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VERTEBRAL FRACTURES IN INSURED AND UNINSURED PATIENTS

Analysis of the Frequency and Duration of Symptoms, Convalescence and Disability

BY

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With the compliments of the Author

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INTRODUCTION

It is common knowledge that the prognosis of fractures of the vertebrae varies with the severity of the lesion. Experience has, however, also shown that apparently minor injury to a vertebra is capable of producing unexpectedly persistent symptoms and a permanent reduction in working capacity. Why some of these apparently minor lesions should run such an unfavourable course is not properly understood.

It is obvious from the literature that interest was formerly focused mainly on the principles of treatment of the various types of fractures of the vertebra and that it was widely accepted that treatment should, above all, aim at securing complete anatomic restitution. Attention was thus directed chiefly to the healing of the bone and to the obviation of subsequent deformity. In recent years, however, more value has been attached to good function than to complete anatomic restitution. It has been shown by NICOLL, for example, that imperfect reduction is compatible with good functional end-results. Moreover, it is often difficult to maintain reduction during the course of healing.

In the past only few attempts have been made to analyse the factors responsible for the persistent symptoms and consequent reduction in working capacity (see NICOLL).

Some writers have, however, stressed the possible importance of injury to certain structures such as the intervertebral disks (SCHMORL, JUNGHANNS, LOB), to changes in the intervertebral joints (LANGE), fractures of the neural arch and unstability (NICOLL). A special aspect of the problem is the difference found in the frequency and degree of disability between insured and uninsured patients. LOB, for example, could not trace any comparison of insured and uninsured from this point of view in the literature and suggested that such an investigation would be of value.

With this in mind the present writer reviewed a collection of insured and uninsured persons treated at the orthopaedic department and the surgical department of the University Hospital, Lund, during the years 1919—1944 and 1934—1944 respectively.[1]

The purpose of the present study was to make an analysis of different types of fractures of the vertebrae and of secondary changes in relation to the frequency and severity of symptoms, the duration of temporary disability and the frequency and degree of permanently reduced working capacity in representative series of insured and uninsured persons.

[1] X-ray films taken at the surgical department before 1934 have been destroyed.

DESCRIPTION AND COMPARISON OF THE SERIES

Author's Series

Of 294 patients treated for fractures of the thoracic or lumbar vertebrae during the period covered by the investigation, 154 were reviewed.[1]

Cases with paraplegia, which occupies a special position with regard to both treatment and prognosis, were not accepted for the present investigation, nor were those with fractures of the cervical spine or with isolated fractures of the neural arches[2] or processes.

The interval between the occurrence of the accident and the reviewal varied between 5 and 30 years (average 12.1 ± 0.35 years). In 35 per cent of the cases the patients were reviewed 5—10 years after the injury, 34 per cent were seen after 10—15 years, 24 per cent after 15—20 years and 7 per cent after more than 20 years. There were 72 insured patients and 82 were uninsured. All of the patients received conservative treatment and, except for an occasional attempt to improve anatomic restitution by the use of a small pad, no efforts were made to reduce the fractures and, but for a few single cases, plaster jackets were not applied either. Every patient except 2 was reviewed and examined neurologically by the writer. The roentgen examination included lateral and frontal views of the entire spine as well as oblique views (GLORIEUX and LOB) for the examination of the neural arches and the intervertebral joints.

The 154 cases were analysed and evaluated mainly on orthopaedic grounds. The primary criterium used in the classification of the cases was the presence or absence of manifest intervertebral disk involvement. This division was decided upon because if the fracture of a vertebra is severe, the adjacent intervertebral disk is practically always involved. Besides this, complete restitution of the disk is never or hardly ever achievable in such cases (LOB, SCHMORL and JUNGHANNS). The

[1] Of the originally 294 patients, 41 had died, 17 could not be traced, 12 were not included because the radiograms taken at the time of the accident were missing, and 12 were either at mental homes or old-age homes and unacceptable because of their poor general condition.

[2] Because there were only 4 with such isolated fractures.

cases were thus grouped according to the presence or absence of disk involvement. For an intervertebral disk to be accepted as damaged, it must have shown primary signs of injury, i. e. at least one of the following changes: narrowing of the disk, indentation of the adjacent articular end-plates, fractures of the limbus, dislocation and distinct slipping of the vertebral body. Sometimes, however, a disk may be severely damaged without the lesion being roentgenographically visualizable until some time afterwards (SCHMORL & JUNGHANNS and NICOLL). Therefore damage to the disk is sometimes inferred only from secondary changes such as narrowing of the disk in the region of the fracture, usually in association with marginal bone proliferations or intervertebral osteochondrosis (SCHMORL). Other acceptable signs are calcified spots in the disk, a slipped adjacent vertebra and unstability (KNUTSON).

General Survey of the Series

Of the 154 patients, 60 (39 per cent) had sustained fractures of more than one vertebra. The total number of fractures was 249, which means 161.7 fractures per 100 cases. In LOB's series the corresponding ratio was 133.58: 100. These figures thus confirm the clinical impression that in fractures of the spine the injury is frequently not limited to a single vertebra (HAUMANN and others).

The distribution of the cases according to the different sections of the spine involved was, roughly speaking, the same as that reported by earlier writers. Thus, most (64,3 per cent) of the fractures were seen in the lower thoracic and upper lumbar vertebrae, while 20.1 per cent were seen in the rest of the thoracic vertebrae and 15.6 per cent in the middle and lower lumbar spine.

As already mentioned, the series was divided into two main groups, patients without intervertebral disk involvement being allocated to group A (table 1), those with such involvement to group B. This second group included not only simple compression fractures with associated disk involvement, but also all fractures of more severe types. In order to avoid groups too small for statistical analysis, group B was divided into only three subgroups. The slightest injuries, the uncomplicated compression fractures, were assigned to subgroup B_1. The more severe and prognostically poorer (WATSON-JONES) comminuted fractures were allocated to subgroup B_2, and the severest, the ones with associated fractures of the neural arch and joint processes, were allotted to subgroup B_3, which also included cases with vertebral dislocation. Various classification schemes have been suggested in the literature. The classification used here is essentially the one suggested by LOB, and it was found to serve the purposes of the investigation satisfactorily.

NICOLL introduced a new classification scheme: he classed his cases as stable or unstable; he also drew attention to a type of fracture he termed lateral wedge fracture. This classification was also tried in the present analysis, the results of which will be discussed in a later section (page 32). As to lateral wedge fractures, they were seen in 11 per cent of the present series, as compared with 14 per cent in a series reported by NICOLL. As regards symptoms and reduced working capacity, these 11 per cent did not differ appreciably from other subgroups, e. g. subgroup B_1; therefore there was no reasons to treat them as a separate subgroup.

The entire series is summarized in table 1, which shows as follows.

a) The average age of those patients with associated fractures of the arches and joint-processes was higher than that of the rest of the series. This difference in age between group A and subgroup B_3 was statistically significant. The other two groups were too small for statistical comparison, but the average age of subgroup B_1 and subgroup B_2, taken together, was 41.9 ± 1.7 years and thus likewise statistically different from subgroup B_3 with 50.0 ± 2.1 years.[1] This higher frequency of the severe lesions in the elderly patients may perhaps be ascribed to decreased elasticity of the intervertebral disk and ligaments and to any pre-existent osteopororis and possibly to a certain degree of awkwardness of such patients. That the condition of the intervertebral disk is responsible for the type of some fractures of the vertebra sustained has been shown experimentally by GÖCKE and LOB. GÖCKE also postulated that the nucleus pulposus is strongest in middle-aged persons and that in fractures of the vertebrae this strenght of the nucleus pulposus results in a rupture and cupping of the end-plates of the adjacent vertebrae and in comminuted fractures, while in elderly patients, in whom the elasticity of the disk is reduced, the vertebra is compressed, i. e. without injury or at least without appreciable injury to the end-plates.

b) The table also shows that involvement of the intervertebral disk must be expected in about 2 out of every 3 cases of vertebral fracture. Thus, in the present series only 38 per cent showed no primary signs of vertebral disk involvement. LOB reported non-involvement of the intervertebral disk in 29 per cent of a similar series. It should be re-

[1] The groups in this series were generally so large that if the difference of a mean value or a frequency compared with its standard deviation (D/Σ_D) was more than 3.1 the difference is significant, and if it is more than 2.8, very probable. With the use of the χ^2 test, by which all borderline values calculated by ordinary methods were checked, $P<5$ per cent was, as usual, considered very probable and $P<1$ per cent. significant, and $P<0.1$ per cent highly significant. These percentages were also used in the analysis of the t-values. (DAHLBERG, ESSEN-MÖLLER and QUENSEL.)

collected that an isolated fracture of a vertebra cannot be established until after the exclusion of later changes. It is as a rule possible by roentgenographic studies to exclude the presence of a fracture of a neural arch or of joint-processes, but the detection of any co-existent injury to the intervertebral disk is not always possible until after a varying interval. At the time of the reviewal 31 per cent showed no signs of disk involvement. As far as treatment is concerned, concealment of such associated intervertebral disk involvement may be of less importance, but in the evaluation of the prognosis and of insurance claims a correct diagnosis must surely be more valuable: this is also apparent from table 1.

c) Intervertebral disk involvement prolongs the symptoms.[1] In the present series 23.1 ± 5.8 per cent of the patients in subgroup B_1 were symptom-free within 6 months, while the corresponding frequency for those without manifest intervertebral disk involvement (group A) was 45.8 ± 6.5 per cent. The difference was statistically probable. This ratio of the frequencies for the first 12 months was also about the same, namely 44.3 ± 6.9 per cent and 67.8 ± 6.1 per cent respectively. This difference gradually decreased with increasing interval, and after the lapse of some years the frequency of sequelae was about the same in all groups. As expected, recovery from comminuted, fractures and more complicated lesions usually required more time, but persistent symptoms were not more common. In this respect subgroups B_1, B_2 and B_3 did not differ statistically from one another, and the figures did not suggest any relationship between the frequency of the symptoms and the severity of the fracture.

d) Return to work is earlier if the intervertebral disk is not involved. Thus, all except 3.4 ± 2.4 per cent (group A) returned to their work within 12 months of the injury, as compared with 16.8 ± 3.9 per cent for the remainder (group B_1, B_2 and B_3, see also tab. 10). The difference was statistically significant (according to χ^2 test $P < 2$ per cent).

e) *Only fractures with intervertebral disk involvement were found to produce a permanent reduction in working capacity.* Vertebral fractures with associated damage to the neural arches and to the joint processes have the poorest prognosis. Only 55.2 per cent of these patients recovered pre-injury working capacity and in 20.7 per cent the injury was followed by permanent, severe or complete disability (see tables). In none of the patients without manifest intervertebral disk involvement did the fracture of the vertebra cause permanent reduction in working capacity

[1] To be understood as local pain and backache+weakness reducing working capacity.

TABLE 1

General survey of the average ages of the patients, the recovery, temporary disability and permanent (partial and complete) disability in different types of fractures.

	Nature of injury	Number of cases		Age in years at time of injury (mean value)	Recovery				Persistent symptoms [1]	Duration of temporary disability in per cent of cases in years				Permanent disability in per cent of cases [2]			
		insured	uninsured		Percentages symptom-free after years					0—1/2	1/2—1	1—2	>2	0	slight	severe	complete
					1/2	1	2	5									
Group A	Fractures without primary signs of disk involvement	27	32	40.3 ± 2.3	45.8	67.8	76.3	79.7	20.3	86.4	10.2	3.4		100			
Group B — Fractures with disk involvement	Simple compression fractures (subgroup B_1)	24	28	41.6 ± 2.0	23.1	44.3	57.8	67.3	32.7	69.8	17.3	5.8	7.8	76.9	13.5	7.7	1.9
	Comminuted fractures (subgroup B_2)	6	8	43.0 ± 3.2	21.4	35.7	50.0	64.3	35.7	71.5	21.4		7.1	71.4	14.3	14.3	
	Fractures with involvement of neural arch or joint processes (subgroup B_3)	15	14	50.0 ± 2.1	10.3	37.9	48.2	62.1	37.9	41.4	31.0	3.4	24.1	55.2	24.1	6.9	13.8

[1] These figures include neither patients with occasional or intermittent local pain nor slight backache + weakness not severe enough to reduce working capacity.

[2] Slight = < 25 per cent reduction of working capacity.

TABLE 2

Comparison of the insured with the uninsured regarding average age, symptoms, duration of temporary disability and permanent (partial and complete) disability.

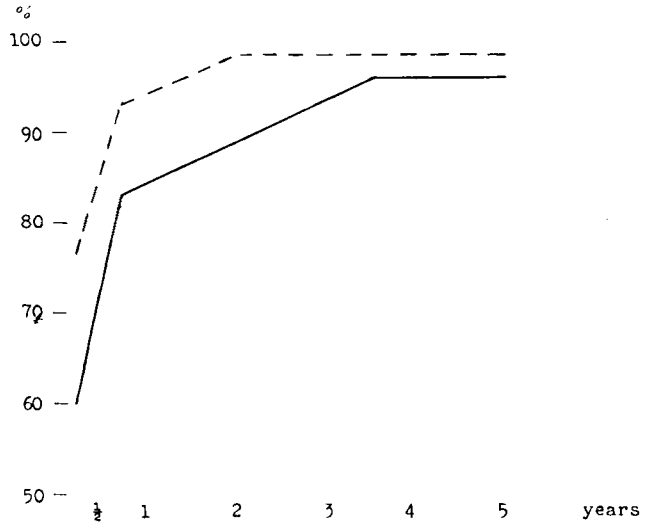
	Nr. of cases	Age at time of injury	Percentages with symptoms > 1 year	Percentage returned to work within years					Percentage not returned to work	Disability in per cent of cases			
				0–1/2	1/2–1	1–2	2–5	> 5		0	slight	severe	complete
Insured	72	47.6 ± 1.6	50.0 ± 5.9	59.7 ± 5.8	23.6 ± 5.0	5.6 ± 2.7	2.8	1.4	6.9 ± 3.0	68.1 ± 5.5	19.4 ± 4.8	8.3 ± 3.3	4.2 ± 2.4
Uninsured	82	43.6 ± 1.8	26.8 ± 4.9	75.6 ± 4.7	17.1 ± 4.1	4.9 ± 2.4			2.4 ± 1.7	92.7 ± 2.8	2.4 ± 1.7	2.4 ± 1.7	2.4 ± 1.7
Difference D/ΣD		0.8	3.0 definite	2.1	1.0	0.2			1.3	4.0 definite	3.5 definite	1.6	0.6

(according to χ^2 test, $P < 0.1$ per cent). This suggests the conclusion that the persistent symptoms claimed by the 20.3 per cent of them could hardly have been severe. (See also tables 11 and 13.)

One might be inclined to ascribe the difference between group A and group B to the higher frequency of more severe fractures in the latter group. This is also to a certain extent true, but it does not alter the fact that the association of manifest intervertebral disk involvement does indicate more severe damage and worsens the prognosis. Comparison of the subgroups B_1, B_2 and B_3, in which the last two subgroups include more complicated fractures, shows distinctly that the difference between these subgroups is smaller than that between group A and subgroup B_1. As intervertebral disk involvement was common to all three subgroups, it does not sound unreasonable to suppose that this involvement was one of the main causes of the difference. This point will be discussed in a later section (page 24).

