TO THE KNEE

by *A. Møllerud* (Oslo)

The author believes that where there is adjacent knee fracture or pseudarthrosis at the same time as an arthrosis in the knee joint one should carefully consider whether an arthrodesis in the knee joint should not be performed at the same time as fracture and pseudarthrosis treatment. Two cases are reported in which a supracondylar femur fracture was present at the same time as an arthrotic, unstable knee joint and where good results were achieved with operative fracture treatment at the same time as arthrodesis in the knee joint and where medullary nailing was used as a method of fixation for both the fracture and the arthrodesis.

PATELLAR SHAPE AND DEGENERATIVE CHANGES IN THE FEMORO-PATELLAR JOINT

by *H. Brattström* and *S. A. Ahlgren,* (Lund, Sweden)

1. *Clinical investigation.* (Brattström).

For three years every X-ray examination of the knee has included an axial picture of the patella in order to discover whether the shape of the patella has any significance in degenerative changes of the femoropatellar joint. The width of the lateral and medial articular surfaces is measured in the X-ray picture and the relationship between the articular surfaces in calculated. This relationship between lateral and medial surfaces is called "the patellar index".

The series is divided into 1. normal (acute, usually traumatic knees), 2. pathological with subsidiary groups, a:–chronic (chronic trouble or degenerative changes on the X-ray picture) but without displacement of the patella, b:–subluxated (degenerative changes and lateral subluxation of the patella). It was then discovered that the dominance of the lateral articular surface, a normal characteristic, is more pronounced in women than men and more pronounced in patients with degenerative changes in the femoropatellar joint. These patellas have consequently a greater "patellar index" than normal patellas. The largest index is found in group 2 b, subluxated patellas.

2. *Pathologic-anatomic investigation.* (Ahlgren).

X-ray examination was made of 113 knee joints (section material) taking axial pictures of the femoropatellar joint and also recording the macroscopic changes in the joint. On statistical analysis and comparison with the normal material of Brattström it was established that the patellar index was higher in that part of the series with macroscopic changes, i.e., degenerative changes occur particularly in cases where the medial facet is small in relation to the lateral.

Amongst the macroscopic findings there is one observation of especial interest. On the ventral side of the femur and in continuation of the joint cartilage on the lateral side of the patellar surface one often finds a tongue-shaped, white formation with a smooth surface. The effect of this is that the ladder-like transition otherwise present from the cartilage to the bone without cartilage is more even on the lateral side. I have never found such a formation in the corresponding place on the medial side. This occurred in 70 cases out of 113 and not only in the higher age groups but also amongst teenagers with macroscopically normal cartilage in the femoropatellar joint. Microscopic investigation shows that it consists of connective tissue. The patellar index for these cases lies between 1.2 and 1.7 with the majority of the cases at 1.4–1.5.

The presence of this "tongue of connective tissue" may give rise to varying speculation concerning the function of the knee joint and the origin of the formation, but for the present I have no adequate explanation of how it arises. It does, however, create a smoother gliding surface for the lateral facet of the patella and this may possibly be *one* of the reasons why chondronmalacia occurs later there than on the medial side.

DISCUSSION:

G. Wiberg (Lund), *R. Magnusson* (Linköping), *H. Novotny* (Oslo), *H. Brattström* (Lund, Sweden).

SOME VIEWPOINTS ON CHONDROMALACIA OF THE KNEE JOINT

by *H. Wahren* (Eskilstuna, Sweden)

It is a commonly known fact that there is a connection between habitual patellar luxation and chondromalacia of the knee joint. Wiberg has clarified this strange lack of congruence between the joint surfaces of the femoropatellar joint. Exudative processes also play a considerable part in the more pronounced cases of chondromalacia. This exudative factor can be combated symptomatically by means of steroid preparations with quite considerable success. The traumatic factor was treated by means of plastics employing the semitendinosus tendon which was detached and fixed against the medial side of the patella. In this way it is conceivable that a lateral displacement of the patella can be prevented. Seven cases were operated on over a period of two years. One case had recurrence in connection with trauma. The other cases showed good results. The operated cases all had slack joint capsules and did not react to normal conservative therapy. On following-up the one case which had recurrence it was found that the semitendinosus tendon had become loose from the patella. If similar cases arise in the future it will be more suitable to perform plastics of a different type, for example, according to Krogius.

THE RESULTS OF PATELLECTOMY IN CHONDROMALACIA AND ARTHROSIS

by *Johannes Christensen* (Aarhus, Denmark)

During the years 1945–1957 patellectomy was employed at the Orthopaedic Hospital in Aarhus on a total of 83 patients while altogether 90 knees were operated on.

The incidence of men and women and that of left and right knee are equal, the age at operation being from 14 to 67 years.

The indication for operation was in all cases pain owing to chondromalacia or arthrosis; the cause of chondromalacia was found in 21 cases to be recurring luxatio patellae, in 9 cases to be patellar fracture; in 41 cases the cause of chondromalacia could not be proved and in 19 cases arthrosis had developed.

The follow-up comprised 86 knees in all, distributed amongst 79 patients; two had died and two had moved abroad, while the others were followed-up with an observation period of at least one year.

The evaluation of the result is difficult, since no reliable relationship exists between the objective findings and the feelings of the patients; after an objective evaluation 28 % were found unsatisfactory while 29 % were found so after subjective estimate. However, the majority of these patients with poor results had undergone before the patellectomy one or more operations in or around the knee joint, or the symptoms had persisted for more than 5 years.

