LONG-TERM CONSEQUENCES OF STABLE FRACTURES OF THE THORACIC AND LUMBAR VERTEBRAL BODIES

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Most fractures of the thoracic and lumbar vertebral bodies are stable according to the classification of Holdsworth (1963). These lesions differ from unstable fractures in that they are not usually complicated by neurological damage and mobilisation is unlikely to injure the spinal cord or nerve roots. Nevertheless, it is apparent from everyday clinical practice that not all patients make a complete and early recovery from stable fractures. There is also a variety of opinion concerning what treatment, if any, is appropriate.

A review has been carried out to study the late results of stable fractures of the thoracic and lumbar vertebral bodies. The intention was to establish the incidence of persistent symptoms and also to assess residual disability. The study was retrospective. Patients had sustained fractures during the period 1963 to 1967 inclusive. They were seen in 1971: so the follow-up period varied from eight years to a minimum of three years after injury.

The patients had all been claimants on the Workmen's Compensation Board of Ontario. In every case the patient's claim had been finally settled and it was made clear to him that the survey would in no way affect any award he might be receiving.

A search of the records produced notes of 623 patients suitable for this study. The fractures were mostly wedge compression fractures of the vertebral bodies. Many also showed infraction of one end-plate (usually the superior one) and the survey also included some bursting fractures of the vertebral bodies. Most patients were men but one in twelve was a woman. The patients came from many walks of life but most were manual workers. Fractures occurred throughout the year and no seasonal pattern was found. Fractures were found to occur with approximately equal frequency at all ages and there was no predilection for any particular age group.

Patients were widely scattered throughout the Province of Ontario and no attempt was made to trace and examine all of them. The results of this study will therefore be presented in two parts, the first consisting of material from the notes of 623 patients and the second being a clinical review of a selected proportion of these patients.

REVIEW OF CASE RECORDS

Distribution of fractures in the spine—This is shown in Figure 1. There was a peak incidence of fracture at the level of the first lumbar vertebra and over 60 per cent occurred at the three levels T.12, L.1 and L.2. This is similar to the finding of Nicoll (1949) and others. Nevertheless, there is a wide scatter in distribution and fractures were seen at all levels from T.1 to L.5. In patients who had simultaneously sustained more than one vertebral fracture the pattern was similar, with a wide scatter and a peak at L.1.

Mechanism of injury—Most patients (71 per cent) were injured as a result of a fall. The remaining 29 per cent sustained a variety of injuries, which included crushing by falling trees and other objects, and road traffic accidents. All had a history of significant injury: patients with pathological fractures were excluded from the survey.

Associated fractures—Approximately 19 per cent (116 of 623) sustained other fractures in addition to the spinal fracture. Fractures of the calcaneus were particularly frequent. Of fifty-nine patients who gave a clear history of a fall landing on the feet, twenty-six (44 per cent) sustained a fracture of the calcaneus on one or both sides.
CLINICAL REVIEW

Southern Ontario being the most densely inhabited part of the Province, it was decided to restrict the clinical review on a geographical basis to this area. All patients whose last recorded address had been within 120 miles of Toronto were asked to attend for interview. Many patients were found to have moved: a few had died. Approximately 6 per cent refused to be seen. One hundred and sixteen patients were interviewed, examined and radiographed, and a comparison of these with the total with respect to age and level of the fracture shows that they were representative.

Incidence and severity of symptoms—Only thirty patients (approximately 26 per cent) stated that their backs were as good as before the accident. The remaining patients had some complaint referable to the back which was attributed by the patient to the accident. Back pain was the main complaint and was present in all patients who admitted to symptoms. Pain was often poorly localised but frequently the patient indicated the fracture level as the site of pain. In addition to pain some patients complained of stiffness or weakness of the back.

The severity of symptoms varied and many patients admitted only reluctantly that they had symptoms from the back. The patients fell into three groups (Table I). Approximately one-quarter were free from symptoms. Another quarter had symptoms attributed to the back injury of such severity that they had been forced to undertake lighter work or even to retire. The remaining group, comprising about one-half of the patients seen, had symptoms but were
still able to do the same type of work that they had done before the injury. A comparison of these three groups follows.

Severity of fracture—In each fracture two measurements were made from the lateral radiograph. The severity of wedge deformity was measured as the angle made between lines drawn along the upper and lower borders of the fractured vertebral body. The height of the fractured vertebra was measured in millimetres between its upper and lower surfaces at a point equidistant between its anterior and posterior borders. The loss in height caused by the fracture could not be measured directly. It was assumed that the previous height of the fractured vertebra had been intermediate between the vertebrae immediately above and below. The height of these two was therefore measured and the average calculated. The loss in height caused by the fracture was expressed thus:

\[
\frac{\text{estimated previous height} - \text{measured height}}{\text{estimated previous height}} \times 100 = \text{percentage loss in height.}
\]

A scale was devised taking into account the angle of deformity and the estimated loss in height of the fractured vertebra. Less than 5 degrees of angular deformity scored 0 point; 5 to 14 degrees, 1 point; 15 to 24 degrees, 2 points; 25 to 34 degrees, 3 points; 35 to 44 degrees, 4 points; and 45 degrees or more, 5 points. Loss in height of less than 15 per cent scored 1 point; 16 to 30 per cent, 2 points; 31 to 45 per cent, 3 points; 46 to 60 per cent, 4 points; and 61 per cent or more, 5 points.