Comparison of the Insured with the Uninsured

No difference was found between the insured and the uninsured regarding the localization of the vertebrae involved, the severity of the fractures or with respect to age-distribution (tables 1 and 2). Despite this lack of differences, the course of the lesions in the insured differed widely from that in the uninsured. These two groups were therefore



Curve 1
Rate of recovery of working capacity.
———— = insured
— — — — = uninsured

treated separately in the analysis. The chief differences observed are summarized in table 2, from which it is clear that the groups differed statistically from one another as regards the duration of the symptoms and disability. We thus see that 12 months after the accident 50.0 per cent of the insured patients still claimed symptoms, while the corresponding figure for the uninsured was only 26.8. This also applied to disability. The insured seem to return to work at a slower rate (curve 1).

Social and Constitutional Factors

Occupation

In the evaluation and comparison of the reduction in working capacity and the symptoms of the two groups social and constitutional factors ought to be considered. It was no easy matter to judge the social standing in every individual case. Therefore no special attempts were made to investigate this point. Most of the insured persons were farm labourers or, though fewer, industrial workers. The uninsured group consisted mainly of small farm-owners and tradesmen working for their own account. As far as occupations are concerned, then, the groups were fairly similar. The occupations are given in tabular form below (table 3).[1] In order to obviate splitting up the series into groups too small for statistical analysis, only two types of work were distinguished, namely heavy and light. Farm labourers, farmers and heavy industry workers were assigned to the former and workers in light industry, artisons and clerks etc. to the latter. The ratio between the

TABLE 3

Comparison of light workers with heavy workers regarding symptoms, temporary disability and permanent (partial and complete) disability.

	Nr. of cases		Percentage of cases with symptoms > 1 year		Percentage of patients who returned to work within 6 months		Permanent disability in percentage of cases	
	insured	uninsured	insured	uninsured	insured	uninsured	insured	uninsured
Light workers	27	35	51.9	25.7	59.3	76.6	29.2	5.7
Heavy workers	45	47	48.9	27.7	60.0	74.2	33.5	8.5

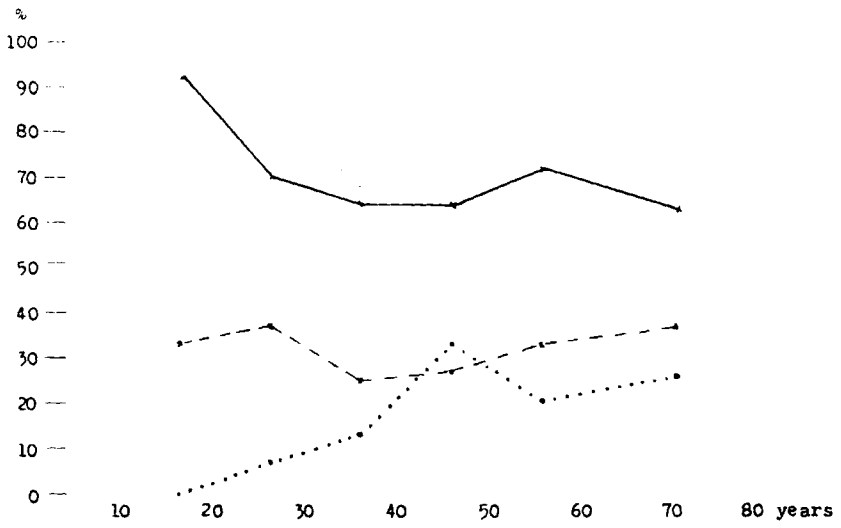
[1] In 11 (9 insured, 2 uninsured) of the cases the patients changed their occupation after the accident.

number of heavy workers and light workers was, roughly speaking, the same in both groups. The percentages of the various types of fractures were also practically equal (table 1). The two groups are therefore also fairly comparable from a statistical point of view. A striking observation apparent from table 3 is that 12 months after the accident these two groups, heavy workers and light workers, did not differ from one another regarding the frequency of symptoms and disability. This applies not only to the insured.

Thus, the differences found between the insured and the uninsured regarding the duration of the symptoms and the frequency of reduction in working capacity cannot be explained on occupational grounds.

Effect of Age

As already mentioned (page 8), it has been shown that the type of fracture of a vertebra often tends to vary with the age of the person (GLORIEUX, LOB and TURNER & MEAD), and therefore it does not sound unreasonable to suppose that age will also influence the prognosis. ABRAHAMSEN and BÖHLER, for example, claimed that the effect of a fracture of a vertebra on the working capacity increases with advancing age of the patient at the time of the accident and BÖHLER suggests that such fractures should not be reduced in patients over 60.



Curve 2

Percentage of patients in various age-groups who returned to work within 6 months of the injury = ————————
Frequency of symptoms >2 years = — — — —
Frequency of permanent disability (complete and partial) = ...

In the present series the frequency of symptoms was about the same in all age groups (curve 2). As to the duration of temporary disability, of those under 20 years of age at the time of the accident 91.7 ± 7.8 per cent were able to return to work within 6 months of the accident, as against only 66.9 ± 4.0 per cent of the remainder. The difference was statistically probable. No such difference was found between any two of the other age-groups. But the curve (Nr. 2) showed the frequency of permanent disability to increase with advancing age of the patient at the time of the injury and that the rise in the curve was more pronounced round the age of 40. *Among the patients who had sustained the injury after they were 40, subsequent permanent disability was about 3 times as common as among the others* (table 4).

TABLE 4

Frequency of disability (partial and complete) in patients above and below 40 years at time of injury.

Age-group	Insured n = 72	Uninsured n = 82	Entire series
< 40 years n = 61	12.1 ± 5.7	3.3 ± 3.1	7.9 ± 3.4
> 40 years n = 93	48.7 ± 8.0	9.6 ± 4.4	26.4 ± 4.6
Difference D/Σ_D	3.7	1.2	3.2

Deforming Spondylosis[1]

Deforming spondylosis is a condition which may reasonably be thought to influence the symptoms and working capacity. The series was therefore analysed for any deforming spondylosis existent already at the time of the accident and at the reviewal. A study of the radiograms taken at the time of the accident showed signs of deforming spondylosis in 34.4 per cent, as against 53.2 per cent at the present reviewal. Therefore in the analysis of the material for any inter-relationship regarding symptoms and disability from deforming spondylosis both frequencies must be taken into account. The results of such studies are given in tables 5 and 6, which suggest that symptoms were somewhat more common among those with deforming spondylosis than among those in whom no signs of spondylosis had been observed.

[1] Deforming spondylosis is to be understood here as general deforming spondylosis or degeneration of the intervertebral disks outside the region of the fracture.

However, the figures were too small for demonstration of any significant difference. This also applies to the figures for complete disability after 1 year and for the frequency of permanent disability, although here the results distinctly suggested a tendency for deforming spondylosis to reduce working capacity. If we compare only the disability of the insured, we find a probable difference (43.2 ± 7.9 per cent . . . 20.0 ± 5.1 per cent). The frequency of permanent reduction in working capacity was also found to be related to the severity of the deforming spondylosis. The figures for the insured were:

TABLE 5

Frequency of symptoms in patients with and without general deforming spondylosis expressed as percentages of the various groups.

General deforming spondylos	At time of injury					At reviewal		
	n	Symptoms > 1 year		Symptoms > 2 years		n	Permanent symptoms	
		insured	uninsured	insured	uninsured		insured	uninsured
0	101	46.0	23.5	38.0	19.6	72	30.3	21.7
		34.7 ± 4.7		28.7 ± 4.5			25.4 ± 5.1	
+	53	59.1	32.3	50.0	29.0	82	48.7	26.7
		43.4 ± 6.8		37.7 ± 6.6			34.9 ± 5.2	

TABLE 6

Distribution of the frequencies of temporary disability of more than 1 year and permanently reduced working capacity in patients with and without general deforming spondylosis.

General deforming spondylos	At time of accident					At time of reviewal				
	n	Temp. disability > 1 year		Permanent disability		n	Temp. disability > 1 year		Permanent disability	
		insured n = 72	uninsured n = 82	insured	uninsured		insured	uninsured	insured	uninsured
0	101	14.0	3.9	26.0	3.9	72	8.6	2.6	20.0	7.9
		8.9 ± 2.8		14.9 ± 3.6			5.5 ± 2.6		13.7 ± 4.1	
+	53	27.5	12.9	45.5	12.9	82	27.0	11.4	43.2	6.8
		18.9 ± 5.4		26.4 ± 6.0			18.5 ± 4.3		23.5 ± 4.7	
Difference D/Σ_D		1.6		1.6			2.5 (P < 3 %)		1.6	

Without deforming spondylosis at the reviewal	16.0± 7.3	per cent disability
With slight, deforming spondylosis at the reviewal	35.0±10.7	„ „ „
With severe, deforming spondylosis at the reviewal	70.0±14.5	„ „ „

The frequency of reduced working capacity among those without deforming spondylosis differed statistically from that recorded in those with severe deforming spondylosis ($D/\Sigma_D = 3.3$). *There was thus no definite, demonstrable difference between the frequency of symptoms in those with and without deforming spondylosis both at the time of the accident and at the time of the reviewal* (see HELLNER), *but the two groups did differ significantly from one another regarding the frequency of permanently reduced working capacity.*

This is of importance in the evaluation of compensation, because it now seems to be generally accepted that trauma can hardly be held responsible for any subsequent general deforming spondylosis in patients who have sustained fractures of the vertebrae.

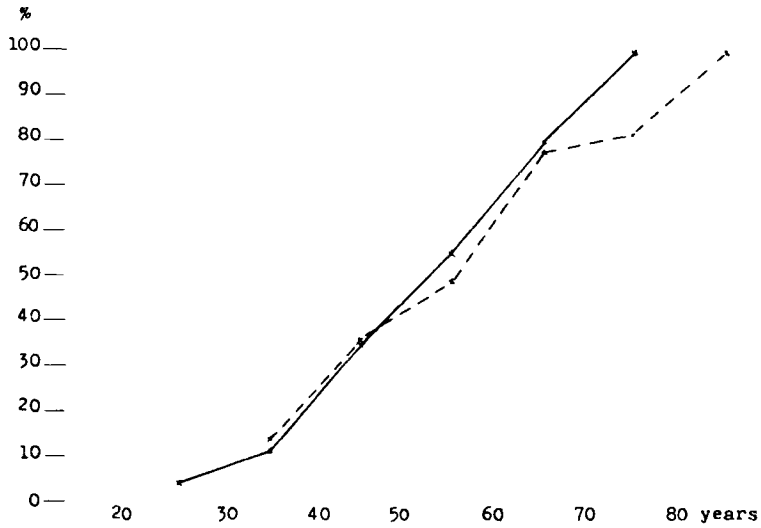
General Remarks on Trauma as a Possible Cause of General Deforming Spondylosis

A not uncommon concept in past years and postulated by RUGE, for example, was that trauma is capable of producing general deforming spondylosis. It was believed among other things that the deformity causes changes in the local mechanics with consequent impairment of the normal resistance of the disks to static stresses (static spondylosis). According to GÜNTZ, lesions accelerate the advance of any pre-existent spondylosis. In recent years many workers in this field (BROCHER, GAUGELE, HAUMANN, HELLNER, JUNGHANNS and others) rejected this theory, some of them on the basis of observations made in the dissecting room, and expressed the opinion that the higher frequency of general deforming spondylosis demonstrable at a reviewal of a series after the lapse of a number of years is not ascribable to the fracture but to the advancing age of the patients. However, opinions of the possible injurious effect of a fracture of a vertebra on pre-existent general deforming spondylosis are less explicit. It is often no easy matter to decide whether or not the fracture has had any effect on the course of such deforming spondylosis. Moreover, as stressed by LOB, for roentgenographic evidence of such marked deterioration to be convincing, the roentgenograms made during the follow-up must have been taken at

exactly one and the same angle throughout. According to BURCKHARDT, JUNGHANNS, LOB, LANGE and others, trauma is possibly capable of worsening the spondylosis, but for any advance in the condition to be ascribable to the trauma, it must be roentgenographically visualizable within 6 months or at most 12 months of the injury.

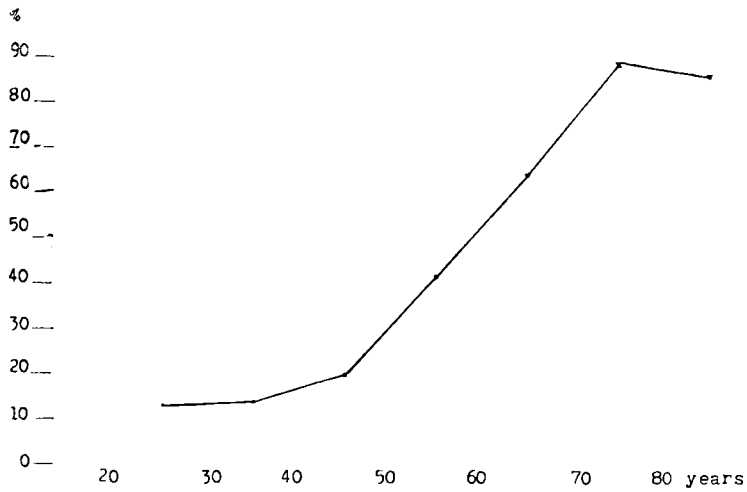
General deforming spondylosis is common in otherwise healthy people and has been reported by GARVIN, for example, in 67 per cent of all men over 50 years, in 40 per cent under 40 years (JUNGHANNS') and in 95 per cent over 75 years. JAEGER gave similar frequencies.