TABLE

The result of treatment in relation to period of anamnesis and previous knee operation.

Group		In all	Lenght of anamnesis				Previous op.
			1 year	1-3 years	3-5 years	≧5years	
objective	A	62	11	25	4	22	14 (22.6 %)
	B	24	3	6	3	12	11 (45.8 %)
subjective	A	61	10	23	6	22	13 (21.3 %)
	B	25	4	8	1	12	12 (48.0 %)

A = good. B = poor.

The follow-up showed that caution must be observed in employing patellectomy, where a complicated knee is involved—i.e., a knee with previous meniscus or other operation and universal, progressive arthrosis, and finally that one must not wait too long before operating, since the prognosis after 3–5 years becomes worse.

DISCUSSION:

J. Agerholm-Christensen (Oxford), *G. Wiberg* (Lund), *J. Christensen* (Aarhus), *S. v. Rosen* (Malmö), *C. Hirsch* (Upsala), *M. Felländer* (Stockholm).

ON "THE COXITIS KNEE"

by *M. Foss Hauge* (Oslo)

The designation coxitis knee is used for that clinical-pathological condition of one knee the hip on the same side is ankylotic. It has *nothing* to do with coxitis as a cause of hip joint ankylosis, but the coxitis patients, particularly the tuberculous patients, form the largest disease group amongst whom it is present.

The author reviews a series from Martina Hansen's Hospital: 135 patients with osseous ankylosis (bone structure throughout and transformation of the bone architecturally) in the one hip. With these patients a clinical and roentgenological analysis of the knee on the affected side was undertaken, on average 14 years after the patient incurred the hip joint ankylosis (3 years to 34 years).

Average age: 35 years (15 years to 68 years).

The clinical symptoms of the coxitis knee are:

1) Characteristic change of contour in 89 %. Particularly striking is the severe atrophy of the vastus medialis and the vastus lateralis.
2) Posterior subluxation of the leg in relation to the thigh in 45 %.
3) Outward rotation position of the leg in relation to the thigh in 58 %.
4) Increased outward rotation possibility of the leg in 75 %.
5) Positive drawer symptom in 62 %.
6) Pathological increase of the physiological valgus position in 35 %.
7) Pathological side mobility (shifting-joint) in 98 %.

The *subjective* symptoms of the patients are strikingly few. An increased feeling of tiredness and weakness may be noticed amongst some, slight pain in others. Even pronounced degrees of side shifting are found without any special discomfort.

The roentgenological symptoms of the coxitis symptoms are:

1) Osteoporosis, more or less pronounced in almost 100 %.
2) Arthrosis changes, in greatly varying degree, without drawing any convincing parallel with the duration of hip joint ankylosis.

The author warns against confusion with the large roentgen changes found after irregular and too early epiphysis closing in the distal end of the femur and the proximal end of the tibia in children with lengthy bed rest or lengthy hip diseases.

The causes of the coxitis knee symptoms are briefly discussed. Some symptoms are very easy to explain, others more difficult (e.g. atrophy of the vastus medialis and the frequent positive drawer symptom *backwards*).

(To be published later in a more detailed form in Acta Orthopaedica Scandinavica).

DISCUSSION:

N. Lindström (Härnösand), *S. v. Rosen* (Malmö), *E. Sandaa* (Oslo), *E. Hj. Larsen* (Copenhagen).

H. Støren (Stavern, Norway):

The drawer symptom is not pathognomonic of rupture of the cruciate ligaments. It is only an expression for an insufficiency of these ligaments—and a slackness of ligament and capsule in general.

In the condition we call "Schlottergelenk" or swinging joint we have the symptom more pronounced or less pronounced.

Then we see the drawer symptoms both forward and backward—as a manifestation of the joint's hypotonus.

M. Foss Hauge (Oslo):

To Doctor *Hj. Larsen:* I did not say that all the coxitis knee symptoms are difficult to explain, but I said expressly that *certain* of them (such as atrophy of the vastus medialis and positive drawer symptom) are difficult symptoms to explain.

To Doctor *Støren:* It is correct that a positive drawer symptom is found in other groups of patients, e.g. in pareses of the lower extremities following poliomyelitis. But according to the *textbooks*, even the most modern, there is no positive posterior drawer symptom, excepting the lesion of the posterior cruciate ligament.

To Docent *von Rosen:* The duration of immobilization varied to some extent but not much after the hip joint arthrodoses. As a rule the patients were given bed rest with a long hip plaster for 3 months, afterwards they were up with a long hip plaster for 3 months, in all 6 months.

To Doctor *Lindström:* No definite parallel can be drawn between the duration of immobilization and the degree of the coxitis knee symptoms. It does not seem to be correct, as the author himself believed in the beginning that early mobilization of the knee can prevent a coxitis knee. Nor is the probable theoretically since *the cause* is the ankylotic hip with pathological conditions of mobility in the knee and changed muscle function.

To Doctor *Sandaa:* The point *when* the coxitis knee symptoms arise after the hip has become ankylotic is difficult (I think, impossible) to state exactly. The symptoms are very often found fully developed ½ to 1 year after the occurrence of hip ankylosis. It seems to be a gradual transition, which is partly concealed by the fact that the patient in most cases has immobilized or spared *the whole* of the lower extremity for a long time previously owing to the primary hip disease.