In each fracture the scores for angular deformity and loss of height were added to give a figure representing the severity of fracture. Thus each fracture was graded according to a 10 point scale of increasing severity of deformity.

There was little difference between the three groups of patients as assessed by these criteria. The mean figure for the severity of fracture in the symptom-free patients was 3.9 (range 2 to 6). For patients with symptoms which were insufficient to cause incapacity the mean severity of fracture was also 3.9 (range 2 to 8). Those patients with symptoms severe enough to cause partial or complete incapacity had a mean fracture severity of 3.6 (range 1 to 7). It is clear that the incidence or severity of persistent symptoms bore no relation to the degree of deformity at the fracture site.

Age in relation to symptoms—The mean age of patients who were symptom-free was 45.6 (range twenty-three to sixty-four). Patients with mild symptoms had a mean age of 44.9 (range seventeen to sixty-seven). Those patients with incapacity from back symptoms had a mean age of 44.4 (range twenty-four to sixty-five). Thus age was found to be not related to the outcome.

Clinical examination in relation to symptoms—Restricted spinal movement was considered to be present in sixteen (62 per cent) of patients with incapacity but in only eight (27 per cent) of those who were symptom-free. Apart from this observation there were no objective differences on examination between the two groups.

Treatment—Patients had been treated in many places by different practitioners and had received a variety of different types of treatment. Some had not been treated. The most common method was a period of bed rest, which was often followed by a course of exercises. Other treatments included ultrasound, a course of local analgesic injections, and manipulation under anaesthesia.

Three forms of treatment were used very commonly: because these involved an active approach to the problem their results were assessed in some detail. These three methods were: application of plaster with or without attempted reduction of the fracture; fitting of a brace or corset; and a course of rehabilitation. Rehabilitation took place at a centre with facilities for physiotherapy, occupational therapy and job retraining, and with experienced medical and ancillary staff. Its work involves the rehabilitation of workmen after all forms of injury. The patients studied in this review received residential treatment for periods of two weeks or more; the usual duration of such treatment was about four weeks.
The results of treatment are shown in Table II. Patients with significant symptoms had received more treatment. This is particularly evident when patients who had received a course of rehabilitation are studied. Only three (approximately 10 per cent) of the patients who were subsequently symptomless had had a course of rehabilitation. In contrast, nineteen out of twenty-six who had some degree of residual incapacity had had a course of rehabilitation.

Two of the patients who attended a course of rehabilitation did so over one year after the injury. The remaining patients started their course of treatment at intervals varying from one

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Number of patients</th>
<th>Number of treatments</th>
<th>Method of treatment (number of patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomless</td>
<td>30</td>
<td>23</td>
<td>Plaster: 12, Brace: 8, Rehabilitation: 3</td>
</tr>
<tr>
<td>Mild symptoms but no incapacity</td>
<td>60</td>
<td>44</td>
<td>Plaster: 13, Brace: 17, Rehabilitation: 14</td>
</tr>
<tr>
<td>Symptoms producing incapacity</td>
<td>26</td>
<td>45</td>
<td>Plaster: 10, Brace: 16, Rehabilitation: 19</td>
</tr>
</tbody>
</table>

TABLE II
TREATMENT OF SPINAL FRACTURES: ANALYSIS OF RESULTS OF THREE METHODS

TABLE III
COMPARISON OF RESULTS BETWEEN PATIENTS ATTENDING A COURSE OF REHABILITATION AND THOSE WHO DID NOT SO ATTEND

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>No rehabilitation (number of patients)</th>
<th>Rehabilitation (number of patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomless</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Symptoms present but able to do former work</td>
<td>46</td>
<td>14</td>
</tr>
<tr>
<td>Some incapacity from back symptoms</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>&quot;Retired&quot; because of back symptoms</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>36</td>
</tr>
</tbody>
</table>

to six months after injury and the usual time that rehabilitation was started was about four months after injury. It is of interest that the average time before return to work of those patients who did not attend for rehabilitation was also four months.

Thirty-six (approximately 31 per cent) of the 116 patients had attended a course of rehabilitation. These patients did not differ with respect either to age or to severity of fracture from those who did not have a course of rehabilitation. Only three of the patients who attended the rehabilitation centre were symptomless at the time of review. Over one-half of this group of patients when seen were partly or wholly incapacitated by back symptoms which were attributed by the patient to the injury. These figures are in marked contrast to the degree of symptoms in the patients who had not attended the rehabilitation centre (Table III).

