FROM THE ORTHOPEDIC HOSPITAL, GOTHENBURG
(CHIEF: H. CAMITZ, M. D.)

VERTEBRAL INSUFFICIENCY[1])

BY
H. CAMITZ

Schanz has dealt thoroughly with this disease, in several papers as well as in his textbook of 1928. In fact, as is well known, it was Schanz who first set up the theory about the development of this condition. To begin with, he met opposition from nearly all quarters and in a comprehensive paper from 1921—»Die Lehre von statischen Insuffizienz Erkrankungen mit besonderer Berücksichtigung der Insufficientia vertebræ«—he replied his opponents convincingly.

In this paper, which deserves far more attention than has been paid to it, Schanz sets up the following axiom which is just as difficult to prove as $2 \times 2 = 4$. It says: »Die zum Tragen des aufgerichteten Körpers dienenden Skeletteile besitzen normalerweise zur Erfüllung dieser Aufgabe erforderliche Tragkraft«.

Schanz emphasizes that the body in erect posture normally is in »static stability«, *i.e.,* balance between the stability of the static system of the body and the load placed upon its functional capacity. If the balance is lost, the result is a more or less pronounced degree of static insufficiency. The individual becomes ill, and certain typical symptoms make their appearance.

Static insufficiency may involve the ankle joint as well as the knee or the hip, but the symptoms of insufficiency involving the back are quite particular—and it is them I shall deal with in this paper.

---

[1]) Read at the joint meeting of *Nordisk Kirurgisk Förening* and *Nordisk Ortopedisk Förening*, at Gothenburg, 28/6 1937.

A disturbance of the loading balance may be due to one or two factors:

1. The load is increased above a certain level.
2. The loading tolerance of the static system is lowered—for some cause or other.

Of course, both factors may be contributory at the same time: overloading and lowered resistance of the static system.

It is safe to say that every one of us has personally been a little acquainted with the condition of acute vertebral insufficiency. We have strained ourselves on some occasion, and afterwards we have noticed a sensation of stiffness and tiredness over the loins. We feel that we have to rest, and next morning all the inconvenience is gone, in most instances.

Naturally, this acute stage may go on to a chronic stage, when the loading balance is disturbed continuously for a considerable length of time. Then, there remains after resting—for instance in the morning—a sensation of tiredness and stiffness in the lumbosacral region. If the balance keeps being disturbed, pain begins to appear, radiating forwards to the abdomen often along the rim of the pelvis, with pain also in one or both hip regions, radiating even down in the legs. These are the pains which long have been designated as sciatic neuralgia, not only by laymen but also by medical textbooks.

People suffering from this insufficiency of the back carry themselves stiffly and have difficulty in walking any considerable distance. They are not able to sit comfortably in a chair; often it seems as if they had swallowed a poker. They are unable to stand for any length of time without leaning against something (*e.g.*, a wall or a table) and they put a hand or an arm to the back. When sitting in a chair they even want some support for the arms. This sensation of inability to keep erect brings about a mixture of nervous and mental symptoms. The patients are depressed, are less keen to work, complain of headache, and are troubled with vague discomforts in various parts of the body; besides their rest at night is disturbed. They are unable to rest on the back, but have to lie on the side, and in pro-

nounced cases they even have trouble in turning around in bed.

Schanz thinks that this condition involves a direct effect on the central nervous system, to which opinion I cannot subscribe. Certainly, I have observed all the nervous symptoms just mentioned, but we have to take into consideration that most of these patients are highly neurasthenic, all too easily affected by difficulties and adversity, and as a rule all these symptoms are of transitory nature, subsiding as soon as the insufficiency is eliminated. One feature is common to all these cases: in the initial stage of the disease as well as in the more pronounced stages, the discomfort increases with increasing load and decreases when the trunk is relieved of its strain.

The condition are very characteristic in the usual form of spondylitis deformans. Several of these cases are associated with severe complaints of discomfort and pronounced clinical symptoms reminding of a condition of chronic inflammation. On the other hand, some cases show roentgenographically a rather advanced degree of deforming spondylitis with complete absence of subjective and clinical symptoms.