KNEE ARTHROPLASTY ON A TUBERCULOUS KNEE, PREVIOUSLY RESECTED

by *H. Støren* (Stavern, Norway)

DISCUSSION:

H. Waldieus (Stockholm), *J. Hald* (Oslo).

PIGMENTATED VILLONODULAR SYNOVITIS IN THE KNEE JOINT

by *E. Hj. Larsen* and *J. Saugmann-Jensen* (Copenhagen)

DISCUSSION:

T. Hiertonn (Stockholm, *Löfgren* (Stockholm).

FURTHER EXPERIENCES ON CAPSULAR CHONDROMATOSIS IN THE KNEE JOINT

by *H. Støren* (Stavern, Norway)

THE POSTURAL FACTOR IN PARALYTICAL SCOLIOSIS

by *Knud Jansen* (Copenhagen)

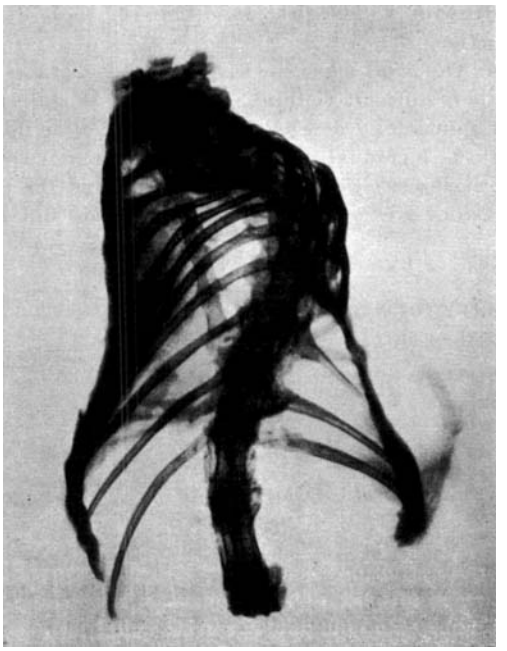
DISCUSSION:

Ivar Alvik (Oslo).

EXPERIMENTAL SCOLIOSIS

by *A. Langenskiöld* and *J. E. Michelsson:*

Clinical studies have not been able to give us exact information about the pathological components of force which give rise to scoliosis. Attempts experimentally to analyse those factors which produce spinal deformities during the growth period may possibly help towards obtaining increased knowledge about the pathogenesis of the scolioses. No descriptions are encountered in the literature, however, of animal experiments at which really severe scolioses have been provoked.



Experimental scoliosis provoked in a rabbit through resection of VI-XI ribs' rear ends. After the intervention, performed at 2 weeks old, the scoliosis advanced to 120 degrees during the course of about 4 months.

In the research laboratory at the orthopaedic hospital at the Invalid Institute in Helsingfors, attempts have been made since January, 1957, to provoke grave scolioses of progressive type. Various interventions in the back musculature produced only mild scolioses and in the majority of the animal experiments the scoliosis was not permanent but straightened out in the course of growth. After resection of the proximal ends of ribs VI–XI on one side, however, severe progressive scoliosis occurred in all the animals who survived the intervention (comp. fig.). By means of resection of a few mm. of ribs VI–XI just laterally of the transverse processes severe scoliosis was provoked in roughly 1/3 of the animal experiments.

Since severe progressive scoliosis can be provoked in animals, possibilities ought to exist of more closely analysing those forces which have a deforming effect on the spine after the initial intervention.

DISCUSSION:

H. Sjövall (Örebro, Sweden).

ON THE MINERAL METABOLISM OF THE SKELETON

by *Göran Bauer* (Malmö, Sweden)

The article will be published elsewhere.

MINERAL METABOLISM IN FRACTURES OF THE FEMORAL NECK

by *Bo Wendeberg* (Malmö, Sweden)

The metabolic activity in twenty fractures of the femoral neck was studied by external counting of Sr^{85} after intravenous injection. The counting rate over the fractures varied with the interval of time after fracture and with the type of fracture. The highest isotope uptake was observed in a case with pseudarthrosis.

Detailed results will be published elsewhere.

LOCALIZATION OF THE SKELETAL TUMOURS WITH SR^{85}

by *Sture Lindberg* (Malmö, Sweden)

Research has been carried out with Sr^{85}, a pure gamma ray with a half-life of 65 days. The distribution of the isotope in the skeleton was studied via external counting. About 50 cases have so far been examined. A quantity of 50 uC Sr^{85} was administered intravenously and counts were made at anatomically well defined points one, two and three weeks after injection.

An unmistakable concentration of the isotope was found within the skeletal parts affected by a tumour. In this way the X-ray diagnosis of skeletal metastases could be verified but metastases could also be demonstrated in some cases where the X-ray examination gave negative results.

Especial interest was afforded cases of cancer of the breast stage II, group 3, according to B. Nohrman's nomenclature. 75 % of these cases have metastases within 5 years, so that this group of patients is very suitable for a study of the possibilities of early diagnosis via the isotope method used here.

7 cases are included in the series which have no clinical or radiological signs of metastases. In counting these patients a marked correspondence was found in the distribution of radioactivity within the skeleton. The testing of possible methods of obtaining a quantitative analysis of counting values is continuing.

An article concerning this research is expected to appear in Acta Radiologica, 1959.