In the present series 34.4 ± 3.8 per cent of the patients showed roentgenographic evidence of general deforming spondylosis at the time of the accident. The incidence of the condition in the various age-groups is apparent from curve 3. This is thus a curve of distribution of deforming spondylosis in various age-groups of a normal Swedish population. At the reviewal the corresponding frequency for the entire series was 53.2 ± 4.0 per cent, which means an increase of 50 per cent. This difference was statistically significant. The curve for the frequency of general deforming spondylosis in the various age-groups at the time of the reviewal (curve 3) showed the same distribution as the normal curve just mentioned. This suggests that the frequency of general deforming spondylosis increases in proportion to advancing age. This assumption is also supported by curve 4 representing only those cases



Curve 3

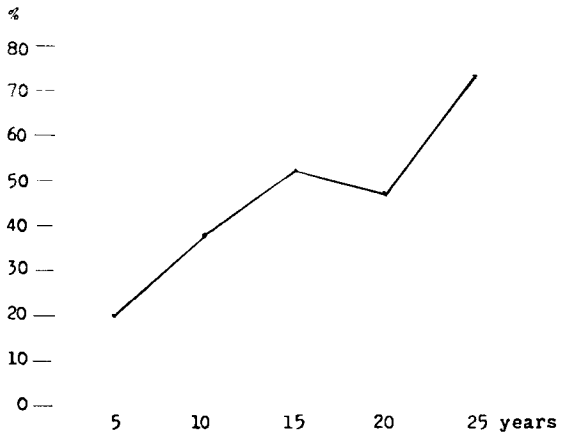
Frequency of general deforming spondylosis in relation to age.
At time of injury: ————
At time of reviewal: — — — —



Curve 4

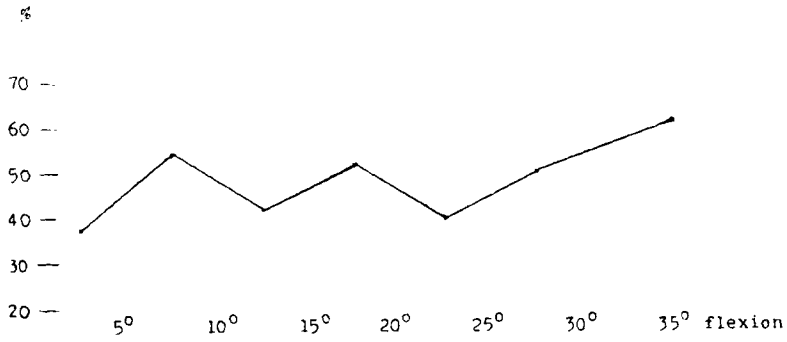
Frequency of increased general deforming spondylosis (post-injury appearance or definite progression) in relation to age at the time of the reviewal.

of spondylosis observed at the reviewal but not at the time of the primary examination and pre-injury cases with distinctly increased changes. A striking, true relationship was also observed between the frequency of spondylosis and the lapse since the accident (curve 5). As a further argument against the frequently denied importance of static spondylosis in fractures of the vertebrae reference is made to curve 6.



Curve 5

Relationship between increase in frequency of spondylosis and the interval between the injury and the reviewal.



Curve 6

Relationship between the severity of residual flexion and increase in general deforming spondylosis at the time of the reviewal.

The curve shows the distribution per cent of the cases in which deforming spondylosis appeared or appreciably increased in relation to the degree of flexion resulting from the accident and measured at the reviewal. The frequency was on the whole the same, except possibly for the largest angles. But there was no statistical difference between the frequency of those in the 0°—5° group (37.2 ± 6.3 per cent) and those in the group with an angle of 30° or more (61.5 ± 13.5 per cent). No difference was found between the frequency of the appearance or distinct progression of general deforming spondylosis and the degree of flexion ($< 15°$ and $> 15°$), as will be apparent from table 7. Neither

TABLE 7

Deformity and frequency of the appearance or distinct progression of general deforming spondylosis since the time of the injury.

Flexion	Scoliosis	Percentage in which def. spondyl. appeared or distinctly progressed since the injury	
$< 15°$	0 n = 81	39.5	42.9 ± 4.6
	+ n = 31	51.6	
$> 15°$	0 n = 19	52.6	52.4 ± 7.7
	+ n = 23	52.2	

was any relation found between the frequency of general deforming spondylosis and of scoliosis. The (over-all) frequency of post-injury and distinctly increased deforming spondylosis was:

42.0 ± 4.9 per cent for those without scoliosis

51.9 ± 7.0 per cent for those with scoliosis

There was thus no demonstrable statistical difference.

It is generally accepted that *spondylarthrosis* (arthrosis of the small joints) is capable of producing back pain and spinal rigidity. According to BROCHER, trauma can cause injury to a previously involved intervertebral joint and the patient may then experience increased symptoms for some time. For exemple, LANGE, BÖHLER and SANDAHL postulate that kyphosis or scoliosis resulting from a fracture of a vertebra will alter the mechanics of the joint and thereby cause spondylarthrosis. SAHLIN, who studied the articulation of the vertebrae, expressed the opinion that a flexion angle of more than 15° or scoliosis with an angle of more than 10° will give rise to arthrosis, but his report contained no accompanying roentgenograms of his few cases. This contrasts with JUNGHANNS' opinion, which is based on a postmortem study of 4 000 spines. He ascribed these arthrotic changes entirely to advancing age and pointed out that they often accompany general deforming spondylosis.

As already mentioned, special films were taken of the intervertebral joints at the reviewal: the observations of interest made are given in tabular form (table 8) and showed that deforming changes were somewhat more common among patients with a fairly large angle of flexion (>15°). The difference was, however, not statistically proved. It should

TABLE 8

Relationship between the frequency of spondylarthrosis and residual deformity at the time of the reviewal.

Flexion	Scoliosis	Percentage with intervertebral joint changes	
< 15°	0 n = 81	12.3	12.5 ± 3.5
	+ n = 31	12.9	
> 15°	0 n = 19	21.1	23.8 ± 6.6
	+ n = 23	26.1	

be pointed out that fractures of the neural arches were more common in patients with more severe deformity of the spine and that it was sometimes impossible to decide at the reviewal wheter the deformity was the result of intra-articular fracture or whether the change should be classed under the heading of genuine arthrosis. Unfortunately, the radiograms taken at the primary examination were not always of help in this respect, because they had been taken in two planes only. *Even if arthrosis of the small joints may be ascribed to deformation of the spine, it does not infer that these changes are the predominant causes of the symptoms* (see page 37).

The results of the analysis were in good agreement with those reported by HELLNER, JUNGHANNS and others, who claimed that persistent deformity caused by a fractured vertebra is of only minor importance in the cause and course of deforming spondylosis or arthrosis and that such changes are simply to be regarded as aging phenomena.

Symptoms and Working Capacity in Relation to Residual Changes

Kyphosis and Scoliosis

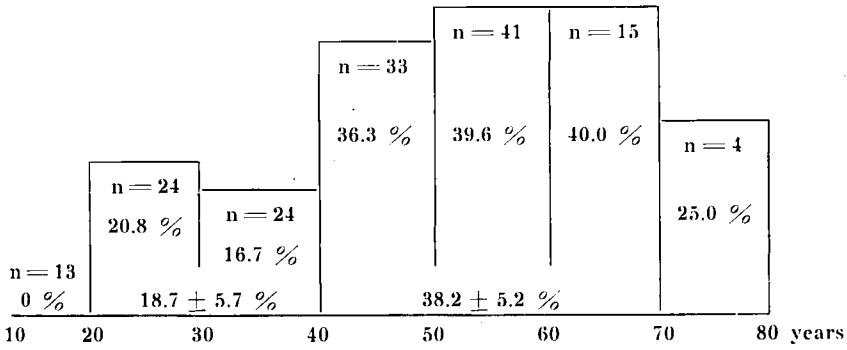
It might be convenient at this stage to recall that the view claiming a good anatomic result necessary for good end results (ALBEE, BÖHLER, DYES, JAEGER, KRAUS, LANGE, WATSON-JONES and others) is now being superseded more and more by the opinion that functionally better results are obtainable without reduction of the fracture[1] (BÜRKLE de la CAMP, LOB, MAGNUS and NICOLL). Moreover, satisfactory reduction is not always achievable and even then it is not always possible to prevent re-displacement during healing (EHRLICH, LEHMANN, TURNER & MEAD). Another argument against reduction is that the procedure may be harmful because of the occasional occurence of a wedge fragment in the posterior corner of the vertebra, as described by BÖHLER, LOB, STRAUBE and WACHS, for example. Above all, reduction by hyperextension (ETTORE and FEHR — Pseudoaufrichtung) may traumatize the disk again and even more severely and thereby impair healing (FEHR and LOB). It should also be recollected that, as pointed out by JUNGHANNS, it is not only the fracture *per se* that causes the deformity, but also any intervertebral disk involvement.

The results of an analysis of the series regarding the importance of age for deformity (flexion) are summarized in the diagram below.

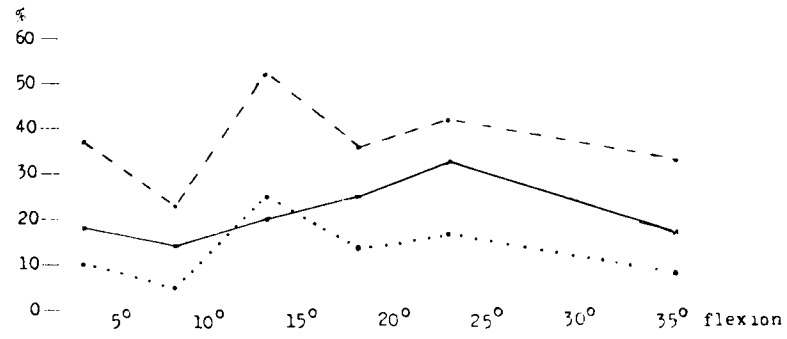
[1] Apart from certain types of luxation fractures.

We see here that the percentage of patients over 40 with a flexion of more than 15° was higher than in patients below this age. This difference is statistically probable and may be ascribable to osteoporosis increasing with age and to decreasing elasticity of the intervertebral disks.

Relationship between the frequency of cases with residual flexion of more than 15 degrees and the ages of the patients at the time of the injury.



In the present series no relationship was found between the degree of spinal deformity and the frequency of symptoms, disability or the duration of convalescence (curve 7). Neither did any co-existent scoliosis appreciably influence these frequencies (table 9). Thus no demonstrable relationship was found between the degree of deformity and symptoms or disability. This is in accord with results published by earlier workers in this field (FEHR, HELLNER, HUSTED & KOEFOED, NICOLL and TURNER & MEAD).



Curve 7

Relationship between the degree of residual flexion at the time of the reviewal and the frequency of symptoms, temporary and permanent (partial+complete) disability.

Symptoms >1 year = — — — —
Disability >1 year = ...
Permenent disability = ————

TABLE 9

Frequency of symptoms and temporary disability after more than 1 year and permanent disability (partial and complete) in relation to the deformity.

Flexion	Scoliosis	Symptomes > 1 year		Disability > 1 year		Permanent disability			
		insured	uninsured	insured	uninsured	insured		uninsured	
		n = 72	n = 82			slight	severe	slight	severe
< 15°	0	47.0	23,3	13.2	4.7	10.1	13.2	0	7.0
	n = 81	34.6 ± 5.3		8.6 ± 3.2		23.3 ± 6.8		7.0 ± 3.9	
	+	58.3	36.8	33.3	10.5	16.7	16.6	5.3	5.3
	n = 31	45.2 ± 8.9		19.4 ± 7.1		33.3 ± 13.6		10.6 ± 6.8	
> 15°	0	36.4	37.5	18.2	0	36.4	0	0	0
	n = 19	36.8 ± 11.1		10.5 ± 6.8		36.4 ± 14.5			
	+	63.6	16.7	9.1	16.7	27.3	18.2	8.3	0
	n = 23	39.1 ± 10.1		13.0 ± 7.0		45.5 ± 15.0		8.3 ± 7.3	

Intervertebral Disk Injuries

Formerly attention was directed almost exclusively to the vertebral fracture *per se* until it was gradually realized that the further course of the injury is to no small degree dependent on the absence or presence and nature of any involvement of the intervertebral disk (SCHMORL and LOB) or of the ligaments (NICOLL and LANGE). As already mentioned, such involvement is common: OLIN reported disk involvement in 80 per cent of his series, and ROGERS claimed that intervertebral disk injuries must be expected in 85 per cent of all fractures of the vertebrae (see FRIBERG, JAEGER, JUNGHANNS and others).

In the present series (see page 12) the fractures ran a less favourable course in cases with intervertebral disk injuries: the symptoms were more persistent, return to work was later and disability was more frequent than in patients without such involvement. It was therefore thought that it might be useful to analyse these complicated cases for any relationship between the degree of the intervertebral disk involvement and the frequency of symptoms and disability. The group was therefore divided into three subgroups (see table 10 and 11). Those cases with only reactionary disk changes[1] were allotted to subgroup

[1] The reactive changes are above all a consequence of injury to the annulus. The severity of these changes does not reflect the degree of disk involvement (JUNGHANNS, LOB, SCHMORL and WATSON-JONES). Disk involvement is not always roentgenologicaly demonstrable (BROCHER, FRIBERG & HIRSCH).

TABLE 10

Relationship between symptoms and temporary disability and intervertebral disk involvement expressed as percentages of the individual groups.

Disk injury Primary signs	Symptoms > 2 years			Disability > 1 year		
	insured	uninsured	entire series	insured	uninsured	entire series
0	29.6 ± 8.8 n = 27	18.8 ± 3.9 n = 32	23.7 ± 6.0 n = 59	3.7 ± 3.6 n = 27	3.1 ± 3.0 n = 32	3.4 ± 2.4 n = 59
slight	60.7	29.0	44.1	17.9	5.1	11.9
severe	60.0 62.2 ± 7.2	50.0 32.0 ± 6.6	53.3 46.3 ± 5.1	28.6 24.4 ± 6.4	11.1 8.6 ± 3.7	20.0 16.8 ± 3.9
with displacement	66.7 n = 45	22.2 n = 50	47.6 n = 95	36.4 n = 45	20.0 n = 50	28.6 n = 95
Difference D/Σ_D	3.0	1.7	2.9 (P < 2 %)	2.7 (P < 3 %)	1.1	3.1 (P < 2 %)

I (+). Those with a distinctly narrowed disk or fracture of the limbus (JUNGHANNS, LOB and others) and those with considerable herniation of the articular end-plates were assigned to subgroup II (++) and those with a slipped vertebra, i. e. a sign that the disk was either torn at the time of the accident or that the disk was undergoing serious progressive degeneration and possibly becoming instable, were allocated to subgroup III (+++). It is clear from table 10 that the frequency of symp-

TABLE 11

Relationship between disability (partial and complete) and intervertebral disk involvement expressed as percentage of the individual groups.

Disk injury	Insured n = 72		Uninsured n = 82		Entire series	
	slight disability	severe disability	slight disability	severe disability	slight disability	severe disability
0 n = 50	0	0	0	0	0	0
slight + n = 62	28.6	14.3	6.5	6,5	16,9	10.2 27.1 ± 5.8
severe ++ n = 21	40.0	20.0	0	10.0	13.3	13.3 26.6 ± 17.7
with displacement +++ n = 21	33.3	33.3	0	11.1	19.1	23.8 42.9 ± 12.9

toms was much higher among the patients with intervertebral disk involvement than among those without, especially in the insured patients. No relationship was found between the duration of the symptoms and the degree of severity of the intervertebral disk injuries, but there was a certain tendency towards a later return to work and a higher frequency of disability in those with a more severe intervertebral disk involvement. The difference was, however, not statistically significant (table 11).

Intervertebral disk injuries are of great importance in the prognosis of fractures of the vertebrae (LOB, SCHMORL, JUNGHANNS and others). Such injuries are sometimes not demonstrable until some time after the accident: this is a point that should be borne in mind, especially in the evaluation of compensation. It may be useful to point out that reactionary changes indicating disk injury (SCHMORL) may sometimes not

be roentgenographically visualizable until after a lapse of 4—6 months (LOB, JUNGHANNS and others), although HAUMANN is of the opinion that they may be detectable already after 4 weeks.