The explanation of this is simple. The skeletal deformity is merely an expression of the attempts of nature to restore the normal stability to an insufficient part of the skeleton. If the organism succeeds in this attempt at repair, all the symptoms of insufficiency disappear, and the patient enters a quiescent stage without discomfort—as when a cardiac defect has been compensated.

This problem, which has been the subject of much and heated discussion, was solved already in 1897, when Bencke published his »Zur Lehre von der spondylitis deformans« (Beiträge zur Wissenschaftlicher medizin. Festschrift an der 59. Versammlung deutscher Naturforscher und Ärzte. Braunschweig 1897). It will be appropriate, I think, briefly to review this monograph which has been so important to our understanding of the deforming processes.

Bencke looked upon the continuous overloading of the vertebral column by heavy manual work together with senile nutritional disturbances as the cause of the phenomenon known even

from ancient times, the first pathologic-anatomical sign in the intervertebral disc: the so-called »braune Erweichung«. This phenomenon is later followed by other degenerative changes, while a reparative process goes on at the same time. As a result of this damage, the intervertebral disc looses its elasticity and is no longer able to fulfil its important task as a buffer.

Bencke points out that the vertebral column becomes shorter during the day and then regains its normal length during the night. So, not even the sound intervertebral disc is in possession of any absolute elasticity. As the elasticity decreases the margins of the intervertebral discs project beyond the edges of the vertebral bodies, especially as the load, the pressure, is greatest at the periphery. The cartilagenous disc becomes more flat and wider than normally.

With this decrease in the elasticity of the discs, every forceful impact against the vertebral column will be transmitted from vertebra to vertebra instead of being intercepted and reduced. According to Bencke, this conditions results in a functional strengthening of the affected parts—a process of reparation. The structures of the vertebral bodies are undergoing a rebuilding at the same time as a new-formation of bone takes place along the edges of the vertebral bodies, with variations depending upon the site and the degree of the increased strain.

Time does not allow me here to enter into the question of spondylitis deformans. I shall merely point out that it took 18 years before Pommer, who fully subscribed to this functional theory, completed the elaboration of this view with his great monograph (»Mikroskopische Befunde bei Arthritis Deformans«. Denkschriften der Kaiserlich. Akadem. der Wissenschaften. Matemat. Naturwissenschaft. Klasse Wien 1914).

From these remarks, I think, it will be evident that I regard all these phenomena—from simple lumbago (a crick in the back) to advanced deforming spondylitis—as different stages of the same morbid process, the affection which Schanz designated as insufficientia vertebræ. My having taken a live interest in these questions through a number of years, is largely because I have myself gone through several stages of this affection. Only for

the benefit derived from Schanz' corset treatment have I been able to keep on with my work. Even now, to-day, I should not be able to stand at the operating table if I did not wear the corset. Thus, I am able to speak of this treatment both as a patient and as a physician.

Since autumn 1928, I have consistently carried through the corset treatment of such cases, and with good results. In 1929, we manufactured here in the bandage department of this institution altogether 200 corsets of cloth, leather or celluloid. In 1936, we distributed over 400 corsets, not including cloth corsets. I have now a patient material of this kind which I estimate approximately as about 2000 cases. This material is rather difficult to survey, and a casuistic investigation of this material covering cases from the first 5 years of this period has not been carried through yet; it cannot be finished till this coming winter.

As I have emphasized the significance of the loading balance in all persons, I think it will be necessary here also to look into the result of a fracture or an infection of the vertebral column.

Fracture of the vertebral column need not necessarily produce an insufficiency of the spinal column, even though it often gives symptoms of insufficiency. From the investigations reported by J. Åkerman (Acta chir. Scandinav., 1932, p. 28) we know that of 304 cases of vertebral fractures notified to the State Insurance Council during the 10-year period of 1918—1927, the outcome was fatal in 22 %, while nearly one half of the remaining cases recovered. The rest, or 41 %, is made up of more or less disabled persons, many of whom will remain invalids throughout life. Hence, only the physician who is treating the patient in question will be able to decide whether or not the patient is in need of a corset. I have had the experience that the consulting physician of an insurance company would not allow corset treatment. This strange behaviour of the physician, which shows a peculiar want of experience, was refuted, and now the patient is under corset treatment.