DISCUSSION:

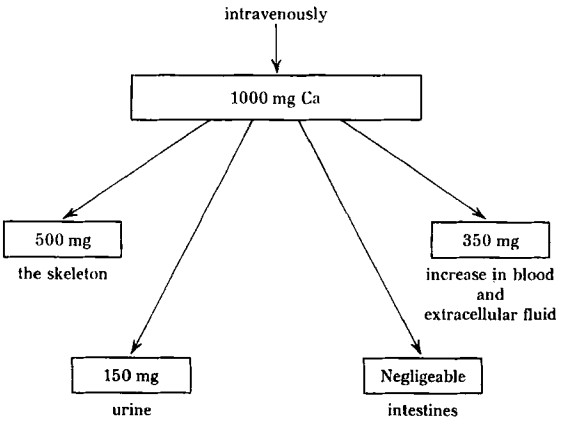
C. Hirsch (Upsala), *G. Wiberg* (Lund), *O. Lindahl* (Stockholm), *R. Magnusson* (Linköping), *J. Gynning* (Malmö), *L. Hult* (Stockholm), *M. Pers* (Göteborg), *B. Wendeberg* (Malmö), *G. Bauer* (Malmö).

OSTEOPOROSIS—A STUDY OF 70 CASES

by *Olov Lindahl* (Stockholm)

Osteoporosis usually means that the skeleton has atrophied partly because the spongiosa pores have become larger and the trabaculae smaller, and partly because the spongiosa bone and the compact bone have become thinner. The reason is assumed to be a defective formation of bone cells and bone protein, so that the calcium which may be found available in the blood has no place to be deposited. The diagnosis is made chiefly by X-ray. The common laboratory tests are normal. According to Fraser calcium infusion test will show low values with his method, and according to the same authority one will be able to make the diagnosis histologically through bone biopsy owing to the abnormal thinness of the trabaculae and the compact bone.

Calcium infusion test according to Fraser (Lancet 823, 1956).



$$\textit{Skeleton retention } \frac{500 \text{ mg}}{1000 \text{ mg}} = 50\ \% \text{ (normal)}$$

Low retention 10–43 %
Osteoporosis

High retention 57–90 %
Osteoporosis, Osteomalacia.

Osteomalacia means that the bone is softened, possibly also atrophied, chiefly owing to lack of calcium. This lack of calcium can arise, for example, through hyperfunction of the parathyroids, through defective resorbtion from the intestines, insufficient supply of calcium in the food or through abnormal losses in the kidneys. The bone protein metabolism is supposed to be normal. The diagnosis can be made by X-ray, by laboratory tests or histologically by bone biopsy. On X-ray the appearance of osteomalacia within the spinal column and the pelvis is the same as in osteoporosis, while the lack of calcium in the hand skeleton will be typical of malacia but will not occur in osteoporosis. Serum values of phosphorus will often be low, calcium in serum slightly increased and the values for alkaline phosphatase will almost always be increased. The excretion of calcium in the urine may vary depending on the cause. Calcium infusion test according to Fraser will regularly show greatly increased retention of calcium in the skeleton, indicating lack of calcium. Often there is an anaemia of macrocytic type and disturbances in the fat resorption. Histologically, the bone biopsy shows unmasked bone cells, i.e., osteoid tissue.

The excretion of calcium in the urine is very much dependent on the calcium intake in the diet. In order that the determination of calcium in the urine may have a diagnostic value the patients must for at least 4 days eat calcium-deficient food with 100–150 mg. Ca per 24 hours. Afterwards the normal excretion of calcium in the urine will be below 3 mg. per kg. of body weight (180 mg. for 60 kgs weight). High values up to 6 mg. are present for example in renal rickets and in hyperparathyrodism. Extremely low values under 2 mg. occur with calcium deficiency in the food and resorption disturbances in the intestines.

For a long time various methods have been tried to determine the calcium metabolism through calcium loading tests, but the results have been varyable. Fraser in 1956 published a method which seems capable of providing more definite information about the calcium metabolism of the body. The principle is (fig. 1) that about 1,000 mg. Ca (110 ml. 10 % calcium glyconate) is given intravenously *over 4 hours.* Losses through the intestines in this short period are considered negligible. In the same period the calcium losses in the urine are determined and also the increase in the quantity of calcium in the blood and extra-cellular fluid. From these figures it can then be calculated how much is retained in the skeleton. According to Fraser the normal values are between 44–56 %, while osteoporosis values very often lie at a lower level between 25–40 % and osteomalacia values are always higher up to 90 %. His series includes 10–15 cases in each of the groups.

During a visit to London in 1957 for the purposes of study I had the opportunity of following the work of Professor Russell Fraser's metabolic department, where interest was chiefly concentrated on calcium problems. Osteomalacia in adults was considered a very common disease in England by roentgenological diagnosis, and I returned with the belief that in Sweden osteomalacia was often misdiagnosed as osteoporosis. Since then I have been able to examine and follow a series of approximately 70 cases of roentgenological osteoporoses in which beside normal laboratory tests, calcium excretion in the urine and calcium infusion test according to Fraser were investigated while a bone biopsy was also performed in almost all cases.

It was with particularly keen interest that I searched for osteomalacia cases. I found that calcium infusion test according to Fraser in almost one third of the cases showed pathologically high retention values indicating osteomalacia. In all

other respects, however, the criteria of the osteomalacia diagnosis were not fulfilled. Thus in this group the phosphorus and calcium in the serum and alkaline phosphatase were normal. Macrocytic anaemia did not occur and fat resorption investigated with vitamin-A resorption test showed normal values. Changes in the hand skeleton on X-ray were sometimes found, at other times not. Finally no osteoid tissue was found in the bone biopsies.

The conclusion from this must therefore be that in all cases osteoporosis was involved and that Fraser's calcium infusion test is not suitable for distinguishing between osteoporosis and malacia.