Intervertebral disk injuries must surely influence the symptoms and function in several ways. JUNGHANNS, LOB and others postulate that complicating intervertebral disk injury with possible damage to the soft parts produces local stiffness of the back. According to LOB, this is of greater importance in elderly patients, because in such persons general deforming spondylosis has already begun to decrease mobility of the spine. Intervertebral disks are avascular and therefore possess only poor power of repair: when injured they heal but slowly or not at all, and then unstability may be expected (see KNUTSON). Vertebral slipping may be due to either neural arch fracture, ruptured ligaments and to primary injury to the disk or secondary disk degeneration (WATSON-JONES, NICOLL). According to OLIN, injury to the intervertebral disk is liable to disturb the local mechanics of the small joints. Sometimes the disk prolapses posteriorly (ALBEE) possibly with involvement of the nerve roots. At this stage it might be convenient to refer to WIBERG'S studies on the pain which he suggests may arise from irritation of the ligamentous covering of the disk and which might explain the origin of lumbago and lower back pain. All of the above-mentioned factors must be considered in the evaluation of fractures of the vertebrae with intervertebral disk involvement. Another point that should perhaps be considered is the importance of the much discussed local traumatic spondylosis.

Local Traumatic Spondylosis

Local reactionary changes leading to the formation of spurs and bridges and often seen in the region of a fracture of the vertebra (according to HELLNER, in 75 per cent) were formerly believed to be periosteal callus formations or rests of fragments (GAUGELE, MAGNUS, WATSON-JONES). Later research has, however, revealed that periosteal callus hardly ever forms in these fractures (GÜNTZ, HAUMANN, LOB, JUNGHANNS). Animal experiments and histologic studies have shown that the proliferations are a manifestation of the reaction of the injured disk to trauma and that they are of the same nature as the changes seen in general deforming spondylosis. Because of the origin of these changes, and in order to distinguish them from general deforming spondylosis, they are usually classed as circumscript traumatic spondylosis.[1] It has been discussed whether or not these bony proliferations

[1] Not to be confused with KÜMMEL-VERNEUIL's traumatic spondylosis.

may be the cause of symptoms, but cumulative evidence (HELLNER) suggests that they are not. These formations are believed to increase in the region of the fracture if fixation is poor (HELLNER, JUNGHANNS, WATSON-JONES). The essential thing about these proliferations is that they indicate involvement of the disk and their formation is probably only a manifestation of attempted repair. In cases with large spurs the intervertebral foramen may become narrowed (LOB) and thereby sometimes involve the nerve roots (ALBEE).

The frequency of traumatic spondylosis is given by LOB, for example, as 53.3 per cent for cases with fractures of the end plates, for limbus fractures as 58.7 per cent and as 81.4 per cent for comminuted fractures of the vertebrae with dislocation. Injury to the annulus fibrosus is a necessary condition for the occurrence of traumatic spondylosis.

Table 12 summarizes the incidence of traumatic spondylosis in relation to the primary intervertebral disk injuries demonstrable shortly after the accident. At the reviewal roentgren examination showed traumatic spondylosis in 28.8 per cent of the cases without manifest signs of disk injury at the primary examination. It is possible that such injury was present in many of these cases at that time but had remained concealed. On the other hand, however, no signs of traumatic spondylosis were seen in 13.6 per cent of those with demonstrable intervertebral

TABLE 12

Frequency of local secondary changes at the reviewal in cases with and without primary signs of intervertebral disk involvement.

Prim. disk injury	Local secondary changes		
	0 n = 50	slight + n = 70	severe ++ n = 34
0 n = 59	71.2 n = 42	28.8 n = 17	0
slight + n = 59	13.6 n = 8	69.5 n = 41	16.9 n = 10
severe ++ n = 15	0	26.7 n = 4	73.3 n = 11
with displacement n = 21	0	38.0 n = 8	62.0 n = 13

disk involvement shortly after the accident. This discrepancy may possibly be ascribed to erroneous diagnoses, but it is also known that minor proliferations (spurs) can be absorbed in the course of healing (JUNGHANNS, LOB) and, secondly, that disk injuries do not always give rise to secondary changes in the surrounding structures, e. g. those with hernation of the end-plates without co-existent injury to the annulus. In younger patients a slight disk injury can heal. Of the 8 cases with primary signs of disk injury but without secondary changes, 5 were under 40 years of age. Severe local spondylosis was more common in those with severe intervertebral disk involvement. The difference was statistically significant, (for example, 62.0 ± 10.6 ... 16.9 ± 4.9 per cent) (se table 12). This does not, however, infer that the severity of the traumatic spondylosis varies with the severity of the disk injury in every single case. Table 13 also suggests that those who showed evidence of traumatic spondylosis at the reviewal returned to work later than the others: in addition, all the cases of permanent disability fell within this group (according to the χ^2 test $P < 0.1$ per cent). No such distinct relationship was seen between the incidence of traumatic spondylosis and the frequency or duration of symptoms.

TABLE 13

Frequency of symptoms, temporary disability and permanent (partial and complete) disability in relation to local traumatic spondylosis.

Traum. spondylosis	Symptoms > 2 years	Temp. disability > 1 year	Permanent disability	
			slight	severe
0	30.0	4.0	0	0
n = 50			0	
slight +	38.7	13.3	12.0	10.7
n = 70			22.7 ± 4.9	
severe ++	44.8	24.1	24.2	17,2
n = 34			41.4 ± 9.1	

The tendency possibly suggested by the table does not, however, infer that it was the local spondylosis *per se* that was responsible for the symptoms and disability, which should be ascribed above all to the intervertebral disk involvement and possible unstability, as reflected by the reactionary changes.

Neural Arch and Joint Process Involvement

As already mentioned (page 9 and table 1) the prognosis of fractures of the vertebrae is impaired not only by intervertebral disk involvement, but also by fractures of the neural arches and of the joint processes. These complicating fractures worsen the prognosis considerably, because they are often associated with luxation and subluxation. Even if such dislocation does not always injure the spinal cord or cauda, it does tear or rupture the disks, soft parts and ligaments. Traumatization of the ligaments and soft parts is known often to result in a varying degree of back stiffnees (JUNGHANNS) or unstability (LOB and NICOLL). In addition neural arch fractures heal poorly (according to SCHMIEDEN, satisfactory healing is achieved in only 20 per cent of the cases) and sometimes give rise to changes in the intervertebral joints and occasionally to a narrowing of the intervertebral foramen by dislocation or callus formation. These fractures are fairly common. HOWORTH, for example, gives a frequency of 15 per cent and stresses that they are often not detectable in the radiogram. LOB expressed the opinion that the neural arch or joint processes are involved in 69.5 per cent of all severe fractures of the vertebrae.

Involvement of the neural arch or joint processes was demonstrated in 18.8 per cent of the 154[1] cases (table 1). In these cases (subgroup B_3) the end-results were the poorest in the series. Such fracture-dislocations with or without involvement of the nerve roots are known to have a generally poorer prognosis. In the present series the severity of the damage in this category varied considerably from one case to another, and therefore it is difficult to judge the subgroup as a whole. The observation made in this subgroup are summarized in table 14, from which it is clear that these patients did not differ from the rest of the series as far as symptoms are concerned. However, the figures for the duration of temporary disability and frequency of permanent disability in patients with neural arch or joint process injure were nearly always higher. The number of cases was not large and the differences were not statistically proved, but the tendency was obvious. The high frequency of slightly reduced working capacity in the insured as compared with the absence of such disability in the uninsured is remarkable. No certain explanation can be offered for this. It might, however, to a certain extent be explained by the tendency of the insured to exaggerate their symptoms (BÜRKLE de la CAMP, BÖHLER and LOB).

[1] On perusal of the records at the department, 4 cases of isolated neural arch fractures were traced. The patients were reviewed and the fractures were found to have healed, and the patients were free of symptoms. Owing to the smallness of the group, it was not included in the present series.

TABLE 14

Relationship between the frequency of cases with and without involvement of the neural arch or joint processes and the frequency of symptoms and temporary disability and permanent (partial and complete) disability.

Involvement of neural arch or joint processes	Symptoms > 2 years		Temporary disability > 2 years		Permanent disability			
					insured		uninsured	
	insured	uninsured	insured	uninsured	slight	severe	slight	severe
0 n = 125	38.6 ± 6.5	23.5 ± 5.2	8.8 ± 3.8	4.4 ± 2.5	12.3 ± 4.3	8.8 ± 3.8	2.9 ± 4.1	2.9 ± 4.1
+ n = 29	53.3 ± 12.9	21.4 ± 10.9	33.3 ± 12.1	14.3 ± 9.3	46.7 ± 12.9	26.7 ± 11.5	0	14.3 ± 9.2

NICOLL described as unstable a group of fractures of the vertebrae with less favourable prognosis and requiring fixation because of the risk of progressive deformity. He classes as unstable all subluxations with associated rupture of the interspinous ligaments, all fracture-dislocations and all neural arch and laminar fractures at the level of the fourth and fifth lumbar vertebrae. This fracture group illustrates the prognostic importance of involvement of the soft parts in fractures of the vertebrae.

Of the 154 cases in the present series, 17 satisfied NICOLL's requirements for classification as unstable. In 11 of them there was evidence of increased subluxation or deformity. By the time of the reviewal the lesion had healed with demonstrable bridging of the vertebrae in 5 cases. An analysis of these 17 cases is summarized in table 15. We see, then, that the interval before the patients returned to work in this group was longer than for the patients assigned to subgroup B_3 (tables 1 and 14). But no other differences were demonstrable.

TABLE 15

Survey of 17 cases filling NICOLL's *requirements for classification as unstable.*

Symptoms > 2 years	Temporary disability 1 year	Permanent disability		Nervous symptoms [1]
		slight	severe	
35.4 %	47.1 %	41.2 %	29.4 %	35.4 %

[1] As mentioned earlier, cases with complete paraplegia are not included.

ANALYSIS OF THE SYMPTOMS

Evaluation of Symptoms

In the analyses hitherto presented the duration of symptoms and reduction in working capacity have been studied in relation to a number of general and constitutional factors, to different types of vertebral fractures and certain relationships were found. In most of these analyses the insured were also found to differ from the uninsured. As mentioned in the introduction, this difference has been suggested by earlier writers: here it was proved statistically. Despite this difference, it hardly sounds reasonable to suppose that the prognosis of the same kinds of fractures in the uninsured should differ from those in the insured. The question that then presents itself is whether one can demonstrate a coincidence or a difference between the symptoms claimed and the clinical findings at the reviewal. As objective an evaluation as possible of the state of the patient is a necessity for a just settlement of compensation. It is known that insured patients are sometimes inclined to exaggerate their symptoms and some of the patients are well aware of such exaggeration and over-compensation, as was confirmed at the present reviewal. On the other hand, the actual disability observed in some cases suggested that the patients were under-compensated.

Proper evaluation of these symptoms is no easy matter and requires a fair amount of experience on the part of the examiner. That the examiner must try to be as objective as possible is self-evident. It is very difficult to find evaluation standards and another difficulty is to deduce the severity of the symptoms from the clinical and radiographic findings. NICOLL tried to give a scheme for analysing pain, range of motion, strength and endurance. A similar method was adopted in the present investigation and an attempt was made to analyse local pain, backache +weakness, back stiffness and the neurologic symptoms. Simultaneous comparison of the insured with the uninsured gave a fairly good standard for the evaluation of the findings.

The subjective nature of pain and back weakness makes it almost impossible to prove or disprove the presence of these symptoms with anything like accuracy, and to grade them according to severity is still more difficult. It is, of course, impossible to judge whether or not a patient realy has pain, but with experience it is possible to a certain

extent to judge the patients' reaction during the examination. In tables 16—18 the cases are classed according to the presence or absence of local pain claimed. All degrees of pain, from the slightest to the severest were included. These reports were then checked with the observations made at the clinical reviewal, i. e. with the presence or absence of tenderness to deep palpation, thumps or jerks and of local pain on movement, i. e. pain at the site claimed by the patient (*provoked local pain*). Reported stiffness of the back was likewise checked at the reviewal. These clinical methods for the assessment of pain and mobility are, of course, crude, but they are the only ones available, except perhaps roentgenographic methods measuring movement. Even in the evaluation of mobility, the measurement offering least difficulty, we meet such complicating factors as constitutional differences. The registration of local slight reduction in local mobility is not easy either. By marking the spinous processes and comparing the different sections of the spine it is, however, possible to obtain a fair idea of any fixation of the back.

TABLE 16

Comparison of the insured with the uninsured regarding local pain claimed and provoked local pain at the reviewal in patients with and without intervertebral disk involvement. (The figures indicate percentages of the individual groups.)

Symptom	Percentage frequency of pain			
	without primary signs of disk involvement		with primary signs of disk involvement	
	insured n = 27	uninsured n = 32	insured n = 45	uninsured n = 50
Local pain claimed n = 48	25.9	15.6	53.3	24.0
Provoked local pain n = 27	14.8	9.4	24.4	18,0
Difference D/Σ_D	11.1 ± 6.0	6.2 ± 4.2	28.3 ± 6.7	6.0 ± 3.4
	0.6		3.0 ($P < 0.5\,\%$)	

Local Pain

The frequency of Local Pain in Patients without and with Primary Signs of Disk Involvement

As to the frequency of fractures without primary signs of disk involvement, the presence or absence of local pain claimed was usually in accord with the clinical findings (provoked local pain) in both the insured and uninsured (table 16). But this was by no means the case with the patients with complicating intervertebral disk injury. Here the insured group (28.3 per cent) differed widely from the uninsured (6.0). This difference was statistically significant (according to χ^2 $P < 0.5$ per cent). Comparison of the insured with the uninsured thus suggested the conclusion that insured patients with severe injuries were inclined to exaggerate their symptoms. In these cases a certain degree of residual changes must be present, for in the less severe cases with minor changes hardly any tendency to exaggeration was noticed. In the latter case the patients probably had no feeling of decreased function and therefore thought that it was hardly worth while pretending they had. Moreover, all of the persons in this group except one had returned to their usual occupation. That insured patients with more pronounced residual changes exaggerated any reduction in function in order to obtain higher compensation from the insurance company is understandable. On the other hand, in order to maintain his income and social standing despite obviously reduced working capacity, an uninsured person may try to make himself believe that any residual symptoms are less severe than they really are.

Local Pain and Traumatic and General Deforming Spondylosis

Though traumatic spondylosis *per se* has no appreciable effect on residual symptoms (page 29), demonstration of its presence does indicate that the disk has been injured. An attempt was therefore made to use traumatic spondylosis as an indicator of the presence and degree of intervertebral diskinjury. The results are summarized in table 17, where the groups are compared in the same way as in table 16. Certain constitutional factors, especially general deforming spondylosis, is also capable of producing the symptoms referred to above, so that it is sometimes difficult to say whether or not the symptoms should be ascribed to deforming spondylosis. In other cases it is difficult to decide to what extent the symptoms should be ascribed to the co-effect of the deforming spondylosis and the traumatic changes. This is an important point, because, as shown above, general spondylosis cannot be considered the result of a single trauma, besides which it is usually accepted

that it can hardly be worsened by a single blow either (JUNGHANNS). It is feasible that a single trauma can transiently decrease the function of a back weakened by general spondylosis, but it is hardly credible that such a blow can have any increased permanent effect on the symptoms of spondylosis (BROCHER, JUNGHANNS and others). It was therefore thought necessary to take into account the frequency of residual pain from deforming spondylosis. For this purpose the series was classed according to the presence or absence of general deforming spondylosis demonstrable at the reviewal (table 17). The table suggests the following conclusions.