It is quite evident that insurance companies and their physicians lay all too great a stress upon the findings presented by roentgenograms. We are still wanting adjuvants by which we

may have an opportunity after an accident to examine also other vertebræ besides the fractured.

Christen Lange, a Danish investigator, has studied the stability, *i.e.*, resistance to pressure, of vertebræ (»Untersuchungen über Elasticitätsverhältnisse in den menschlichen Rückenwirbeln«, Zeitschrift. f. orthop. Chir., Band X). For the sake of comparison, Lange examined regularly the 10th thoracic vertebra. In his material he had one vertebra from a young strong working man who met with a fatal accident. This vertebra appeared to be perfectly uninjured, but when it was tested in the press its resistance was greatly lowered (»Dieser Wirbelkörper zeigte in der Druckmaschine eine ganz ausserordentliche Verminderung der Tragkraft«). It is obvious that a traumatic injury to the vertebral column may give one or several fractures visible in the roentgenogram, and also damage to the intervertebral discs, besides something I should wish to designate as internal vertebral injuries (hæmorrhages and rupture of trabeculæ in the spongiosa), which give no roentgenographic signs, but rather clinical symptoms. Patients with the last mentioned injury are still met as simulants and loafers—a social injustice, revolting to anyone who sees such patients again and again.

On the whole, the conditions are similar during or after an infection. The process may or may not give symptoms of insufficiency. In the presence of such symptoms the patient should be treated with corset till the loading balance is reestablished.

There now remains briefly to touch upon the result of deformities and insufficiency symptoms in the lower extremities.

Since Lindstedt's paper in 1920, flat-foot, knock-knee, etc. have been regarded as apt to produce the so-called sciatica.

Of course, I have seen patients suffering from vertebral insufficiency who were also flat-footed, and I have asked myself in every instance if the finding of this defect may be of any significance. How is it possible that a non-fixated flat-foot may give symptoms of vertebral insufficiency, when I have never seen —and nobody has ever pointed out—that the contracted flat-foot should constitute a special onus in this respect. At any rate, neither the deformity nor the pain may be the decisive factor,

for they are usually rather marked in the contracted pes planovalgus.

More attention, I think, deserves to be paid to the conditions prevailing after an amputation on the lower extremities.

In Sweden no physicians meet so many cases of amputations as the physicians of the orthopedic hospitals. We see them not only shortly after the operation but also, from year to year, as long as they live. They come to us with too wide or too short, ill-fitting, protheses that ought to fulfil all requirements for bringing about faulty static conditions in the trunk and the sacrolumbar region. Yet, in 17½ years I have only seen two or three cases of vertebral insufficiency of this kind.

Therefore I feel very doubtful about the Lindstedt hypothesis and its justification. I do not believe that a flat-foot plate is of any therapeutic value in a case of the so-called sciatica, but this does not exclude, of course, that the flat-foot must be corrected anyhow.

On the other hand, I think, that the common difference in the length of the leg is of some etiological significance. Generally we are used to look upon a symmetrical development of the two halves of the body as a normal thing and deviations from this rule as infrequent phenomena. This is not correct, however, as far as the length of the legs is concerned. On the contrary, it is a very common thing that one leg is from a half to two centimeters shorter than the other. Greater differences are rare. To me it seems only natural that a difference in the length of the legs with a resulting obliqueness of the pelvis may give disturbances in the balance, at any rate if the back is already overtasked by strain and a condition of insufficiency is threatening to develop.

Turning to the sacrolumbar region, we find certain congenital malformations that may play a role in disturbances of the static stability. I was thinking especially of spondylolisthesis, occult spina bifida, lumbalization and sacralization.

