H. CAMITZ, GOTHENBURG:

INSUFFICIENCY STATES, MUSCULAR CONTRACTURES AND ARTHRITIS DEFORMANS

When continuously engaged with pathological conditions of the static system it behoves us to systematise in order to get the various clinical pictures clearly demarcated. In so doing we shall soon find that a definite relationship exists between insufficiency states, muscular contractures and arthritis deformans, a subject I have wished to get the opportunity of discussing with the colleagues here present.

As early as in the autumn 1933 I published in Acta Orthopaedica an article under the title: »Die deformierende Hüftgelenksarthritis und speciell ihre Behandlung«. In that article I referred to the present question and gave an account of my views on this joint. I would now like to deal with this problem a little more in general and to start with I would then say that as soon it is a question of our joints I attach greater importance to what I would like to call the functional pathology than to the patho-anatomical and roentgenological pathology.[1])

Above all we must keep in mind that the purpose of a joint is to function, and this in a correct manner. A joint kept immobile eventually becomes damaged but even a joint that can be moved normally in all directions but *one* suffers from this since the static system is disturbed in its function. In a restricted

[1]) This is something that has been emphasized many times before, among others by *Haglund* in Acta Orthopaedica vol. I, 1930, in an exceedingly important work: »Über chronisch defekte Gelenke«; it cannot, however, be emphasized too often since it is even of fundamental importance for the proper care of the joints of man.

sense the joint is insufficient and if the lost movement is not regained the reduced mobility becomes gradually increased and before long the patient will complain of the joint feeling stiff and of getting tired on moving about and exerting himself. Eventually he suffers pain.

The body itself tries to stabilize an insufficient joint, partly through abnormal use of the muscles, partly through deforming changes arising in the joint.

Thanks to prolonged and painstaking work in every country we now know, particularly through *Pommer*'s investigations, the initial microscopical changes of arthritis deformans. The process commences by the elasticity of the articular cartilage becoming reduced in some way or other, often through some minor injury whereby the underlying bone becomes exposed to all the minor traumata continuously encountered in our daily life. This causes activation of the quiescent subchondral marrow; this becomes cellular and rich in cells and from the bone marrow vascular branches enter the cartilaginous layer bordering on the bone. The bony system is getting ready to respond to the increased stress.

Thus new bone is formed which may subsequently become more and more deposited in a direction of the cartilage surface. The process may also become arrested before the ossification of the cartilage has taken the upper hand. Should the superficial layer of the cartilage get lost this is due to, as Burchardt says, »teils durch Absleifung, teils durch die sich fortsetzende Verknocherung«.

Marginal outgrowths arise through vascularization and ossification of the marginal parts of the cartilage. The old term osteophyte is therefore, according to *Pommer,* inaccurate since the marginal outgrowths are a direct extension of the bony trabeculae.

A joint may become impaired either through some primary injury to the musculature appertinent to the joint or on account of some primary damage to the joint itself, i.e. its capsule, cartilage or its bony parts.

We must always keep in mind that the static system is made

up of skeleton and musculature forming a uniform system and greatly dependent on one another!

An injury of some kind or other may cause for instance a pain on account of tearing of a muscle. Movements pulling on this muscle give rise to pain wherefore the patient by every means tries to avoid such movements. She makes use of her muscular system as far as possible in order to prevent the joint, by increased tension of the muscles surrounding it, from moving. Should this muscular contraction persist for a longer time a contracture arises, the joint becomes immobile at least in one direction, the joint cartilages get out of function, their elasticity diminishes, a whole lot of minor traumata cause activation of the bone-marrow and a deforming process is under progress.

But it may also take place in a different way, let us for instance *consider the back.* It is far too common to take for granted that we all possess qualitatively the same good skeleton. Certain it is, at any rate, that a work one person is able to carry out for a long time without any ill-effects, another person may only be able to do for a short time.

To start with, however, a person with a so to speak qualitatively poor skeleton may clear up a work which is really too much for her. She must then however use the reserve power of her musculature. This can at first be done without discomfort but a muscle too often used more than it is really meant for gradually passes into a permanent contraction, a contracture. When such a contracture has arisen the musculature is no longer under the influence of the will, we are then unable to relax it after work has ceased. It will be readily understood that in this case the joint cartilages of the vertebrae get out of function, their elasticity diminishes, the minor daily traumata above mentioned cause activation of the quiescent marrow which becomes rich in cells and greatly vascular; a deforming process is then under progress.

The cardinal symptoms in such an overstrained spine are fatigue and pains in the back, a pain radiating into the chest, abdomen and the extremities, perhaps both in arms and legs. In addition these patients generally present a picture of neuras-

thenia, i.e. they suffer from depression, rapid exhaustion, sleeplessness and so on.