TABLE 17

Relationship between the frequency of local pain claimed and provoked local pain in insured and uninsured with and without traumatic and general deforming spondylosis at the reviewal.

Symptoms	Without gen. def. spondyl.				With gen. def. spondylosis			
	insured		uninsured		insured		uninsured	
	0 traum. spond. n = 14	+ traum. spond. n = 20	0 traum. spond. n = 20	+ traum. spond. n = 18	0 traum. spond. n = 5	+ traum. spond. n = 33	0 traum. spond. n = 11	+ traum. spond. n = 33
Local pain claimed	21.4	35.0	15.0	22.2	0	63.6	18.2	24.2
Provoked local pain	21.4	10.0	15.0	16.7	0	27.3	9.1	15.2
Difference	0	25.0 ± 9.7	0	5.5 ± 5.4	0	36.3 ± 8.4	9.1 ± 8.6	9.0 ± 5.0

a) Provoked local pain is about as common in the uninsured, as in the insured irrespective of the presence or absence of general spondylosis. This is apparent from the following figures.

Frequency of provoked local pain in all patients

with general spondylosis ..... 18.3±4.3 per cent

Frequency of provoked local pain in all patients

without general spondylosis ..... 15.3±4.2 „ „

Thus residual local tenderness and pain on movement were not manifestly related to general deforming spondylosis. The figures also suggest that the residual pain was due to the accident and not to general deforming spondylosis.

b) Hardly any relation existed between intervertebral disk injury, as indicated by demonstrable traumatic spondylosis and provoked local pain.

c) However, a statistically probable difference was found in the insured with signs of traumatic spondylosis. In these patients there was a much larger deviation between the local pain claimed and the clinical findings. This was especially so in those with coexistent signs of general deforming spondylosis. The difference was 36.3 per cent, as compared with a difference of 9.0 per cent for the uninsured (see table 17). The difference was statistically probable (according to the χ^2 test $P < 1.0$ per cent). As mentioned in an earlier section, this suggests that a certain degree of anatomic changes is a pre-requirement for such over-estimation.

Arthrosis of the Intervertebral Joints and Local Pain

According to BÖHLER, LANGE and others, arthrosis of the intervertebral joints is largely responsible for residual symptoms, especially for local pain (see page 21). The oblique views taken in the roentgenographic investigation at the reviewal showed arthrosis of the intervertebral joints in 24 of the cases. The frequency of local pain and observations made at the clinical reviewal are summarized in table 18. The number of cases here was thought to be too small to permit subgrouping. It is clear from the table that residual local pain was not more common in this group than in the series as a whole. This does not infer that these changes are of no prognostic importance, but it does argue against the concept that arthrosis of the intervertebral joints is a dominating cause of local residual pain.

TABLE 18

Relationship between the frequency of local pain claimed and provoked local pain in patients with spondylarthrosis and the entire series.

Symptoms	With signs of spondylarthrosis n = 24	Entire series	
		without gen. def. spond. n = 72	with gen. def. spond. n = 82
Local pain claimed	33.3	23.6	37.8
Provakod local pain	20.8	15.3	18.3
Difference	12.5 ± 6.7	8.3 ± 3.3	19.5 ± 4.4

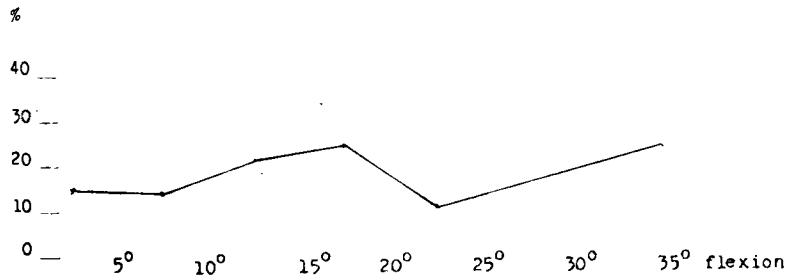
TABLE 19

Relationship between the frequency of local pain claimed, provoked local pain and degree of spinal deformity.

Symptoms	Kyphosis				Kyphosis + scoliosis			
	insured		uninsured		insured		uninsured	
	inflexion		inflexion		inflexion		inflexion	
	$< 15°$ n = 40	$> 15°$ n = 8	$< 15°$ n = 41	$> 15°$ n = 11	$< 15°$ n = 14	$> 15°$ n = 10	$< 15°$ n = 17	$> 15°$ n = 13
Local pain claimed	35.0	25.0	14.6	27.3	57.1	70.0	23.5	30.8
Provoked local pain	15.0	12.5	12.2	18.2	21.4	40.0	17.6	15.4
Difference	20.0 ± 6.3	12.5 ± 11.8	2.4 ± 2.5	9.1 ± 8.6	35.7 ± 12.8	30.0 ± 14.5	5.9 ± 5.7	15.4 ± 10.0

Spinal Deformity and Local Pain

No relationship was found between provoked local pain and the size of the angle of flexion (curve 8). Neither does table 19 show any difference between the cases with a flexion angle of less or more than 15°. Nor was local pain more common in those with coexistent kyphosis and scoliosis. This suggests, then, that the frequency of this local pain does not increase with increasing severity of spinal deformity.



Curve 8

Frequency of provoked local pain and residual flexion.

The table also shows a similar discrepancy between the frequency of symptoms claimed and the frequency of the clinical findings in the insured. This difference was most striking in the patients with flexion of less than 15 degrees. In the insured the difference was 20.0, as against 2.4 per cent in the uninsured. This difference is statistically probable (according to the χ^2 test $P < 2$ per cent). A similar tendency was observed in the subjects with both kyphosis and scoliosis. The above-mentioned finding that the degree of deformity and the local pain are fairly independent of one another also supports the conclusions made about spondylarthrosis and symptoms (page 22).

To recapitulate, the analysis produced no evidence arguing that residual local back pain is more common in subjects with static malalinement and possibly associated disturbance of the local mechanics of the intervertebral joints.

Fractures of the Neural Arch and Joint Processes and Local Pain

It is obvious from the preceding sections that malalinement and arthrosis of the intervertebral joints can hardly be important causes of residual pain. A fracture of the joint, joint processes or neural arch may, however, be capable of causing such pain. In these cases the anatomic changes can lead to reduced stability. Such unstability is favoured not only by the actual fracture and deformation of the joints *per se*, but

also by the known poor healing tendency of neural arch fractures (SCHMIEDEN), by associated rupture of the ligaments and injury to the disk and the soft parts (NICOLL). As mentioned before (page 30), in fractures of the neural arch other factors may also be responsible for residual local pain, e. g. narrowing of the intervertebral foramen by instant or gradual slipping of the vertebra, callus etc. Despite the wide variation in the severity of co-existent fractures of the neural arch and of the joint processes and the consequent difficulty in analysing the material, the cases were therefore put together and treated as a single group in table 20.

The frequencies of local pain claimed and the clinical findings made in these 29 cases are compared with corresponding figures for the rest of the series in table 20. Clinically provoked local pain was almost twice as common among these 29 as among the rest (27.6 per cent, as against 14.4 per cent). This difference was not statistically significant. There was, however, a possible tendency for provoked local pain to be more common in patients with fractures of the neural arch and joint processes than among the others. The table also shows that the difference between the frequency of reported local pain and the frequency of provoked local pain at the clinical examination was about the same for both the insured and the uninsured. This suggests that the subjects with more serious changes did not exaggerate any local pain as frequently as did those with moderate changes (see page 35). The higher figures for the patients with involvment of the neural arch or joint processes compared with those without (see table 20) are hard to explain but may be due to the higher frequency of neurologic lesions in the former. (See page 42.)

TABLE 20

Relationship between the frequency of local pain claimed and provoked local pain in patients with and without signs of involvement of the neural arch of joint processes.

Symptoms	Involvement of neural arch or intervertebral joint processes		Without involvement of neural arch or intervertebral joint processes	
	insured n = 15	uninsured n = 14	insured n = 57	uninsured n = 68
Local pain claimed	53.3	35.7	35.1	17.6
Provoked local pain	33.3	21.4	15.8	13.2
	(27.6 ± 8.3)		(14.4 ± 2.8)	
Difference	20.0	14,3	19.3	4.4

Assessment of the degree of unstability by methods such as that described by KNUTSON would, of course, have been of value. Unfortunately, no such investigation was made. However, the reactionary bony proliferations (local traumatic spondylosis) may be used as a sign of unstability. According to ALBEE et al., JUNGHANNS and WATSON-JONES, such proliferations are larger if the region of the fracture is not immobilised. It is difficult to evaluate the size of such proliferations, so that it is hardly possible to make any definite conclusion about this point. In the entire series there were 28 cases with pronounced osteophytic spurs. Among these provoked local pain was recorded in 14.3 per cent and therfore they did not differ in this respect from the rest of the series (table 20). It should be mentioned that in almost half of the cases bridging was observed. Such bridging, had no appreciable influence on the frequency of local pain in the remainder (20.0 per cent). Neither did an analysis of the cases for those filling the requirements laid down by NICOLL for a case to be classed as unstable help to settle the question whether unstability favours the occurrence of local pain.

In subgroup B_3 the vertebra had slipped in 9 of the subjects. In subgroup B_2 and B_1 there were only 4 such cases and in these it was due entirely to intervertebral disk degeneration. Such secondary slipping suggests poor fixation. Local provoked pain was noted in 23.1 per cent of these 13 subjects and therefore give no indication as to whether such slipping is a common cause of local pain.

The analysis thus gave no answer to the question whether unstability is a cause of local pain. This does not, however, exclude this possibility. Further investigation of this point is desirable.

As already mentioned, several factors may be involved in the cause of the tendency of pain to be more common in subjects with fractures of the neural arch and joint processes. If we now direct attention to the actual intervertebral joints, joint processes and the neural arches, it was found that of the 29 cases, examination at the reviewal revealed changes in one or more of these skeletal parts in 20. In 2, possibly in 3, there was still a manifest defect of the neural arches. The frequency of provoked local pain in these 20 cases was 30.0 ± 11.6 per cent and does not differ statistically from the cases in the rest of the series, 14.4 ± 2.8 per cent, though the figure 30.0 may suggest a possibility.[1] Intimately connected with these injuries is a narrowing or deformation of the intervertebral foramen. Such changes were seen in 25 cases (86.2 per

[1] Narrowing of the intervertebral foramen was recorded in 12 of the cases in the other series. Of these, 8 were due to intervertebral disk generation and 4 to fracture fragments. The frequency of local pain in these 12 cases was 25 per cent.

cent) of group B_3 and of these, provoked local pain was recorded in 32.0 ± 9.3 per cent.

The analysis thus showed a possible tendency for local residual pain to be more common in those subjects with fracture deformity of the neural arch or joint processes and those with narrowing of the intervertebral foramen than in the rest of the series (see table 20).

This suggests that deformity and joint changes may play a part. This assumption cannot, however, be forthwith accepted and the analysis of the conditions is complicated by various factors. For example, the frequency of nervous symptoms was highest in this group of fractures of the vertebrae. (As pointed out in the beginning of this paper, cases with total paraplegia were not included in the present investigation). The neurologic findings are summarized in table 21, from which it is clear that nervous symptoms in group B_3 were almost three times as common as in the other two subgroups together (34.4 per cent as against 12.0 per cent). The difference was statistically probable (according to the χ^2 test $P < 1.0$ per cent).

TABLE 21

Neurologic symptoms in the various fracture-groups.

Fracturegroup	Partial paresis	Impaired reflexes	Impaired reflexes and sensibility disturb.	Over-all frequency of nervous symptom
A n = 59	0	2	0	
B_1 n = 52	1	7	2	12.0 %
B_2 n = 14	2 [1]	1	0	
B_3 n = 29	3	4	3	34.5 %

[1] Compression of medulla by displacement of a bone fragment against the neural canal.

Lumbago and Sciatica

It is known that prolapse and protrusion of the intervertebral disk is capable of causing lumbago and sciatica, and essential factors of the mechanism involved have been cleared up. The importance of trauma as a causal factor has been the subject of much discussion (ALBEE, BROCHER, LOB, WIBERG and others), and isolated injury to otherwise apparently sound intervertebral disks is known to occur, especially on

violent hyperextension of the spine, but such complications are believed to be uncommon. Other causes of root symptoms are, for example, neural arch injuries and narrowing of the intervertebral foramen. Altogether 11[1] of the subjects complained of sciatica since the accident, but none of them considered the pain severe enough to require hospital treatment. Most of them had only one or at most a couple of brief attacks.

Acute lumbago was reported by 10 (2 of them had also had sciatica). In these cases, too, the attacks had been brief and the pain had gradually passed off. The distribution of the cases with sciatica and acute lumbago is given in table 22. It is obvious from the table that the fracture was located to the thoraco-lumbar junction or to the lumbar region. Neural arch fractures do not seem to be of appreciable importance as a cause of such pain. Thus in 19 (about 12 per cent) of the 154 subjects, then, lumbago and sciatica occurred after the accident, but the symptoms were not severe. In about 80 per cent of these cases the radio-

TABLE 22

Relationship between symptoms of sciatica and lumbago [1] and the level of the fracture the presence of general and traumatic spondylosis and narrowing of the intervertebral foramen.

Level of fracture	Sciatica						Lumbago attacks					
	Gen. def. spondyl.		Traumat. spondyl.		Narrowing of interv. foramen		Gen. def. spondyl.		Traumat. spondyl.		Narrowing of interv. foramen	
	0	+	0	+	0	+	0	+	0	+	0	+
Th_{11}—L_1	1	6	1	6	6	1	1	4	0	5	3	2
L_2—L_5	1	3	1	3	3	1	0	3	1	2	3	0

[1] Two patients with both sciatica and lumbago symptoms are classed under "sciatica". Three patients with fractures of the middle thoracic vertebra had pain round the trunk.

graphs showed traumatic or general deforming spondylosis. In 4 of the sciatica cases and in 1 of the cases of lumbago reflex anomalies were demonstrated. The possibility of a primary or secondary prolapse of the disk due to the injury in these patients cannot, of course, be excluded, and myelographic examination would possibly have been informative, but those patients offered such investigation were not willing to cooperate.

[1] In 3 cases the patients had had sciatica before the fracture, and in these lumbosacral disk degeneration was demonstrated at the reviewal.