It is evident that the static stability is lowered by spondylolisthesis with its displacement of the ventral margin of the 5th lumbar vertebra over the 1st sacral vertebra (or this dis-

placement may happen at a higher level, involving the 4th lumbar vertebra) and a (congenital?) defect of the vertebral arch dorsal to the superior articular process. All cases of this kind present very severe symptoms of insufficiency. On the other hand, I can hardly imagine that a defect in the arch of the 5th lumbar vertebra (or the arch of the 1st sacral vertebra) would imply a decrease in the carrying power. It is not to be denied that occasionally we incidentally discover an occult spina bifida without any symptoms of insufficiency being present. But I always mark down such a finding as a phenomenon to be kept under observation.

Lumbalization, signifying that the 1st sacral vertebra is partially or entirely separated from the os sacrum, means that the lumbar part of the spinal column consists of 6 vertebræ. In my opinion it seems reasonable to imagine that such a back is all too limber and pliant to have sufficient carrying power.

Sacralization, meaning that the left lumber vertebra is partly or entirely fused with the os sacrum ,reduces the lumbar part of the spinal column to only 4 free vertebræ. It seems rather reasonable to expect that this condition will give too little springiness and elasticity to the back. Professor Ingebrigtsen has published two cases of this kind, in which he treated the patients operatively, with a good result. Without wishing in any way to belittle this result, I shall merely point out that it is very difficult correctly to estimate how much of the good result is due to the operation and how much may be owing to the fact, that the patient after such an operation is confined to bed for a considerable length of time, with complete relaxation of the trunk. Hence, I am inclined to think that this question is still unsettled.

For the sake of simplicity I shall outline, step by step, how I perform the examination of these patients.

The patient must stand in front of me completely naked. The first point to ascertain is whether both anterior superior iliac spines are at the same level. If the legs differ in length, the shortening is corrected with a piece of board of suitable height. Then I turn to the dorsal aspect of the patient.

We have to be prepared to find that the carriage of the trunk may be perfectly normal, for in the mildest cases there is nothing to be seen, even though kypholordosis or scoliosis are common findings. Sometimes the back may appear to be plane and this is an important sign for further observation; for we know from experience that the carrying power is slight if the normal lordosis is absent, probably because the normal springiness and elasticity is lowered in such backs. The appearance of the muscles of the back is noticed at once.

In order to cope with different loads, man has a considerable amount of reserve power in his musculature. It is only in the earliest stages of vertebral insufficiency that the musculature of the back appears to be normal; in all subsequent stages it presents a more or less pronounced degree of contracture.

If the musculature is utilized to its utmost yielding capacity, its reserve power will not suffice, and symptoms of insufficiency make their appearance in the form of stiffness, fatigue, pain, and fixation. The contracted muscle can relax only in resting, and in the more advanced cases it does not relax even when the patient is lying on his back (cases of sciatic scoliosis).

We cannot assert summarily that all the skeletal tissue is equally good in quality; and the same applies to the musculature too. There are two conditions under which we know that the muscular quality is lowered. This is the case above all if the musculature is exposed to the effect of cold; a cold muscle is considerably less elastic than a warm muscle. In the next place, neurasthenic patients have an increased irritability, and their musculature tires readily.

It is to be mentioned that the patients do not refer their subjective discomfort along the course of the muscles involved, but to their insertions, at the rim of the pelvis, to the sacrolumbar region.

The contractures may be equally pronounced on both sides of the spinal column, as is seen in cases of kypholordosis. The long muscles of the back form two thick rounded ridges, one on each side of the vertebral column, which disappear distally as in a groove. The insertions along the rim of the pelvis stand out sharply as if chiseled.

The contracture may also be unilateral, or it may be more pronounced on one side. Then, there appears a condition of scoliosis. In this way different phenomena may develop. It is my impression that an elongated contracture acts as the string of a drawn bow. A contracture on the left side produces a scoliosis with the convexity to the right, and vice versa. If, on the other hand, the contracture is short, corresponding to the height of only a few vertebræ, the contracted muscle will pull these vertebræ in its direction, so that a contracture on the left side gives a scoliosis with the convexity to the left.