Radiological assessment—All fractures appeared radiologically to have united. There was no tendency for the original deformity to increase measurably. In some cases fusion had occurred between the fractured vertebra and the vertebra above or below. This appearance was seen both in the symptomless patients and in those with continuing incapacity.

Particular attention was paid to the appearance of degenerative changes, and it was recorded whether such changes if present were immediately adjacent to the fractured vertebra or were more widespread in the spine. "Degenerative change" is taken to refer to narrowing of the intervertebral space and to formation of spurs at the margins of the vertebral bodies.
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The posterior articulations were also studied but were more difficult to assess: Table IV refers only to changes observed between vertebral bodies. The spine was free from degenerative changes in only a minority of patients. Also the incidence of such changes was as high in the symptomless patients as in those with incapacity from back symptoms.

Other abnormalities were also seen. There were three cases of spondylolysis (one symptomless), one of ankylosing spondylitis, one of ankylosing hyperostosis and one of idiopathic scoliosis. One patient had a spinal fusion for his fracture. This appeared radiologically to be soundly united but he was totally incapacitated by back pain.

DISCUSSION

About three-quarters of a series of patients with stable fractures of the thoracic and lumbar vertebral bodies were found to be suffering from continuing back symptoms.

No correlation was found between the severity of fracture and the presence or severity of symptoms. In this respect the findings confirm the conclusion of Nicoll (1949) who believed that function after spinal fracture depends on stability and not the position in which stability is achieved. The fractures in the present series were all considered from the outset to be stable injuries.

TABLE IV
INCIDENCE OF RADIOLOGICAL EVIDENCE OF DEGENERATIVE CHANGE

<table>
<thead>
<tr>
<th>Radiological changes</th>
<th>28 symptomless patients</th>
<th>25 patients with incapacity from symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>Generalised degenerative change</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Local degenerative change adjacent to fracture</td>
<td>22</td>
<td>79</td>
</tr>
<tr>
<td>No degenerative change</td>
<td>5</td>
<td>18</td>
</tr>
</tbody>
</table>

Symptoms were not related to the level of fracture and no connection was found between the presence of symptoms and radiological evidence of degenerative change or other abnormality. Degenerative changes were seen in most radiographs and if a symptomless patient had complained of back pain it would usually have been possible to explain such pain on the basis of a radiological abnormality.

Patients with persistent symptoms had in general received more treatment than those who were symptomless: in particular they were more than seven times more likely to have had a residential course of rehabilitation. The significance of this observation is debatable. Patients may have received a course of rehabilitation because they were not improving; indeed, this is probable, because such treatment was usually started at about four months, corresponding with the usual time for return to work of those patients who were subsequently symptom free. It certainly may not be inferred that rehabilitation was a cause of persisting symptoms. On the other hand, there is no proof that such treatment helped, and in many cases it is clear that it did not. Thus symptoms persisted in over 90 per cent of the patients who attended a course of rehabilitation and in one-half of the patients so treated there was permanent incapacity.

Nicoll (1949) advocated “functional” treatment for spinal fractures. He recommended a short period of rest followed by graduated exercises of increasing severity. His patients were usually back at light work in twelve weeks though full activity was deferred for a further two months. He found the results from this active regime to be better than those obtained by a plaster jacket applied in hyperextension and worn for about four months. In the present
series patients were not treated with such prolonged immobilisation: neither were they subjected early to a course of rehabilitation. The findings are in agreement with those of Nicoll, however, in that the best function was in general seen in those who returned early to full activity.

A residential course of rehabilitation is expensive and time-consuming. Some patients may benefit from such therapy if treated early, but it has been found in this series that few achieve full recovery after therapy started late.

The reasons why some patients continue to complain of symptoms is uncertain. It is possible that unrecognised soft-tissue injury is important. There appears also to be a danger of overtreatment. Some who continue to complain may be reflecting the concern that has been expressed about their condition by their medical attendants. The functional outcome of these injuries is in most cases established early and a return to full activity should not be delayed by treatment unless such treatment can be shown to have a beneficial effect.

SUMMARY
1. The late consequences of stable fractures of the thoracic and lumbar spine have been assessed in a series of workmen. The incidence of symptoms has been recorded and an attempt made to assess the degree of associated incapacity.
2. It has been found that most patients continue to have some symptoms attributable to the back injury and that approximately one in five of the patients who attended for review was partially or completely incapacitated as a consequence of such symptoms.
3. The persistence of symptoms was found to be unrelated to the severity of fracture, to its level, to the presence of radiological evidence of degenerative change, or to the age of the patient.
4. Persistent symptoms were found more commonly in those patients who had received more treatment. The implications of this observation are discussed.

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REFERENCES