Lower Back Pain and Weakness of the Back

These are among the most common residual symptoms of fractures of the vertebrae. The patients complain of more or less frequent spells of back pain (backache) and weakness sometimes causing reduction in working capacity. This is sometimes accompanied by diffuse ache, usually in the lumbar region. A typical feature of such pain is that it usually disappears during rest and reappears and becomes worse on strenous exertion. In many cases these symptoms are associated with local pain at the site of the fracture. NICOLL tried to evaluate the reduction in working capacity ascribable to such symptoms. It is, of course, not possible to find a masure for anything like an accurate evaluation of these symptoms, for the examiner must base his judgement entirely on the patient's report. Nevertheless, it was thought of interest to compare the insured with the uninsured in this respect. The results of such a comparison are summarized in table 23, where the cases are classed according to the severity of the symptoms claimed.[1] In the table slight

TABLE 23

Percentage of patients with symptoms of backache+weakness[1] *at the time of the reviewal.*

Symptoms	Insured n = 72	Uninsured n = 82	Difference D/Σ_D
0	62.5 ± 5.7 n = 45	75.6 ± 4.7 n = 62	1.8
slight	20.8 ± 4.8 n = 15	15.9 ± 4.0 n = 13	0.8
severe	16.7 ± 4.4 n = 12	8.5 ± 3.1 n = 7	1.5

[1] All degrees have been included. Cf. table 1.

symptoms are to be understood as symptoms not severe enough to reduce working capacity to any appreciable degree, while symptoms reducing working capacity are classed as severe. The frequency of lower back pain and weakness was thus higher among the insured than among the uninsured. This was particularly the case with severe symptoms, which were twice as common among the insured. The difference is, however, not statistically significant.

[1] Only a few reported to have had such trouble before the injury.

In the evaluation of these symptoms the occupations of the patients must be considered. It is clear from table 24 that the symptoms were more common among heavy workers. No relation was found between the frequency of back pain and weakness and the age at the time of the accident (table 25 and curve 9). In this respect, then the elderly patients were not worse off than the younger (see BÖHLER).

TABLE 24

Frequency of backache+weakness ("severe") in heavy workers and light workers.

Type of work	Insured n = 72	Uninsured n = 82
light n = 62	4.0 ± 3.9 %	4.3 ± 2.9 %
heavy n = 92	23.4 ± 6.1 %	14.3 ± 5.9 %

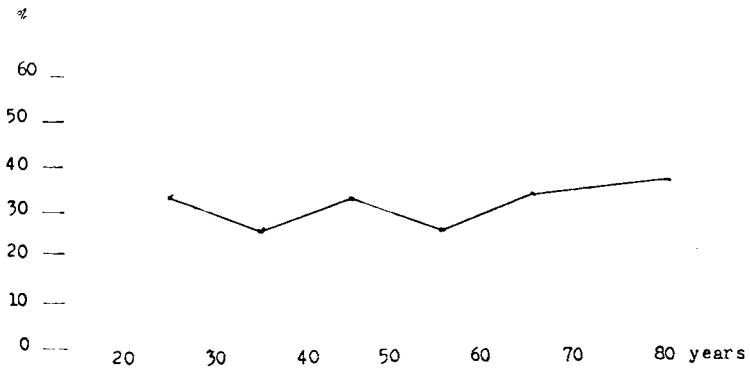
TABLE 25

Frequency of backache+weakness in patients above and below 40 years of age at the time of the injury.

Age-group	Insured n = 72		Uninsured n = 82	
	Symptoms		Symptoms	
	slight	severe	slight	severe
< 40 years n = 61	21.2	15.2	13.3	10.0
> 40 years n = 93	20.5	17.9	17.3	7.7

Here, as in the analysis of the frequency and intensity of local residual pain, the mental make-up must also be considered. Other constitutional factors possibly influencing the occurrence are deforming spondylosis and osteoporosis.

The incidence of the symptoms in patients with and without spondylosis is given in table 26. The frequency of back pain and weakness in those with general spondylosis did not differ from those without such changes, nor was any such difference seen between, those radiographically demonstrable, severe, deforming spondylosis and the remainder.



Curve 9

Relationship between the frequency of low back pain + weakness and age.

In the insured group, however, there was a certain preponderance. In those with slight spondylosis at the time of the reviewal it was 44.4 ± 9.6 per cent as against 20.9 ± 8.3 per cent in the uninsured.

Roentgenographic signs of general osteoporosis were seen at the

TABLE 26

Relationship between the frequency of backache+weakness in patients with and without general deforming spondylosis.

	Gen. def. spondyl.	Insured		Uninsured	
		Symptoms		Symptoms	
		light	severe	light	severe
At time of accident	0	22.0	16.0	15.7	9.8
		n = 50		n = 51	
	+	19.0	14.3	14.3	7.1
		n = 21		n = 28	
	++		100	33.3	
		n = 1		n = 3	
At time of reviewal	0	17.6	14.7	18.4	10.5
		n = 34		n = 38	
	+	25.9	18.5	16.7	4.2
		n = 27		n = 24	
	++	18.2	18.2	10.0	10.0
		n = 11		n = 20	

reviewal in 14 cases. In half of them the patients reported lower back pain and weakness: 5 of them described their trouble as severe and 2 as slight. The frequency of back pain and weakness in this group was thus possibly higher than in the rest of the series.

Disk Involvement

If we compare the occurrence of lower back pain and weakness with the frequency of primary injury to the intervertebral disk (table 27), we see that these symptoms were more common in patients with such disk involvement. In the group with primary intervertebral disk involvement the frequency was 38.9 per cent as against 18.6 per cent in the group without signs of primary disk involvement. This difference is statistically probable (according to the χ^2 test $P < 1$ per cent). As

TABLE 27

Frequency of backache+weakness in patients with and without primary signs of intervertebral disk involvement.

Disk injury	Symptoms		
	slight	severe	slight + severe
0 n = 59	11.8 ± 4.2	6.8 ± 3.3	18.6 ± 5.1
slight n = 59	23.8	16.9	
severe n = 15	20.0 — 22.1 ± 4.3	20.0 — 16.8 ± 3.9	38.9 ± 5.0
luxation and subluxation n = 21	19.0	14.3	
Difference D/Σ_D	1.7	2.0	2.9 (P < 1 %)

expected, then, back pain and weakness was claimed more often in cases in which the subjects had sustained more severe injury. To what extent this may be ascribed to the actual disk involvement is difficult to say. However, the frequency of symptoms claimed by subjects with traumatic spondylosis, which, as pointed out earlier, is a definite sign of a changed disk, is summarized in table 28. The table shows no relationship. The fact that the frequency of the symptoms in the uninsured was roughly the same among those with and without traumatic spondylosis and to a certain extent the same as the figures for the insured

patients without local changes, suggests that traumatic spondylosis does not appreciably influence the frequency of the symptoms. The figure 43.4 per cent (see table 28) is, however, less reliable, especially in view of what was said before about the possible over-estimation. That it was mainly the cases with slight symptoms (24.5 per cent) that was responsible for this increase tends to support the probability of this being the case.

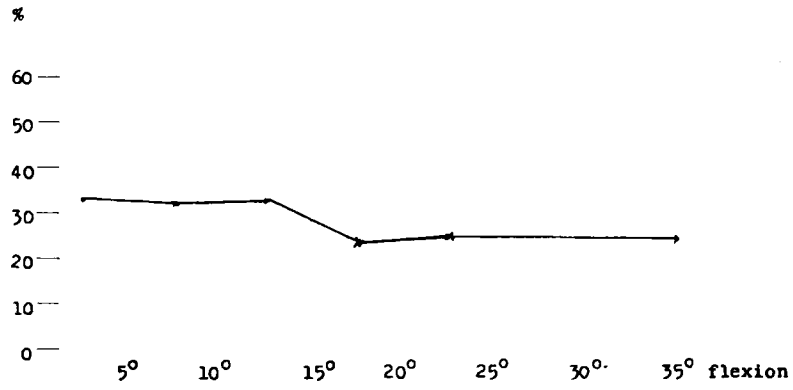
TABLE 28

Frequency of backache+weakness in patients with local traumatic spondylosis.

Traumatic spondyl.	Insured n = 72		Uninsured n = 82		Entire series	
	Symptoms		Symptoms		Symptoms	
	slight	severe	slight	severe	slight	severe
0	10.5	10.5	19.3	6.5	16.0	8.0
n = 50	21.1 ± 9.3		25.8 ± 7.9		24.0 ± 6.0	
+	24.5	18.9	14.1	9.4	19.3	14.4
n = 104	43.4 ± 6.8		23.5 ± 6.0		33.7 ± 4.6	

Spinal Deformity

In patients with spinal deformity, one is often inclined to ascribe any residual back pain and weakness to the deformity. It is believed among other things that the changed static mechanics of the spine cause an increased abnormal strain on the muscles, ligaments etc., at least if the deformity is not fixed.



Curve 10

Relationship between the frequency of low back pain+weakness and residual flexion.

With this in mind reference is made to curve 10, which compares the frequency of lower back pain and weakness with the severity of the flexion, as measured at the reviewal. No relationship was found between the frequency of back pain and weakness and the size of the angle. Table 29, in which the presence of scoliosis is also taken into account, conveys the same impression. The figures, then, suggest that the frequency of lower back pain and weakness does not increase with increasing degree of spinal deformity. However, comparison of these figures with table 31, which shows the frequency of objectively confirmed back stiffness did suggest the frequency of stiffness to increase with increasing deformity of the spine. The question that then presents

TABLE 29

Relationship between the frequency of backache+weakness and residual spinal deformity at the time of the reviewal.

Flexion	Scoliosis	Symptoms	
		slight	severe
$< 15°$	0 n = 81	17.3	13.6
	+ n = 31	19.4	16.1
$> 15°$	0 n = 19	15.8	5.3
	+ n = 23	21.7	8.7

itself is whether the curve for lower back pain and weakness is influenced by increasing stiffness of the back and whether the latter is responsible for the flat course of the curve. A corresponding assumption might possibly be made in the evaluation of the frequency of residual local pain which was not found to bear any relationship to the degree of deformity either.

Stiffness of the Back

Stiffness of the back is mainly an aging phenomenon and as such it is associated with general deforming spondylosis. Several pathologic conditions such as fractures of the vertebrae are known sometimes to be followed by stiffness of the back. It is, however, no easy matter in a given case to decide whether and to what extent the spinal injury is

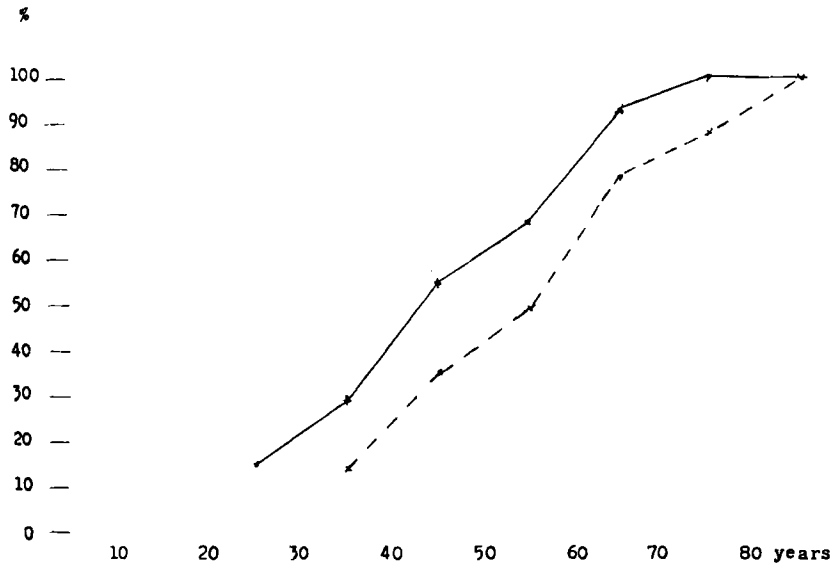
responsible for demonstrable spinal immobility or whether any reduction in mobility should be ascribed to other factors. Local stiffness in the region of a fractured vertebra of an otherwise mobile spine suggests the fracture as the causal factor. The picture is not always so clear, but is often complicated by co-existent spondylosis, which then makes the decision difficult. As already mentioned, it is not always possible to detect a slight stiffness of the back with certainty. On the other hand, it seems that decreased spinal mobility is only one of the minor causes of disability from fractures of the vertebrae. Sometimes local or even general stiffness of the back may result in freedom from pain, backache and weakness and thereby promote the function. Traumatic local spondylosis can, in this way, lead to a bridging of the fragments and thus produce the same effect as ALBEE's operation. The importance of such bridging in unstable fractures is obvious. It is therefore questionable whether it is a wise policy to try to correct the anatomy of the fractured vertebra possibly at the expense of stability. It should also be recollected that manipulation during reduction of a fracture may often lead to further injury of the disks (LOB), and in view of their avascularity and poor healing power, such injury may impair the end-results, or at least retard healing. It has also been stressed by NICOLL that interspinal ligaments never completely recover from important injuries, nor is their normal strength restored, despite exact reposition.

Stiffness of the back at the site of the injury is therefore not always a disabling symptom, but in many cases a change favouring spinal function. Therefore, in the present investigation such local stiffness was not said to be a really disabling symptom. It was considered useful to analyse the material for any relationship between back stiffness and spinal injuries.

Back Stiffness and Deforming Spondylosis

As pointed out above, back stiffness is essentially an aging phenomenon, and if we now study the frequency of back stiffness observed in the various age-groups at the reviewal (curve 11), we find that the frequency of back stiffness increased with increasing age. The figure also contains the frequency curve for general spondylosis seen in these cases. The curves do not differ appreciably from one another in shape, which suggests that they are functions of the same factors, especially of the ages of the patients. The frequency of back stiffness was, however, slightly higher throughout than that of general spondylosis. This suggests that the stiffness is related to but not coincident with general deforming spondylosis. This may be due to the fact that deforming

spondylosis may cause a certain degree of back stiffness without the pathologic changes being roentgenographically demonstrable. On the other hand, in the younger age-groups, the course of the curves may indicate that this lack of coincidence must be due to a factor common to all ages. This common factor is probably the stiffness resulting from the fracture. A curve of the frequency of back stiffness before the



Curve 11

Comparison of the frequency of backstiffness and general deforming spondylosis in the various age groups at reviewal.
Back stiffness = ————
Gen. def. spondylosis = — — — —

injury in these patients and a corresponding one for a series of controls including any with uncomplicated deforming spondylosis would have been valuable for checking the tenability of this assumption, but unfortunately no such curves were available.

Back Stiffness and Local Traumatic Spondylosis

However, it is possible to form an opinion of the importance of general deforming spondylosis and the lesion (as seen in traumatic spondylosis) in relation to back stiffness (table 30). The frequency of reduced spinal mobility in subjects with general deforming spondylosis differed statistically from the frequency found in those without this condition. The figures for cases without traumatic spondylosis were 56.3 per cent

TABLE 30

Relationship between the frequency of back stiffness observed in patients without and with traumatic and general deforming spondylosis.