Clear it is that a short muscle that happens to be the seat of contracture cannot produce any more marked scoliosis, such as for instance in cases of large sciatic scoliosis. In these cases we have to consider the lumbar portions of M. sacrospinalis and M. longissimus dorsi besides M. psoas major (Plate) which have long and powerful muscular bellies. Another condition is probably that the contracture should be unequally severe on both sides; in the case of equal tension on both sides of the spine we get no scoliosis though an abnormal lordosis is then of common occurrence.

That a hard muscular contracture gives rise to intensive pains does not seem to me difficult to understand, nor does it seem to require any round-about way explanations. Not even the radiating character of the pains seems to me to offer any particularly peculiar phenomenon. Thus we know well enough that for instance in a case of cholecystitis the patient may refer his pains rather a long way from the gall-bladder or the bileduct, e.g. to the left of the epigastrium.

Schanz says that the greatest practical importance of the trauma is the way it reduces »Die Tragfähigkeit« of the damaged skeletal part. Should thereby the stabilization become disturbed we get as a direct consequence an insufficiency disease. These cases are difficult to diagnose since there is no clear-cut demarcation between the disturbance brought about by the trauma and the insufficiency directly caused by the trauma. In what way this inpaired weight-bearing capacity arises a roentgen examination generally informs us, in that we find the appearance of Sudeck's calcium atrophy, a phenomenon really continuously encountered.

Christen Lange, a Danish observer, found on testing that an injured vertebra had a surprisingly small capacity for enduring stress although no naked-eye damage could be detected, and *Schmorl* has shown that large parts of the marrow of a damaged vertebra may undergo necrosis without any visible external signs thereof.

Schanz maintains that the hour-glass shape often encountered in lumbar vertebrae in men doing heavy work is an expression of an attempt on the part of these vertebrae to adapt themselves to increased stress.

Insufficient vertebrae are therefore the result of a disproportion between the stress and strength of the spinal column. To my mind then, says *Schanz,* it seems obvious, not only that anatomical changes may cause insufficiency diseases but also that anatomical changes may arise as a result of insufficiency diseases. Finally may anatomical changes be formed as »Abwehrprodukte« of the diseased organism, in the first place then deforming changes.

Spondylitis deformans is generally considered a disease sui generis. This is far from the case. This was pointed out already long ago by *Benecke* as well as *Schanz.* On the contrary deformed changes are a kind of physiological phenomena. It is an expression of Nature's effort to build up the skeletal system, to increase and stabilize its capacity of withstanding stress. *Schanz* states that should a technical expert be charged with the task of stabilizing a »Tragsäule« such as the spine, the supporting device would be of exactly the same kind as that we now see on our radiograms. Schanz's publication will be found in Langenbeck's Arkiv Bd. 139.

The usual procedure of this process is that at first the entire reserve power of the musculature is gradually put in, one stage after the other. In the meanwhile the deforming changes begin to appear, subsequently increasing in extent. When these changes have reached a sufficient degree for stabilization to take place, the musculature may be relieved of its stress; powerful muscular contractures may, however, persist for a long time and give rise to pains.

As causative factors I would in the first place mention traumata and inflammations of various kinds, new growths, metabolic diseases and disturbances in the ossification, with as well as without resulting deformities. It is of exceedingly common occurrence that patients, in the belief of doing the right thing, try to spare, as it is called, a joint that has been exposed

to some injury or been subjected to some surgical operation and it is far from unusual that in so doing they are encouraged by their medical attendant. If the joint is put out of function, ordinary stress as well as every-day movements being thereby left out, Sudeck's calcium atrophy will be seen before long to arise, at the same time as the reserve power of the limb, the musculature, generally begins to undergo atrophy. Should one wish, for as short a time as circumstances permit, to spare a joint, a great deal is gained by letting the patient, while in bed, freely move his limb. Is the leg to be used the patient should be encouraged to use the one as much as the other, is one of them to be spared, its fellow should be spared to an equal extent.

If some part has to be put into plaster, e. g. an ankle-joint, it is of advantage if the patient can be permitted to put weight on his foot but this should be done as early as possible.

It is sometimes argued that insufficiency states often occur without any signs of deforming arthritis being present. This is of course quite correct because the insufficient condition must be present for a sufficiently long time for the deforming process to get going and reach a certain development.

Finally deforming changes may also be observed although no insufficiency state can be said to be present. This must not be misunderstood. A severe state of insufficiency has then been present, which has gradually been overcome, may be on account of the deforming changes.

If this theory is correct the proper treatment can only be one and may be summarised in the words »*rest and unloading*« and we may possibly add, combat the muscular contractures and prevent them from arising.