If the entire series is considered as osteoporosis the following may be of special interest.

1. Lack of calcium in the hand skeleton is present with osteoporosis and is correlated with the degree of severity of the osteoporosis. In advanced osteoporosis one observes calcium deficiency in the hand skeleton; in moderate osteoporosis this is rare.
2. Laboratory values for serum calcium, serum phosphorus and alkaline phosphatase are normal.
3. Moderate, normocytic anaemia occurs occasionally.
4. ESR is often increased.
5. In 21 % of the cases eosinophilia is found (5 % or more eosinophil cells).

In the cases with eosinophilia, with one exception, increased values for calcium excretion in the urine were never found. In osteoporosis it was almost as common to find low, normal and high calcium excretion in the urine, as well as low, normal and high calcium retention values.

There is no proportion between calcium excretion in urine and calcium retention in the skeleton. The more pronounced the osteoporosis (evaluated through the hardness of the bone at the bone biopsy), the greater usually is the calcium retention.

What then are the conclusions from these investigations and values? In the first place; 1) osteomalacia in Sweden is rare, and 2) that Fraser's calcium infusion test cannot be employed as a differential diagnosis between osteoporosis and malacia. Furthermore osteoporosis must not be ragerded as a stationary, but as a dynamic disease, in which the patient can at some periods excrete large quantities of calcium and at other periods small or normal quantities, and in which the skeleton can show great affinity with calcium (high retention) or reject the calcium supplied (low retention).

I believe that the exposition of these conditions is of great importance in the understanding and treatment of osteoporotic patients. It would probably be not only pointless but also dangerous to the kidneys to give a patient with low retention large quantities of calcium. In such a case one must seek to increase the retention power of the skeleton for example by means of hormone treatment.

In cases with very high skeletal retention, nevertheless, I believe that only a large supply of calcium can suffice as a therapy and that then hormone provision may be unnecessary.

In prolonged cortisone treatment which very often leads to osteoporosis I have observed extremely low calcium retention, to 9 %. In cases with high calcium retention values, where there has been occasion to suspect that the osteoporosis was caused by deficiency of calcium in the diet or by poor resorption of calcium, I have

been able to administer extremely large quantities of calcium intravenously (1500 ml. 10 % calcium glyconate in 2 months). The same quantity in more normal dosage intramuscularly would have taken 1–2 years.

In cases where calcium retention was low, it increased after hormone treatment, indicating that the treatment was effective.

DISCUSSION:

A. Langenskiöld (Helsingfors), *G. Bauer* (Malmö), *O. Lindahl* (Stockholm).

EXPERIMENTAL PREVENTION OF GROWTH WITH PAPAIN

by *Anders Hulth* and *Olle Westerborn* (Upsala)

Curious changes in the fundamental substance of cartilage can be obtained with the growth enzyme papain (from the Papaya tree). Thomas found that papain injected into young rabbits produced drooping of the ears after 3–4 hours. Also, and this was demonstrated at the Academy Hospital in Upsala, damage was done to the epihysis lines of the animals. The damage was reversible after one single injection but cannot be reversed after repeated injections, e.g., injections every day for 3–4 days, as the bones of the epiphyses have closed. Injections are carried out intravenously. The results are the same on all animals tested: rabbits, mice, young rats, guinea pigs, or dogs. Histologically changes can be perceived as soon as 3 hours after injection: the basophilia of the matrix diminishes or disappears, the cells in the proliferation zone swell, then expand. The differentiation between hypertrophic and proliferation cells disappears. The bone bridges formed are coarse, broad and shorter than normal and the whole epiphysis zone narrows. Over a period of 5–7 days the changes regress successively. On repeated injections there is widespread damage to the epiphysis cartilage, often with osseous closing as a result. The epiphysis lines of the mouse are all closed after 3 injections 3 days following.

DISCUSSION:

S. Friberg (Stockholm), *C. Hirsch* (Upsala), *P. H. Widmark* (Malmö), *A. Hulth* (Upsala).

PRELIMINARY RESULTS OF DETERMINING THE FIRMNESS OF CALLUS ON NAILING

by *Jörgen Falkenberg-Christensen* (Malmö, Sweden)

The investigations are an attempt to determine the firmness of callus in fractures on various stages of healing both on normal bone and on bone with medullary nailing.

Experimental animals: rabbits with a weight of ca. 2.5 kg. Medullary nail: Kirschner wire with a diameter of 1.2 mm. and a length of 5–6 cm. Experimental bone: radius. Operative technique: identical fractures are made with a circular saw on both radii at the same level. The one side is nailed by means of a drill hole in the lower radius. The other bone is used as a control.

Material: 60 rabbits divided into groups of 7–8 animals. There were intervals of 10 days between the groups. The fractures were 10–80 days old.

Maximal loading at the fracture site is determined by a special traction apparatus. The cross section area of callus is determined and the specific degree of firmness, i.e., firmness per mm^2 of cross section is calculated.

Results: The specific firmness increases slowly in the first 30 days. Afterwards there is a more rapid increase during days 40–60. From 60–80 days the firmness increases but slowly. At 80 days the firmness is only 1/3–1/2 of the firmness of normal unfractured bone. No difference between the firmness of the two sides could be demonstrated.

DETERMINATIONS OF THE ELASTICITY MODULE OF BONE

by *Per Forssblad* (Upsala, Sweden)

Small plates of bone were sawn out of the corticalis on the upper part of the femur. With the aid of wire extension apparatus the elasticity module was determined for each plate of bone.