State	Without traum. spondyl. n = 50	With traum. spondyl. n = 104	Difference D/Σ_D
Without gen. def. spondyl. n = 72	14.7 ± 6.1	26.3 ± 7.1	1.2
With gen. def. spondyl. n = 82	56.3 ± 12.4	74.2 ± 5.4	1.3
Difference D/Σ_D	3.0	5.4	

and 14.7 per cent respectively (difference according to χ^2 test, $P < 0.3$ per cent) and for the groups with co-existent traumatic spondylosis were 74.2 per cent and 26.3 per cent. This shows that general deforming spondylosis was an important causal factor of back stiffness in the present series. The high frequencies found in the groups with traumatic spondylosis shows that the fractures of the vertebrae were also responsible for back stiffness. That local traumatic spondylosis and back stiffness are often co-existent is also obvious from a comparison between the frequency of all cases with roentgenographic signs of such changes and that found in all subjects without such signs. The frequency for the former group was 58.7 ± 4.7 per cent against 20.0 ± 6.0 per cent for the latter. The difference is statistically significant ($D/\Sigma_D = 5.6$).

The question then presents itself whether any relationship could be demonstrated between intervertebral disk injury demonstrated shortly after the injury and back stiffness seen at the reviewal. At the reviewal of those cases which showed no primary signs of such disk involvement back stiffness was seen with a frequency of 37.3 ± 6.3 per cent as against 53.7 ± 5.1 per cent) in those with exidence of such involvement at the time of the injury. Though the difference is not statistically significant, the tendency is obvious.

Back Stiffness and Deformity

It was considered of interest to try to find out whether and to what degree primary injury of the vertebrae and subsequent deformity were responsible for back stiffness. When studying the possible cause of

back stiffness following deformity, the influence of any general deforming spondylosis must also be considered. Such consideration has been given to this influence in table 31. It is clear from the table that back stiffness was more common in subjects with more severe flexion. The difference (44.4—14.8 per cent) is not statistically significant, but the tendency cannot be denied. However, another factor, age, must also be taken into account. It was shown earlier (page 23) that more severe flexion is more common among elderly patients and that age must be at least partly responsible for this difference. A comparison of the mean

TABLE 31

Relationship between the frequency of back stiffness observed and residual deformity in patients with and without deforming general spondylosis.

Deformity		Without gen. def. spondyl. n = 72	With gen. def. spondyl. n = 82
Flexion	< 15° n = 112	14.8 ± 4.5	65.0 ± 6.2
	> 15° n = 42	44.4 ± 16.6	81.8 ± 6.7
Scoliosis	0 n = 100	19.6 ± 5.7	66.1 ± 6.7
	+ n = 54	16.7 ± 10.9	79.4 ± 6.2

ages of patients with flexion of < 15 degrees and without signs of general deforming spondylosis at the time of the reviewal was 53.1 years, while corresponding age for those with flexion of > 15 degrees was 58.6 years and for those with deforming spondylosis 65.0 years and 67.6 years respectively. However, no statistical difference was demonstrable.

It is clear from the table that the frequency of back stiffness was not related to the frequency of scoliotic deformity.

The figures in the table stress further the predominant relationship between deforming spondylosis and stiffness of the back.

Stiffness of the Back in Relation to Local Pain and Lower Back Pain and Weakness

It was, of course, of interest to determine to what extent stiffness of the back influenced the symptoms, e. g. whether provoked local pain

was less common in patients with than in those without stiffness of the back. Table 32 summarizes the frequency of the symptoms in relation to the frequency with which back stiffness was observed, at the reviewal. We see that local pain was found mainly in patients with decreased mobility of the back, while the isolated low back pain and weakness was more common in patients without reduced spinal mobility. However, the smallness of the groups would not permit statistical conclusions (according to χ^2 test $P > 10$ per cent).

TABLE 32

Frequency of local pain claimed and backache+weakness in relation to back stiffness observed.

Back	Only local pain n = 18	Local pain + backache + weakness n = 30	Only backache + weakness n = 17
Stiff	61.1	56.7	35.3
Mobile	38.9	43,3	64.7

DISCUSSION

The main purpose of the present investigation was to analyse and compare series of fractures of the vertebrae in two statistically comparable groups, one group consisting of insured subjects, the other of uninsured persons.

It has often been suggested that fractures of the vertebrae in insured persons seem to require longer convalescence and cause a greater loss of working capacity than in uninsured persons. *The analyses of the present series showed statistically that the percentage of individuals claiming residual symptoms as well as the frequency of disability was higher in the insured.* Convalescence was also longer in the insured group.

Demonstration of these differences first required the analysis of some general and constitutional factors as well as of different types of fractures. This analysis showed that the nature of the *occupation*, i. e. heavy or light work, had no noticeable influence on the differences in the frequency of symptoms and disability being just as common in light workers as in heavy workers. *Age* proved of certain importance: the youngest (under 20 years) returned to work sooner than the older, in whom permanent disability was also more common. The above-mentioned differences between the insured and the uninsured were demonstrable in all age-groups. The frequency of *general deforming spondylosis* proved directly related to age, and the increase in the occurence of general deforming spondylosis appearing after the injury was in direct proportion to the ages of the patients at the time of the reviewal and to the number of years that had elapsed since the accident. It was also demonstrated statistically that the frequency of general deforming spondylosis is not influenced by the deformity (kyphosis and scoliosis) following the accident. *General deforming spondylosis is an aging phenomenon, and no convincing evidence is available to show that it can be caused by fractures of the vertebrae or that such fractures can appreciably worsen the course of pre-existent spondylosis.* There was a certain tendency for convalescence to be longer and for the symptoms to be more persistent in persons with deforming spondylosis at the time of the accident. The frequency of permanent disability was also statistically higher in those with general deforming spondylosis.

It is thus clear that although general deforming spondylosis is not directly influenced by a fracture of the vertebra, the prognosis of such a fracture is worse in patients with pre-existent spondylosis. This probably also explains why, as mentioned above, disability was found to be more common in the older subjects.

Some writers have suggested that spondylarthrosis plays an important part as a cause of residual symptoms after fractures of the vertebrae. In the present investigation particular attention was directed to this point, and special oblique views were taken of the intervertebral joints. *It was found that the frequency of residual symptoms and of disability was about the same in patients with arthrotic changes as in those without, which infers that spondylarthrosis is not an important cause of residual symptoms.* The above-mentioned observations made in the present series accord with the opinions expressed by JUNGHANNS, LOB and by others.

As to the actual fractures and residual anatomic deformity, it was found that in cases of *fractures without demonstrable primary intervertebral disk injury, admittedly one fifth of the patients claimed minor symptoms, but these cases occupy a special position, in that working capacity was not reduced in any of them.*

Fractures with primary intervertebral disk injury, and seen in about two thirds of the cases, have a poorer prognosis, especially among those with co-existent fractures of the neural arch and joint processes. In this connection it might be useful to point out that the age of the patients with the latter type of complicated fractures was on the average higher than that of the rest of the series. Comparison of those without and with intervertebral disk involvement showed a statistically significant difference, the symptoms being more persistent in the latter and, as pointed out before, all cases of disability were found in this group in which convalescence also tended to be longer. Although it is difficult to say to what extent disk involvement influences the general picture, it does indicate that the injury is not slight.

What was said above about the cases with primary signs of intervertebral disk involvement is probably of practical value not only in the establishment of the prognosis, but also in the evaluation of symptoms in cases of less severe fractures of the vertebrae, i. e. without disk involvement.

This difference between fractures with and without intervertebral disk involvement is also reflected by the results obtained on analysis of the material for the occurrence of local traumatic spondylosis. This condition is caused exclusively by intervertebral disk injury and is thus a sign of changes secondary to primary involvement of the disk. This

"sign" is *per se* of no demonstrable importance regarding symptoms except in those cases in which a bridging of the fragments has led to fixation, which may be regarded simply as the results of healing, a result promoting function. No relationship was demonstrable between the severity of traumatic spondylosis and symptoms or disability. However, comparison of those patients with those showing no signs of traumatic spondylosis, (i. e. without secondary changes of disk involvement), indicated that in the former group symptoms are more frequent, disability is more common and convalescence is much longer. Intervertebral disk injury was thus found to be an important factor in the cause of decreased spinal function after fractures of the spine.

Deformity has often been considered a prominent cause of residual symptoms and decreased working capacity, and some writers ascribe the symptoms to changes in the local mechanics of the intervertebral joints. *However, no relationship was demonstrable between the degree of deformity (kyphosis or scoliosis) and the frequency of symptoms or disability.* One observation made in the present material was of special interest, namely that in subjects of more than 40 years of age the deformity i. e. the angle of flexion, is often larger than in the lower age-groups. This difference may possibly be explained by osteoporosis or decreased elasticity of the disks in such persons or awkwardness due to age.

To judge and analyse such symptoms as local pain and reduced spinal function is no easy matter, and it is very difficult to formulate any rules for such an evaluation. Comparison of e. g. the frequency of local pain claimed by the patients and the frequency of provoked local pain, e. g. tenderness to thumps or jerks or movement in the region of the fracture by the investigation may be of some value if we compare the insured with the uninsured. This was done, and it was found that the pain claimed was in accord with the reaction to pain assessed at the clinical reviewal in the slight and most severe cases in both insured and uninsured patients. *However, in those with moderately severe fractures there was a statistically significant difference between the insured and unisured.* This suggests that the patients in this group were inclined to exaggerate their symptoms. As no such difference was found in the group with less severe fractures, it may be inferred that the prerequirement for such over-estimation is a certain degree of moderate fractures. As pointed out above, the symptoms claimed and the clinical findings were in better accord in the group of subjects with severe fractures e. g. of the neural arches and joint processes. This may be explained on psychologic grounds: patients with severe residual changes need not fear that their symptoms will be overlooked or under-estimated, while

those with less severe changes may be inclined to believe that the examiner may underassess the symptom and their trouble. This seems to be more common in patients with general deforming spondylosis.

Local pain was claimed more frequently among those with signs of intervertebral disk involvement. But no relationship was demonstrable between the severity of traumatic spondylosis and residual pain. The possibility of any unstability as a cause of local pain was considered and discussed but the examination was not informative in this respect.

General deforming spondylosis, like arthrosis of the intervertebral joints was not found to increase the frequency of local back pain.

Deformity did not seem to be an important cause of local pain. On the other hand, involvement of the neural arch or joint processes did show a tendency to increase the frequency of residual local pain. It might be useful here to point out that nervous injuries in the form of slight paresis, reflex or sensitivity disturbances in the latter group were very common. These symptoms were often associated with a narrowing of the intervertebral foramen due mainly to a slipping of the vertebrae or deformation of the neural arch or joint processes.

Acute lumbago and sciatic pain occurred in 12 per cent of the cases after the injury and in 80 per cent of them traumatic or general deforming spondylosis was demonstrable in the thoracolumbar junction or lumbar region. In all of these cases the symptoms were brief and no case gave the impression that the symptoms were as intense as those caused by prolapse of an intervertebral disk.

It was shown statistically that residual lower back pain and weakness was reported more frequently by the insured than by the uninsured. These symptoms were often accompanied by local pain. The frequency of backache and weakness did not increase with the ages of the patients and advancing general deforming spondylosis. These symptoms did, however, show a possibly slight tendency to be more common in heavy workers and in patients with general osteoporosis. In patients with intervertebral disk involvement the frequency of backache and weakness was statistically higher. This frequency was, however, not influenced by the severity of secondary changes in the region of the fracture (traumatic spondylosis). In other words, then, symptoms were just as common an accompaniment in patients with slight roentgenographic changes as in those in whom the changes were more severe.

One might be inclined to suppose that a deformity causing changes in the static mechanics of the spine would increase backache and weakness. Statistical analysis of the material revealed no such difference. This may be explained by a possible tendency of more severe deformity to cause a certain amount of stiffness of the back.

Back stiffness is mainly an aging phenomenon and gives a curve running parallel with that for general deforming spondylosis.

Traumatic changes do of course also play a certain part, but the stiffness of the back seen in patients with an earlier fracture of a vertebra, must be evaluated in the light of the person's age and the possible presence of general deforming spondylosis. Any local stiffness of the back in the region of the fracture will, of course, help the examiner to decide whether or not the rigidity can be ascribed to the injury. However, stiffness of the back cannot be strictly considered as a symptom reducing working capacity. On the contrary, such stiffness in the region of the fracture may promote spinal function. In this connection it might be useful to mention the value of primary fusion and the indications for such a procedure, a point that has been discussed in the literature during the last few years (ALBEE, SANDAHL and others).

Stiffness of the back was a more common residual symptom of certain types of fractures than of others. This is true for those with signs of primary involvement of the intervertebral disk and those with signs of local traumatic spondylosis. The analysis also showed that the frequency of stiffness of the back tended to be higher in those patients with more pronounced flexion angle of the spine. In these cases, however, the ages of the patients were on the average higher. This suggests that age and general deforming spondylosis play an important rôle so that the importance of spinal deformity for stiffness of the back may be questioned.

With reference to what was said above, it was thought of interest to study the effect of spinal stiffness on the symptoms (local pain, backache and weakness). An analysis of the material for any relationship between these symptoms and local or more general stiffness of the back suggested that patients with stiffness more frequently complained of local pain only, while the isolated symptoms of backache and weakness were more common in patients in whom no stiffness of the back could be demonstrated.

SUMMARY

One hundred and fifty-four cases of fractures of the thoracic and lumbar spine were reviewed. No cases of total paraplegia were included. The interval between the accident and the reviewal ranged from 5 to 30 years. The series comprised 72 cases in which the patients were insured and 82 in which they were uninsured. These two groups were similar and statistically comparable. Among other things, it was observed that vertebral fractures with fractures of the neural arches and joint processes are more common in elderly people. The most pronounced post-traumatic deformities are also seen more frequently in elderly patients. The youngest (< 20 years) returned to their work earlier than the elderly (> 40 years), in whom the permanent disability was also more common. The type of occupation had no appreciable effect on the duration and frequency of symptoms or permanent disability. Patients with deforming spondylosis required a longer convalescence, and in these the frequency of partial or complete disability seems to be higher. Deforming spondylosis is to a large extent an aging phenomenon and independent of the type of the fracture or the degree of post-traumatic deformity. This also applies to arthrosis of the intervertebral joints. Fractures with associated intervertebral disk injury have a poorer prognosis, and this is particularly the case in patients with co-existent fractures of the neural arches and intervertebral joints. Fractures without co-existent disk injury have a good prognosis: in none of these cases was working capacity permanently reduced. Local traumatic spondylosis is only an indication of disk injury and probably has per see no effect on the symptoms or disability. Deformity was not accompanied by increased symptoms or decreased working capacity. This also applies to spondylarthrosis, and it was thus shown that, in contrast with what is often believed, spondylarthrosis does not play a dominating rôle in the causation of the symptoms.