Not to trouble you with too many details I shall entirely pass the upper extremities and only be dealing with the trunk and lower limbs.

As we all know insufficiency states of the back are one of the commonest static disturbances in existence and the sovereign treatment is to apply a well-fitting jacket of cloth, celluloid or leather, quite particularly is treatment by jacket indicated in the presence of so-called sciatic scoliosis. Severe pains rapidly

abate, the patient is in no need of any hospital treatment and the whole period of treatment seldom lasts more than 3 months, often 6—7 weeks. In males with unyielding scoliosis and powerful musculature I apply under anaesthesia a large plaster case from the axillar down to the knee-joint. In this way the patient is corrected in one stage and put straight in a few weeks time, confinement to bed for several months is thereby avoided. As soon as the patient is straight he is allowed to get up, still, however, wearing his jacket for whatever time it is necessary.

It stands to reason that a great deal of muscular tension of various degrees and duration should occur. It is equally clear that such muscular tensions need be of no account to the patient except giving rise to discomforts for some time. It is quite a different matter if the contracture becomes permanent and of special interest it seems to me that each joint has got its own typical contracture which is always seen to recur. Time only permits me to deal with this in a summary manner and I shall begin with the hip-joint.

Since I shall only be recapitulating what has already appeared in Acta Ortopædica I shall only here give a brief outline of it. Causes are: trauma, static impaired conditions, overstrain and deformities arisen in childhood, in the first place coxa plana.

The first subjective symptoms are the common complaints of insufficiency, fatigue and stiffness. Purely in a reflex manner the patient seeks support for his weak hip and this he attains by putting the leg in a position of adduction whereby the pelvis is supported by the femoral diaphysis.

To start with the patient assumes this enforced position only for a short while when he is tired but the worse the joint becomes, the more frequent this posture recurs, finally to become constant. This adducted position may become extremely severe, I have seen a case where (the case was bilateral) the patient adopted the scissor-leg position. This is unusual but all of us have probably seen bilateral cases walking in a so-called narrow-gauged manner. They put their feet in front of one another, the front one exactly covering the one behind. This

causes the balance to become uncertain wherefore they try to make up for this by rotating the foot outwards, a position that finally leads to a permanent outward rotation. In such manner we get the persistently recurring enforced position in arthritis deformans of the hip-joint.

By this enforced position the patient is able to take off weight from the limb. The leg is felt to be shorter which of course practically speaking is the case and the time it has to bear weight in walking will also be brief. This means increased work for the healthy side which in its turn predisposes to deformity also of this hip.

Even if this adducted position affords a certain relief it is only for a short time. It is soon succeeded by a continuous pain in the contracted adductor muscles, the pains being localized to the muscular insertions on the pelvis, thus in the region of the groin. It stands to reason that the patient moreover should be troubled by discomforts in the joint, at any rate in all more advanced cases, but these are of mild nature and do not disturb his night's rest. The pain of the contracture is generally the most troublesome. This contracture must be energetically fought against and the earlier this can be done, the more hopeful is the outlook to retain for many years through vigorous treatment a useful joint.

I therefore advise the patient the following simple operation, myotomy of the pectineus and resection of the obturator nerve, both carried out at one sitting; for further particulars I wish to refer to the publication already mentioned. The operation is followed by a course of baths and massage treatment which treatment the patient is encouraged to repeat annually once or twice.

Time does not permit me of submitting any actual cases in illustration but I have formed a favourable impression of this method and I would repeat again that when we are unable to eliminate weightbearing from the hip-joint, we must at all costs prevent the loss of any one movement in the joint, lest we should ultimately lose every movement, with consequent ankylosis. In order to replace to some extent the qualitatively poor

skeleton the muscular power must be maintained as intact as possible, this being the patient's last reserve.

I shall now pass on to the knee-joint. This is one of the most sensitive joints in the body and it may be questioned whether insufficiency states of various degrees, from slight atrophy of the quadriceps muscle to advanced stages of arthritis deformans, occur as frequently in any other joint. Early treatment plays a very great role here. Above all is it of importance to arrange so that the patient can maintain his power of extension, and this so completely that hyperextension, present in all infants, may be retained. The advice to these patients must therefore be: stretch the knee-joint, stretch continuously, those who can maintain the overstretching need have no fear of their knees becoming stiff and unyielding. From what I have said it is evident that in the knee-joint it is the flexion contracture that is the deformity dreaded above everything else and that must at all costs be fought against.

As in the hip-joint there is contracture of the adductors and atrophy of the abductor muscles, so do we find in the knee-joint contracture of the flexors and atrophy of the extensor muscles. In my experience a flexion contracture of more than 20° can rarely be overcome without operative correction. The most usual method in these cases would seem to be trying to prevent atrophy of the quadriceps from arising through an early course of baths and massage treatment; this is in most cases successful.