The measurements thus obtained show that the elasticity module value is not constant within the corticalis layer. This indicates that certain areas are more suited to resist mechanical strains than others, depending on the physical qualities of the bone.

It is possible that studies of this kind may give us a clearer picture of the mechanical structure of a skeletal part and a lead to other principles of osteosynthesis.

EARLY DIAGNOSIS AND EARLY TREATMENT OF CONGENITAL HIP LUXATION

by *Sophus von Rosen* (Malmö, Sweden)

When two years ago in Helsingfors I gave an account of our experiences with early diagnosis and early treatment of congenital hip luxation the series comprised 8 cases with 14 "clicking hips". Only 4 of the hip joints, in three girls, did not show normal X-rays at the latest X-ray examination. In two of them both hip joints were involved. In the one case, as in the second one, the mother had not found it possible to carry out treatment with abduction cushion and abduction plate in a satisfactory way. The third case was still under treatment. The treatment was not begun here until the child was three weeks old.

I also described a new type of fixation splint which we had begun to use at the clinic. Its advantages were to be that it achieves effective fixation of the hip joint in the reduced position that it is easy for the mother to handle and that it does not involve any inconvenience at all for the new-born child.

Since then a further 12 cases have been diagnosed and treated. In each case the orthopaedic surgeon confirmed the presence of a true dislocation and in the most recent cases a dislocation could be demonstrated roentgenologically completely clear owing to the new method of investigation which *Andrén* and I reported in Acta Radiologica six months ago.

Our total experience now persuades me to discuss the following four questions:

1. What is the cause of the congenital hip joint luxation?
2. Is the dislocation always present at birth?
2. Can the dislocation always be diagnosed immediately after birth?
4. How long a period of treatment is required?

Question 1: What is the cause of the congenital hip joint dislocation? We know that a grave congenital malformation of the hip joint may be present in cases of arthrogryphosis. We have had one case like this, in which there was considerable upward displacement of the femural head with shortening of the leg on one side, restricted mobility of the knee and varo-equinus foot on the same side, calcaneo-valgus foot on the other side and also urogenital rectal malformation. In this case the hip joint could not even be reduced the second day following birth. Later I performed an open reduction to achieve whatever effect possible. A somewhat similar case led us to the new X-ray projection mentioned earlier. The boy died three hours after birth and showed bilateral malformations of the kidneys on authopsy. I myself was going to look a little more closely at the musculature of the child's hip joints, but felt the legs before I began the dissection. A clear reduction click could be felt on the left side. The dissection of the hip joint showed a small inner acetabulum in which a defective ligamentum teres was firmly set and outside this a rather larger, but shallow acetabulum into which the joint head slipped on reduction. Thus it was an acetabulum with a double bottom.

How often such "primary" grave malformations are present in the dislocated hips cannot easily be ascertained without employing arthrography, an investigation which we have not wished to try on new-borns.

There has been much discussion of the degree and scope of the part played by external factors in the appearance of a congenital hip joint luxation. Recently *Nyström* and *Zilliacus* gave an account of a luxation series and there discussed whether a breech presentation could be the cause of a luxation. In their series 16 % were born in this position. In our series no less than 8 out of 20, i.e. 40 % were born in the breech or foot presentation.

The proportion of girls to boys in our series is about the same as in other series, to be exact 4–1. Three of our four boys were born in the breech presentation.

Another circumstance which might argue in favour of the space available in the uterus and in the passage through the pelvis playing a part in the occurrence of the luxation is that the first-borns are in the strong majority. In our 20 cases 14 were children of the first confinement. The first-borns were thus more than twice as numerous as the others. I have not seen this pointed out previously.

As is well known, the role of heredity has often been discussed. Amongst our 20 cases there is not one in which luxation is known to have occurred in the family.

Question 2: Can all hip joint luxations be diagnosed immediately after birth?

The reply to this question is yes. The reduction click is easily demonstrated and the new roentgen method seems to be able to confirm the diagnosis clearly even if the procedure requires most exact definition in certain respects, when we obtain further experience.

In cases of severe deformity (according to *Ortolani* about 2 %) it may happen that one cannot even reduce the joint immediately after birth and thus a reduction click cannot be felt. In these rare cases the deformity is probably evident from the varying length of the legs and other deformities.

Question 3: Is the dislocation always present at birth?

The answer to this question is also yes. Since 1952, when the hip joints of all new-borns in the city of Malmö were routinely examined, during the first days following birth, no single case has been discovered later. With the supervision

existing at the centres for child care, such cases if present would, one can say, be inevitably picked up.

Question 4. How long a period of treatment is required?

It has been found that the dislocated hip joints, after reduction and effective fixation, already during the first week after birth, generally on the third-fourth day after birth, are stabilized surprisingly quickly. In the majority of cases the dislocation cannot be reproduced even in the 2nd-3rd week and we have concluded that the fixation can already be dropped after about 3 months.

Summarising I should like to point out that the diagnosis and treatment of the luxations immediately after birth must be described, as a great advance. I regret that we did not earlier discover in our clinic the treatment procedure now outlined. That it has emerged and can be pursued so constistently is due to the opportunities which are present, e.g. a true teamwork between pediatricians, radiologists and orthopaedic specialists which is possible when the orthopaedic department is included as a part of a large hospital.