In the present series a statistically significant difference was found between the insured and the uninsured. In the former the duration of the symptoms was longer, disability was more frequent and convalescence was longer. An attempt to analyse the symptoms suggested the following conclusions. Among other things the patient's report of local back pain as compared with the clinical observations such as a sign of

reaction to pain provoked at the reviewal (provoked local pain), differed in a way that suggests that insured patients exaggerate their symptoms. This was particularly the case in patients with fractures of moderate severity, while those with slight injury and those with the severest injury did not show any tendency to such exaggeration. It was also shown that local pain is commonest in cases with signs of disk injury and in cases of fractures of the neural arch and joint processes. On the other hand, the degree of deformity, general deforming spondylosis and spondylarthrosis do not seem to be associated with any increase in the frequency of local pain. Symptoms of back pain and weakness were apparently more common among insured patients than among uninsured. Age and deforming spondylosis are not of appreciable importance to the development of symptoms, but they are more common among heavy workers. However, disk injury and deformity may possibly increase the frequency of backache and weakness.

Stiffness of the back is dependent mainly on age and increases with deforming spondylosis. Such stiffness is also a sequal of the fracture, and it is fairly common in patients with associated disk injury (local traumatic spondylosis). In the presence of severe deformity stiffness of the back is also more common but here age is a contributory factor, too, severe deformity being more frequent in elderly patients. Local pain was more often seen in association with a stiffness of the back, while backache + weakness were more common in a mobile back.

Post-traumatic lumbago and sciatic pain, though not severe, were recorded in 12 per cent.

RÉSUMÉ

L'auteur a porté son enquête sur 154 cas de fractures de vertèbres dorsales et lombaires. Les cas comportant paraplégie totale ont été éliminés. L'enquête a été entreprise entre 5 et 30 ans après accident. Les matériaux comprennent 72 cas où les sujets étaient sûrs et 82 cas non sûrs. Ces 2 groupes étaient de même nature, et, du point de vue statistique, tout à fait comparables. On a pu constater entre autres que les fractures de vertèbres combinées à des fractures de pédicules et d'apophyses articulaires sont plus courantes chez les sujets plus âgés. De même, plus le sujet est âgé, plus la déformation posttraumatique est fréquente et importante. Les tout jeunes sujets ($<$ 20 ans) ont une convalescence plus courte et chez les plus âgés ($>$ 40 ans) nous constatons que l'invalidité permanente est plus courante. Le métier pratiqué par le patient n'a d'influence notable ni sur la durée et la fréquence des symptômes ni sur l'invalidité. Les cas présentant une spondylose déformante ont en principe une convalescence plus longue et dans ces cas la fréquence d'invalidité semble être également plus forte. La spondylose déformante est essentiellement un phénomène qui provient uniquement de l'âge et ni la nature de la fracture ni le degré de déformation post traumatique n'ont eu d'influence sensible sur le degré ou l'existence d'une spondylose déformante courante. Ceci est valable aussi pour les arthroses des articulations intervertébrales. Les fractures comportant aussi des lésions de disques constituent un pronostic nettement plus fâcheux et il en est ainsi en particulier dans les cas comportant à la fois fracture du pédicule et de l'apophyse articulaires. Les cas où ne se présentent pas de signes de lésions de disques sont toujours bénins et dans aucun de ces cas les patients n'ont été atteints d'invalidité permanente. La spondylose traumatique locale n'est qu'un simple indicateur de lésions de disques et ne saurait en soi-même avoir la moindre influence ni sur le symptôme ni sur l'invalidité. Une déformation assez importante n'a pas révélé entraîner de symptôme accru ni d'incapacité de travail plus grande. Cela vaut également pour la spondylarthrose et l'on a pu ainsi montrer qu'une spondylarthrose ne joue pas un rôle aussi dominant pour le symptôme que celui qu'on veut lui accorder de bien des côtés.

Dans les matériaux, on a pu signaler une différence, montrée statis-

tiquement, entre les cas sûrs et non sûrs. Chez les premiers, la durée du symptôme est plus longue, l'invalidité plus courante et la convalescence plus longue que chez les non sûrs. On a procédé à un essai d'analyse du symptôme et on a pu de ce fait constater, entre autres: Les indications du patient sur les douleurs dorsales locales ont été comparées avec des observations cliniques telles que les signes d'une réaction provoquée à la douleur (provoked local pain) faite en cours d'examen, et de cette comparaison on a noté certaines différences qui indiquent que les cas sûrs avaient exagéré leurs symptômes. C'est ce qui arrive surtout dans les cas de lésions vertébrales de gravité moyenne, tandis que celles qui sont superficielles ou au contraire très graves ne montrent pas la même tendance à amplifier leurs symptômes. En outre, il a pu être montré que la douleur locale est très courante dans les cas comportant des signes de lésion de disques et dans les fractures de pédicules et d'apophyses articulaires. Le degré de déformation, la spondylose déformante ordinaire et la spondylarthrose ne semblent pas au contraire avoir entraîné de fréquence accrue des douleurs locales. Les troubles de l'insuffisance sont, semble-t-il, plus courants dans les cas sûrs que dans ceux qui ne le sont pas. L'âge et la spondylose déformante n'ont aucune influence notable sur ces troubles mais en revanche ils sont plus courants chez les sujets qui accomplissent un travail pénible. Il se peut au contraire que les lésions de disques et la déformation entraînent une fréquence accrue des troubles de l'insuffisance.

La rigidité dorsale dépend avant tout de l'âge et son degré est fonction de celui de la spondylose déformante. La rigidité provient aussi des suites de fractures et dans les cas comportant des lésions de disques (spondylose traumatique locale), la rigidité vertébrale est plus courante. Dans les cas de déformation accentuée, il semble que la rigidité dorsale soit également plus courante, mais sur ce point l'âge doit être un facteur concourant, étant donné que les déformations d'une certaine importance se présentent plus souvent chez les personnes âgées. Les douleurs locales semblent être plus courantes dans une colonne vertébrale rigide tandis que les troubles de l'insuffisance le sont au contraire dans une colonne vertébrale mobile.

Le lumbago et les troubles ischiatiques post traumatiques se sont présentés dans 12 % des cas, mais pas à un degré particulièrement accentué.

ZUSAMMENFASSUNG

Der Verfasser berichtet über Nachuntersuchungen, die er bei 154 Fällen von Frakturen in der Thorakal- und Lumbalwirbelsäule durchgeführt hat. Fälle mit totaler Paraplegie wurden in dieser Zusammenfassung nicht mitgerechnet. Die Nachuntersuchungen wurden 5 — bis 30 Jahre nach Entstehung des Schadens vorgenommen. Das Material umfasst 72 Fälle versicherter und 82 Fälle unversicherter Patienten. Die Schäden beider Gruppen waren gleichgelagert und können aus statistischen Gesichtspunkten verglichen werden. Unter anderem konnte man konstatieren, dass Wirbelkörperfrakturen in Kombination mit Wirbelbogen- und Querfortsatzfrakturen bei älteren Patienten häufiger vorkamen. Auch posttraumatische Deformitäten fanden wir häufiger unter der Gruppe der älteren Patienten. Die jüngsten Patienten, unter 20 Jahren, zeigten eine kürzere Rekonvaleszenz während wir bei der Patientengruppe mit über 40 Jahren öfter eine dauernde Invalidität beobachten konnten. Der Beruf hat nie in nennenswerter Weise Dauer und Frequenz der Symptome oder Invalidität beeinflusst. Fälle mit Spondylosis deformans haben in der Regel eine längere Rekonvaleszenz und in dieser Gruppe ist auch die Frequenz der Invalidität höher. Spondylosis deformans ist im wesentlichen ein reines Altersphenomen, und weder die Art der Fraktur noch der Grad der posttraumatischen Deformität hat nachweislich auf den Grad oder das Vorkommen der allgemeinen Spondylosis deformans Einfluss. Dies gilt ebenso für die Arthrosen der Intervertebralgelenke. Frakturen, die mit Diskusschäden kombiniert sind, haben eine sicher schlechtere Prognose, besonders solche, die mit Bogen- und Intervertebralgelenksfrakturen einhergehen. Fälle, die kein Zeichen für einen Diskusschaden zeigen, sind in unserem Krankengut immer gutartig gewesen und verursachten nie eine dauernde Invalidität. Die lokale traumatische Spondylose ist lediglich Zeichen für Discusschäden und scheinen an und für sich keine Einwirkung auf die Symptome oder die Invalidität zu haben. Selbst bei grösseren Deformitäten zeigen sich weder Zunahme der Symptome noch Verschlechterung des Arbeitsvermögens. Das oben gesagte gilt ebenso für Spondylarthrosen und es konnte damit gezeigt werden, dass eine Spondylarthrose keine so dominierende Rolle im Bezug auf die Symptome spielt, wie man von verschiedenen Seiten geltend macht.

In unserem Material konnten wir einen statistisch bewiesenen Unterschied zwischen versicherten und nichtversicherten Patienten aufzeigen. Bei der ersten Gruppe sind Dauer der Symptome länger, Invalidität häufiger und die Rekonvaleszens langwieriger. Ein Versuch die Symptome zu annalysieren wurde gemacht, und wir haben dadurch feststellen können, dass unter anderem bei Vergleich der angegebenen lokalen Schmerzen mit der klinischen Beobachtung bei einer während der Untersuchung ausgelösten Schmerzreaktion (Provoked local pain) sich Differenzen zeigten, die darauf hinweisen dass die Versicherungsfälle ihre Symptome übretreiben. Dies hat sich bei mittelschweren Fällen als am häufigsten vorkommend erwiesen, während die Patienten mit leichten oder schweren Schaden nicht die Tendenz hatten ihre Symptome zu aggravieren. Weiter konnte aufgezeigt werden, dass lokale Schmerzen am häufigsten bei den Fällen bestehen, die auf einen Diskusschaden, Frakturen von Wirbelbogen oder Querfortsätzen hinweisen. Der Grad der Deformität die allgemeine Spondylosis deformans oder Spondylarthrosis scheint dagegen keine erhöhte Frequenz der lokalen Schmerzen mitzuführen.

Die Insuffizienzbeschwerden sind möglicherweise häufiger bei den versicherten Fällen. Das Alter und die Spondylosis deformans haben keine offenbare Bedeutung für diese Beschwerden. Dagegen kommen sie öfter bei Patienten mit schwerer Arbeit vor, und bei den Diskusschäden und den grösseren Deformitäten sind die Insuffizienzbeschwerden vielleicht auch etwas gewöhnlicher.

Wirbelsäulenversteifungen hängen meist mit dem Alter zusammen und nehmen parallel mit dem Fortschreiten der Spondylosis deformans zu. Aber auch Frakturen ziehen Versteifungen nach sich und bei Fällen mit Diskusschäden (Locale traumatische Spondylosis) scheint eine Versteifung häufiger zu folgen. Auch bei hochgradigen Deformitäten scheinen Versteifungen häufiger aufzutreten, doch dürfte das Alter als zusätzlich erschwerender Faktor angesehen werden, da die grösseren Deformitäten, wie gezeigt wurde, häufiger bei älteren Patienten vorkommen. Bei Versteifungen der Wirbelsäule sind lokale Schmerzen gewöhnlicher, während dagegen Insuffizienzbeschwerden häufiger bei beweglicher Wirbelsäule vorkommen.

Posttraumatische Lumbago und Ischiasbeschwerden kamen bei 12 % unseres Krankengutes vor, zeigten sich aber als nicht besonders hochgradiger Natur.

REFERENCES

ABRAHAMSEN, H. Nord. Kir. för. 16:de möte 1927.

ALBEE, F. H., POWERS, J. & MCDOWELL, H.: Surgery of the Spinal Column. Philadelphia 1945.

BROCHER, I.: Die verkannten Wirbelsäulenverletzungen. Leipzig 1944.

BURCKHARDT, H.: Beitr. klin. chir. 1930, 149, 171.

BÜRKLE DE LA CAMP: cit. LOB.

BÖHLER, L.: Die Technik d. Knochenbruchbehandlung. Wien 1943.

DAHLBERG, G.: Statistical Methods. London 1940.

DYES, O.: Arch. f. Orth. u. Unfall-Chir. 1932, 32, 297.

ERLICH & LEHMANN: cit. DAHL-IVERSEN, E. & ANDREASSEN, M.: Nord. Med. 1942, 16, 2939.

ESSEN-MÖLLER, E.: Kompendium i statistik för medicinare. Lund 1949.

ETTORE, E.: Cit. JUNGHANNS.

FEHR, A.: Schweiz med. Wsehr. 1940, 70, 906.

FRIBERG, S. & HIRSCH, C.: Acta ortop. Scand. 1949, 19, 222.

GARVIN: cit. JUNGHANNS.

GAUGELE, K.: Z. orthop. Chir. 1933, 60, 346.

GLORIEUX, P.: Les traumatismes rachidiens. Bruxelles 1932.

GÜNTZ, E.: Z. orthop. Chir. 1933, 60, 136.

GÖCKE, C.: cit. LOB.

HAUMANN, W.: Die Wirbelbrücke u. ihre Endergebnisse. Stuttgart 1930.

HELLNER, H.: Arch. f. Orth. u. Unfall-Chir. 1931, 29, 417.

HOWORTH, M. B.: A textbook of orthopedics. Philadelphia 1952.

HUSTED, E. & KOFOED, S. E.: Nord. med. tidskr. 1942, 16, 2939.

JÆGER, W.: Praxis, 1934, 29.

JUNGHANNS, H.: Die med. Welt, 1936, 1, 509.

— Der Chirurg 1934, 1, 18.

JUNGHANNS, H. & SCHMORL, G.: Die gesunde und kranke Wirbelsäule in Röntgenbild und Klinik. Stuttgart 1951.

KNUTSON, F.: Acta radiol. 1944, 25, 593.

KRAUS, H.: D. Ztschs f. Chir. 1933, 241, 553.

LANGE, M.: Grundlagen d. Beurteilung von Wirbelsäulenverletzungen u. Erkrankungen, Unfallheilk. 1951, 41.

LOB, A.: Fortschr. auf dem Geb. d. Röntgenstr. 1939, 60, 199.

— Die Wirbelsäulenverletzungen und ihre Ausheilung. Leipzig 1941.

MAGNUS, G.: Unfallheilk. 1931, 8, 59.

NICOLL, M. E. A.: J. of Bone and Joint Surg. Brit. 1948, 30, 725.

— Soc. internat de chir. orthop. et de traumat. 1948.

OLIN, H.: Am. J. Roentgenol. 1939, 42, 235.

QUENSEL, C.-E.: Den teoretiska statistikens grunder. Lund 1944.

ROGERS: cit. ALBEE et al.

SAHLIN, O.: Nord. med. 1951, 45, 516.

SANDAHL, C.: Nord. med. 1951, 45, 636.
SCHMIEDEN, V. & REISNER, A.: Vereinesbl. d. Pfläz. 1933.
SCHMIEDEN, V. & MAHLER, L.: Die Verletzungen der Wirbelsäule. Stuttgart 1935.
SCHMORL, G.: Arch. f. Orth. u. Unfall-chir. 1931, 29, 389.
STRAUBE, W.: Chirurg 1940, 12, 452.
TURNER, V. C. & MEAD, N. C.: Surg. clin. N. am. 1949, 29, 195.
WACHS, E.: cit. LOB.
WATSON-JONES, R.: Fractures a. Joint Injuries. Edinburgh 1946.
WIBERG, G.: Acta ortop. Scand. 1949, 19, 211.
— Sv. läkartidn. 1941, 38, 1219.