We now return to the examination and ask the patient to bend forwards and downwards while keeping his knees straight. In several cases, this test will reveal a contracture that was concealed before. If this contracture is more pronounced on one side, the forward flexion gives a deviation to that side. At the same time we notice whether the lumbar region is kept fixed, and besides we get an idea about Lasègue's phenomenon in standing posture.

The rest of the examination is carried out with the patient lying on the table. At first, we make sure with the tape measure, whether the length of the legs is now the same as that found when the patient was standing. Then we examine the hip-joints. We make sure whether abduction and inward rotation are free. Finally, we ascertain whether the patellar reflexes are present on both sides.

Then the patient is told to lie flat on his belly. In this prostrate position the scoliosis or kypholordosis observed before will often disappear. Only deformities of osseous nature and the most advanced cases show a persistent scoliosis or kypholordosis (cases of sciatic scoliosis). In this posture, according to Schanz, it should be possible by tapping with the percussion hammer or by pressure on the spinous processes of the vertebræ to disclose distinct pressure tenderness. But I have to admit that I have not been able to elicit this sign. On the contrary, I think that there is no pressure tenderness in these cases, and that this feature distinguishes them from tuberculous spondylitis.

The muscles of the buttocks are to be examined closely; atrophy is present in many cases.

In those cases where the abductors of the hip-joint are contracted we may find a very marked tenderness, and these are the very patients who most often complain of severe lancinating pains in the leg. That vertebral insufficiency may easily involve the muscles of the buttocks is most clear, perhaps on comparison of these cases with poliomyelitic patients in whom the same muscles are paralyzed. These patients are limping, waddling, as in congenital luxation of the hip. With every step on the paralyzed leg the trunk sinks down and over to the side, as the ability to keep the body in erect posture is gone. It seems rather obvious, without further explanation, that in vertebral insufficiency this musculature of the balancing function may be overtasked just as well as the musculature of the back.

Finally, the Achilles tendon reflex is to be examined. In several cases, it is absent on that side where the patient has pain in the leg.

There now remains the X-ray examination of the entire spinal column, from the 5th thoracic vertebra to the sacrum, an examination that should never be omitted—not least because we must make sure that there is no malignant new-growth or inflammatory process (tuberculosis). To limit the roentgenography to the lumbar part of the spinal column, as is done by many clinicians and roentgenologists, is a fault.

If one is interested in this problem, it is soon realized that when spondylitis deformans is localized to the thoracic region alone, it never gives pain in the leg, but often in the lumbar region, and sometimes in the buttocks. The lower the level of the deforming changes, the lower are the pains encountered, and they may extend even down in the foot. This experience may be expressed also in this way: that the pain is always located a good distance below the place to which the pathologic-anatomical changes are localized.

As to the therapy, this general rule holds good: Vertebral insufficiency, with muscular fixation and deformity, may be remedied in every case through rest and relief from strain, but

not through any therapy with active or passive motions. Undoubtedly, massage may be tolerated in some cases, but never if there are any symptoms of irritation, for then the condition will only be aggravated. And this applies in an even higher degree to gymnastic exercise.

Schanz says: »Schon leichte Fälle reagieren darauf häufig mit erhöhten Beschwerden. Besonders gilt das auch von Skoliosenkindern mit stärkeren Insufficienserscheinungen. Die schweren Fälle bei Erwachsenen und da wieder besonders die traumatischen vertragen Gymnastikkuren gar nicht.« I have had exactly the same experiences, and I fully subscribe to these statements.

The therapy employed by me is, as mentioned before, a consistent treatment with corset, but it naturally varies somewhat from one case to another. In its main features this therapy may be outlined as follows:

1. If the insufficiency is not associated with any visible deformity, only with a muscle contracture, in standing posture, a cast is taken at once for a removable corset of leather or celluloid. While this corset is being made (about 24 days), the patient is directed to be as cautious as possible in his work, preferably rest completely. When the corset is finished, it is put on the patient, and he is told to wear it from the time he rises in the morning till he goes to bed. No other therapeutic measures are taken.