DISCUSSION:

E. Severin (Göteborg), *E. Hj. Larsen* (Copenhagen), *I. Alvik* (Oslo), *S. Friberg* (Stockholm), *G. Wiberg* (Lund), *A. Langenskiöld* (Helsingfors), *C. Hirsch* (Upsala), *L. E. Laurent* (Helsingfors), *H. Nilsonne* (Stockholm), *S. v. Rosen* (Malmö).

RESECTION OF THE SPONGIOUS TISSUE ON ARTHROSIS DEFORMANS COXAE

by *Carl Hirsch* (Upsala)

DISCUSSION:

S. Friberg (Stockholm), *O. Löfgren* (Stockholm), *O. Lindahl* (Stockholm), *L. Hult* (Stockholm), *J. Agerholm-Christensen* (Oxford), *C. Hirsch* (Upsala).

OPEN REDUCTION AND OSTEOSYNTHESIS ON MEDIAL FRACTURES OF THE FEMORAL NECK

by *Olle Thorén* (Upsala)

DISCUSSION:

S. Wiberg (Lund), *O. Thorén* (Upsala).

ANTEVERSIO COLLI FEMORIS

by *Ivar Alvik* (Oslo)

DISCUSSION:

O. Löfgren (Stockholm), *E. Severin* (Göteborg).

FRACTURES OF THE TIBIAL SHAFT

by *Per Henrik Widmark* and *Göran Bauer* (Malmö)

An account of the preliminary results of an investigation comprising 175 tibial shaft fractures from 1950 to 1956.

The final results of the investigation will be published in Acta Orthopaedica Scandinavica.

DISCUSSION:

J. Spotoft (Kalundborg, Denmark):

I appears evident that this is a problem of sunken union of the osteosynthesis with Lane plate and screws.

It does not need to be a problem. In transverse fractures (and it is these we are concerned with) when the fracture is reduced and fixed with Lane plate, applied to the lateral surface of the tibia, a sliding graft is prepared, sawn out with a double saw from the subcutaneous medial surface of the tibia: one third of its length is below the fracture site and two thirds above. The graft is then turned so that the longer part will lie across the fracture site. The whole procedure takes a few minutes only.

J. Palmer (Stockholm), *E. Moberg* (Göteborg), *J. Ernst* (Copenhagen), *S. v. Rosen* (Malmö), *H. Wahren* (Eskilstuna), *H. Holmdahl* (Linköping), *P. H. Widmark* (Malmö), *G. Bauer* (Malmö).

SURGICAL CASE OF ATLAS SUBLUXATION

by *Bengt Eriksson* (Boden, Sweden)

A case of recurring spontaneous atlas subluxation treated by means of fusion C_1–C_2 is reported. A short summary of the etiology and treatment of the atlas subluxation is given.

The case will be published in Acta Orthopaedica during 1959.

ARTHROGRAPHY AND EXPLORATION OF RIGID SHOULDER JOINTS

by *Anders Lidström* (Upsala, Sweden)

DISCUSSION:

P. Linton (Mölndal), *E. Severin* (Göteborg), *H. Sjövall* (Örebro), *E. Moberg* (Göteborg), *I. Alvik* (Oslo).

ARTHROGRYPOSIS MULTIPLEX CONGENITA

by *O. M. Hansen, E. Hj. Larsen and L. Zachariae* (Copenhagen)

By arthrogryposis multiplex congenita a congenital disease is meant which is characterized by defective function of the extremities owing to contractures and malpositions in several joints combined with soft tissue changes. There is often found at the same time patellar dysplasia, hip luxation, contraction of the skin

around the joints, pterygium, hypoplasia of the lower jaw, together with pareses or dysplasia of the muscles.

From the Orthopaedic Hospital in Copenhagen come 44 cases of arthrogryposis multiplex congenita. These are divided in 2 groups: the older group, conservatively treated, and a younger group treated according to the author's own principles. The lower extremities are most often attacked. Furthermore a survey is made of the distribution of causative changes in this series.

It is pointed out that the status of the joint on examining the conservatively treated older cases is the same as at birth. Tenotomies and bone operations were previously the only operations undertaken.

The new principles consist in early, radical, but function-preserving soft tissue operations on the contracted structures. Thus we have always preferred to lengthen tendons rather than cut through them, and we have only cut joint capsules, fascia and suchlike.

In the short observation period we have obtained encouraging results and in particular in several cases we have reaches the point where apparently unusable muscles could be trained to acquire a certain function following removal of the contractures and lengthening of the tendons. In a few cases it was impossible to correct flexion contractures owing to stretching of vessels and nerves.

It is the purpose of the authors to continue with the outlined methods of treating arthrogryposis multiplex congenita, i.e., correction of the contractures by early soft tissue operations with following energetic excercising of the muscles.

DISCUSSION:

H. Holmdahl (Linköping), *J. Lou* (Kolding), *G. Wiberg* (Lund), *Hj. Larsen* (Copenhagen), *O. M. Hansen* (Copenhagen).

SPONDYLOLISTHESIS WITH ISCHIAS

by *Bertil Holmquist* (Malmö, Sweden)

A series of 64 cases with spondylolisthesis is presented. There was spondylolysis alone in 2 cases. Ischias trouble occurred in 24. Treatment was first of all conservative. 14 cases were treated surgically. Before 1956 6 had the fusion operation combined in 1 case with extirpation of the disc prolapse. After January, 1957, laminectomy ad modum Gill was employed in 7 cases. In 1 case only one disc prolapse was extirpated. The results have been good on the whole. The average period of care as well as the period before work begins was in the case of the Gill-operated patients half the corresponding time for those operated on by fusion.