In those cases where surgical correction must be tried, the flexion contracture must not, however, be too great, at most 40°—50°. In these cases one should begin with doing a plastic fascia lata operation, attaching this to the patella whereby the M. tensor fascia lata is entirely transformed into an extensor muscle and the firm contracture at the outer side of the knee-joint is freed. This method is described in Acta Chirurgica vol. LXV, 1929. In this way an extension of 20°—25° may often be gained but rarely more. In more severe cases it will therefore be necessary about 4 weeks later to do a capsulotomy in the popliteal fossa as suggested by *Putti* (La Chirurgia degli organi

di Movimento 1921); thereby we generally also get the last 20°—15° corrected. In very severe flexion contractures we nearly always fail to correct the last 5°.

If we then pass on to the ankle-joint we shall find that insufficiency states in the anterior astragaloid articulation are of common occurrence. The insufficient foot is a flat-foot, but this does not imply by any means that all flat-feet are insufficient. Sooner or later the risk of this is, however, very great wherefore they should always, as soon as discovered, be relieved of weight-bearing. Where an insufficiency state has arisen the patient is complaining of fatigue, stiffness and aching pains. The pains may be due either to a position of subluxation in the anterior astragaloid joint with abnormal stress of capsule and ligamentous apparatus, or else to contracture pains as a result of the severe contracture present in the peroneal muscles and the extensor brevis digitorum.

Many a time after admission of such a patient with flat-foot under contracture we find, particularly in young people, that the contracture relaxes after rest in bed for a couple of days. Then is the time to relieve and correct the joint by some suitable appliance.

Should the contracture fail to relax by itself we have to relieve it as quickly as possible, more so if a radiogram shows that no deformity has as yet taken place. This should not, however, be done by manipulation over wedge or osteoclast.

Those who practise this method will only be provoking a deforming arthritis and will cause the contracture, one wished to relieve, to become before long still more severe than prior to the so-called treatment.

Correction should be done by open operation and as cautiously as possible for the anterior astragaloid joint. By a straight incision extending from the achilles tendon obliquely across the external malleolus one can easily manage to lengthen the peroneal tendons a bit up the leg. At the same time I am able to sever the lateral ligamentous apparatus and detach the extensor brevis digitorum from its upper insertion at the ankle-joint. After that, yet not always, it is generally easy to supinate

the foot. Sometimes a bony ridge has formed at the lateral border of the scaphoid and many a time this has to be removed before free supination can take place. The operation is concluded by merely suture of the skin. The patient is put in plaster for a month, this being followed by application of pressure through individually made inlays, massage etc.

Should a well-marked deforming arthritis be present I prefer to carry out arthrodesis of the anterior astragaloid articulation.

Finally I would like to say a few words about hallux rigidus.

This is the way I picture to myself the course of events: a person has sustained some injury and afterwards the big toe is unable to stand weight-bearing. The patient has difficulty in bending his big toe and is thus unable to take off the ground since this causes pain. The result is a strained sort of gait. Should it be impossible rapidly to overcome the contracture arising in the flexor hallucis brevis, the mobility in the big-toe joint will be arrested and a deforming arthritis arise. It may of course happen that the skeletal parts have been chiefly injured and less so the muscles, or vice versa, on the whole the course of events will be about the same. The medical attendant will seldom see the patient until a considerable stiffness and contracture have begun to develop in the short plantar flexor of the big toe.

In this case too the contracture has to be removed in the first place and the big-toe joint relieved of stress; the latter is done by a hand-made foot-inlay, the former operatively by either severing the attachment of the flexor hallucis brevis from the cuneiform bone or else by dividing the tendinous attachments from the sesamoid bones. The foot is then put into plaster with the big toe in strong dorso-flexion. The plaster is kept on for 17—18 days. No other after-treatment is required but a suitable foot-inlay.

In the case of the deformity being very severe some plastic operation may prove necessary.

With these words I have on the whole said what I intended to say and even if a few words might also have been said about especially the shoulder-joint I hope nevertheless it will be pos-

sible for me on some future occasion to return to the subject a little more fully. As a preliminary communication I trust this may have some justification.

DISCUSSION:

P. Haglund, Stockholm:

To an old orthopaedic surgeon who during his soon concluded period of teaching, in speech as well as writing, has always laid stress on the biologico-functional standpoints as dominating the mechanico-morphological and anatomical, it was a pleasure to listen to Camitz's paper. On the problem of contracture Frising and Kahlmeter, besides myself, have adopted a functional view. I am very happy to say that our idea of this problem—one of the most central in orthopaedics—has been quite revolutionised in the course of the past 25 years.