2. If the insufficiency is so severe that scoliosis has appeared, this deformity has to be corrected before a removable corset can be made. This correction is carried out by means of plaster corsets which are changed every 3 or 4 weeks. If the scoliosis is severe, the plaster corset is applied with the strongest correction possible, after fixing the patient in the plastering posture. Generally such a correction takes from 2 or 3 weeks up to 10 weeks, seldom more. When the removable corset is ready, it is put on the patient, and the further treatment is as outlined under point 1.

Excepted from this rule are those cases in which the scoliosis is very severe—the so-called »sciatic scoliosis«—often associated

with a flexion. To me it certainly appears as if the psoas major in these cases is in a state of contracture (on the side affected). Such a patient stands with his trunk displaced to the right or to the left and also somewhat forwards (flexed). Cases of this type are not suitable for dispensary treatment; they belong to the ward.

The correction is carried out under total anesthesia, on a plastering table. As soon as the deformity and all contractures disappear under the anesthesia, a large plaster cast is applied, extending from the nipples to the knee-joints. This cast is allowed to stay on for 3—4 weeks. After this the patient is ready for dispensary treatment, which is carried out as mentioned above.

3. Kypholordosis in mild or moderate form may be treated with carefully selected gymnastic exercise (without bending, rolling or twisting of the trunk), so that the patient may learn to counterbalance the swaying. This, as a rule, may be accomplished in 10—20 days; it seldom takes longer time. As soon as the patient is able to stand in a normal posture, he is equipped with a removable corset, after which the treatment differs in no way from what is said above.

In several cases, however, kypholordosis is associated with so severe symptoms of irritability that correction of the sway-back has to be put off till these symptoms have subsided. Such patients are at once supplied with a supporting plaster corset, which is replaced as soon as possible by a removable corset of leather, not of celluloid. For, when later the sway-back is corrected through proper gymnastic exercise, the corset has to be adjusted to the new carrying of the trunk; and this can be done only to a leather corset, not to a celluloid corset.

Rather marked symptoms of insuffiency may occur in very young patients in whom the so-called Scheuermann's kyphosis is developing. During those years when the softening process occurs in the 6th—10th thoracic vertebræ, it is best for these patients to wear a leather corset. This measure offers a fair prospect of avoidance of juvenile kyphosis. If Scheuermann's kyphosis has healed with wedge-shaped vertebræ, nothing can

be done to the lesion; patients without symptoms of insufficiency are not to have any treatment at all. But if tiredness and pain reappear, such patients are also to be treated with corset, even though the prognosis in these cases is far from being good.

The choice of material for the removable corset is largely a question of personal preference. Still, it can be established definitely that for manual workers leather is the only material suitable for the corset. Corsets of fabric are most serviceable for women with slight symptoms who are not doing any manual work. Such a corset may also be used as a transitional form from leather corset to no corset, when the patient is convalescent. I employ the celluloid corset mostly in cases of young girls.

How long the patient has to wear his corset is impossible to say beforehand. Generally, I tell him about two years, but it may be 3 or 3½ years, or even longer.

Schanz says: »Man lasse dem Patienten sein Korsett so lange er es trägt. Länger als nötig trägt kein Mensch ein solches Ding an seinem Leib herum.«

I was myself wearing my corset daily for 3½ years. Even now I put it on from time to time, for when I have once contracted vertebral insufficiency, I may do it again.

There is only one exception to what is said above: cases associated with severe psychoneurosis. Great caution is to be taken in dealing with such patients, because there is always the chance that such a patient will never take the corset off, once it is put on. In cases of this kind, I usually consult with a psychiatrist before treatment is instituted.

After-treatment other than the corset is required but seldom —a most fortunate thing, as most of these patients could hardly, or not at all, submit to an after-treatment consisting in baths and massage.

If the patient lives in a locality where after-treatment may be carried out, and he asks for it, I recommend two salt baths a week, or carbon-arc light-baths (Finsen method). Massage should not be employed, at any rate never applied to the back, although massage of the buttocks may perhaps be serviceable

in some cases, for a few weeks. Gymnastic exercise is advisable only if there is any prospect of improving a deformity of the trunk; it is never to be employed as a therapeutic measure, and not unless an expert physician is at disposal.