DISCUSSION:

E. Laurent (Helsingfors), *E. Severin* (Göteborg), *Hj. Larsen* (Copenhagen).

EXPERIENCES WITH OPERATIVE TREATMENT OF SPONDYLOLISTHESIS

by *Lars Erik Laurent* (Helsingfors)

During the period 1944–1956, 809 cases of spondylolisthesis or spondylolysis were observed at the Orthopaedic Hospital of the Invalid Foundation. 85 patients (10.5

per cent) were treated surgically. Of these, 59 (69 per cent) had sciatica, 25 having jerk disturbances. A combination of symptoms which could be explained as root syndrome occurred in twelve cases. In 45 explorations or laminectomies, disc protrusion was present twice and adhesions to nerve roots six times. Direct compression of roots due to the fibrocartilaginous tissue in the part interarticularis was not observed. The author's opinion is that whilst in certain cases root irritation due to the fibrocartilaginous tissue may occur, in most cases it is the instability of the spondylotytic vertebra which is responsible for the root irritation. The low back pain probably emanates from muscles, ligaments and intervertebral joints. The instability seems to increase in some cases after laminectomy without fusion.

Of the 85 cases which were treated surgically, 77 underwent follow-up examination. Dorsal fusion with or without exploration was made in 44 cases, ventral transperitoneal fusion in 7 cases and laminectomy without fusion in 26 cases. The length of follow-up was 3–10 years for the fusion cases and 1–2 years for the laminectomy cases. Primary consolidation of the graft was achieved in only 19 cases (37 per cent), uncertain union or non-union occurring in 32 cases (63 per cent). The functional results were satisfactory in many cases, however, despite uncertain union or non-union. The results of treatment with fusion were clearly better than the results of laminectomy without fusion. Satisfactory results with fusion were obtained in 44/51 cases (86 per cent), after laminectomy in 17/26 cases (65 per cent). The degree of slipping did not influence the results. The observations indicate that laminectomy without fusion should be performed only in exceptional cases. Of all the 77 cases followed-up satisfactory results were achieved in 61 (79 per cent). The indications for operative treatment are longstanding pain in the back or sciatica, which are not relieved by conservative treatment. Such treatment should always be tried first. In the case of olisthesis in adolescents with danger of total displacement of the vertebral body fusion is indicated. Progression can not always be prevented, however, despite fusion treatment.

DISCUSSION:

H. Støren (Stavern):

That the operation for spondylolisthesis should not always be given the credit of a good result will be seen from a small example which I shall give.

A girl aged 20 was operated on for spondylolisthesis with back pain—transperitoneally ad modum Burns. She became painfree and the spondylolisthesis showed no slipping after 8 years, but at the same time the X-ray shows that there is complete resorption of the transplant in the intervertebral space. In oher words one may assume that she would also have been pain-free if she had not been operated on.

In parenthesis I should like to add that I have employed transperitoneal fixation of corpora in spondylolisthesis and other diseases in 24 cases (discussed in Oslo Surgical Association) but only this case operated on ad modum Burns. In the other cases a solid bone block was used in a broad channel in the two vertebral bodies and intervertebral disc. In these cases solid bone formation arose.

S. von Rosen (Malmö), *C. Hirsch* (Upsala), *E. Severin* (Göteborg), *I. Alvik* (Oslo), *P. Lütken* (Aalborg), *G. Wiberg* (Lund), *Ståhl* (Lund), *H. Sjövall* (Örebro), *L. E. Laurent* (Helsingfors).

NEUROLOGICAL COMPLICATIONS FOLLOWING MYELOGRAPHY

by Lennart Söderberg, Sven Sjöberg and *Per Langeland* (Malmö, Sweden)

Neurological complications following myelography with Abrodil (contrast U 20 % "Les") have not been reported. At the X-ray clinic in Malmö during the last six years myelography with Abrodil has been performed on about 760 patients, admitted to the Orthopaedic clinic, Malmö, with the diagnosis of disc herniation. In consequence of the myelography neurological complications arose in three cases. The patients were three men aged 39, 43 and 53. In each case disturbances of sensibility occurred of the riding breech type, with incontinence of bladder and bowels together with sexual impotence. These neurological disturbances diminished very slowly. Complete recovery of bladder and rectal function occurred in one case only. In this case deterioration of sensibility remains perianally (observation period 2 years), in the other two cases minor degrees of bladder and bowel function paresis still exist (observation period 1½ and 1 year).

The paper will be published in somewhat altered form in Acta Orthopaedica Scand.

DISCUSSION:

T. Hiertonn (Stockholm), *C. Hirsch* (Upsala), *G. Wiberg* (Lund), *N. Lindström* (Härnösand), *H. Sjövall* (Örebro), *S. Cronqvist* (Lund), *P. Lütken* (Aalborg), *E. Hj. Larsen* (Copenhagen), *S. Scheller* (Göteborg), *L. Söderberg* (Malmö).

THE MYELOGRAM AFTER DISC OPERATION

by *Sten Cronqvist* (Lund, Sweden)

DISCUSSION:

N. Lindström (Härnösand), *C. Hirsch* (Upsala), *S. Cronqvist* (Lund).

MEASURING OF INTRADISCAL PRESSURE

by Alf Nachemson (Upsala)

DISCUSSION:

C. Hirsch (Upsala), *H. Sjövall* (Örebro), *A. Nachemson* (Upsala).