Thoracolumbar Spine Fractures in the Geriatric Fracture Center: Early Ambulation Leads to Good Results on Short Term and Is a Successful and Safe Alternative Compared to Immobilization in Elderly Patients With Two-Column Vertebral Fractures

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Abstract

Introduction: Thoracolumbar spine fractures are common osteoporotic fractures among elderly patients. Several studies suggest that these fractures can be treated successfully with a nonoperative management. The aim of this study is to evaluate the conservative treatment of elderly patients with a vertebral fracture. Methods: This study is a retrospective cohort study, which included all patients with an age of 65 years and older, who were diagnosed with a vertebral fracture and were therefore admitted to the Geriatric Fracture Center over a period of 2 years. Primary outcome was the level of functioning 6 weeks and 3 months after admission. Results: We included 106 patients with 143 vertebral fractures, of which 61 patients were evaluated after 3 months. In our population, 53% of the patients had a fracture involving both middle and anterior columns. The majority of the patients functioned sufficiently 6 weeks and 3 months after admission. Analysis showed that age <80 years is an independent predictor of a sufficient level of functioning after 6 weeks. Discussion: The nonoperative treatment of elderly patients with a vertebral fracture leads to a sufficient level of functioning 6 weeks and 3 months after admission. In our population, only age <80 years is an independent predictor for a sufficient level of functioning 6 weeks after admission. The level of functioning at 6 weeks predicts the level of functioning 3 months after admission. On comparison, the level of functioning after early ambulation is equal to the level of functioning after immobilization. Where immobilization may lead to complications, early ambulation was not associated with new complications or neurological damage. Based on these advantages, the treatment of elderly patients with a fracture involving both middle and anterior columns may be altered from immobilization to mobilization in the future.

Keywords

vertebral fractures, elderly, nonoperative treatment, level of functioning

Introduction

Vertebral fractures are, together with proximal femoral and wrist fractures, the most common osteoporotic fractures among elderly patients. The number of fractures detected in people older than 55 years of age on radiological examinations is 15,970 annually. The incidences of the fractures are 2 of 1000 in males and 7 of 1000 in females.¹

The majority of these fractures are situated in the thoracolumbar spine, from the 10th thoracic vertebra to the 4th lumbar vertebra.² Previous research showed that vertebral fractures are associated with an increased level of morbidity and mortality.³⁻⁵

Isolated fractures of the anterior column are usually treated by early ambulation. At this moment, no clear guidelines exist for fractures which also involve the middle column.⁶ Previous research showed that a nonoperative treatment gives the same result with regard to the level of mobility compared to an operative treatment.⁷⁻¹³ Several studies also suggest that a nonoperative treatment, immobilization, followed by delayed ambulation

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with the use of a brace when necessary, is a safe and successful
treatment for fractures involving the middle column.\textsuperscript{7,9}

Damage to the middle column is crucial to determine the
treatment strategy, immobilization in case of damage to the
middle column, and mobilization when only the anterior col-
umn is involved. It has been established that the computed
tomography (CT) scan is the appropriate device to detect dam-
age to the middle column.\textsuperscript{14,15} Therefore, the detection of mid-
dle column damage on CT images is crucial in the diagnostic
process and determines the type of treatment.

In our practice, we observed that immobilization is accom-
panied with problems such as pneumonia, which is a poten-
tially lethal complication. These problems often force us to a
change in treatment from immobilization to early mobilization,
apparently without negative side effects. We want to investi-
gate the consequences of these changes regarding the level of
mobility and the occurrence of neurological and other compli-
cations. Furthermore, we want to explore which factors con-
tribute to a level of mobility after hospital treatment for
vertebral fractures among the elderly patients.

The aims of this study are to evaluate the conservative treatment
of elderly patients with a thoracolumbar spine fracture and to iden-
tify factors that influence the level of mobility after treatment.

**Methods**

**Study Design**

This study is a retrospective cohort study, which included all
patients with an age of 65 years and older, who were diagnosed
with a vertebral fracture and were therefore admitted to the
Geriatric Fracture Center (GFC). The GFC is part of the Surgi-
cal Department of the hospital ZGT, Almelo, the Netherlands.

All patients were recruited between January 1, 2009, and
December 31, 2010. Exclusion criteria were cervical spine
fractures, fractures that needed operative treatment, and
patients who were transferred to another hospital. The indica-
tion for surgical treatment was made after consultation of an
expert center. Decisions were made based on the radiologic
imaging, that is, a 3-column fracture was an indication for
operative treatment. Although vertebroplasty is an operative
procedure, we did regard it not as an operative procedure for
meeting our exclusion criteria but as a less invasive instrument
to facilitate mobilization. The duration of the follow-up varied
from 6 weeks to 3 months after admission. Patients lost to
follow-up were excluded from the analysis, regarding func-
tional outcomes at the respective moments of follow-up.

This study took place in the GFC. We provide multidisciplin-
ary care, registered in clinical pathways, from admission until the
follow-up in the outpatient clinic, which has proven to result in
fewer complications, a significant decrease in readmissions,
and gets patients in a better condition at the moment of discharge.\textsuperscript{16,17}

**Variables**

We registered the following demographic variables of all
patients: age, gender, comorbidity based on the Charlson
Comorbidity Index (CCI), and number and location of the frac-
tured vertebrae.\textsuperscript{18,19}

The CCI is an index, which scores the burden of comorbid-
ity based on different conditions. Each condition has his own
score, based on the relative mortality risk in 1 year, and the CCI
is an accumulation of these scores. The relative risk of mortal-
ity in 1 year can be classified as low, intermediate, and high
based on the CCI. A CCI of 3 or more is considered to be a high
risk of 1-year mortality.

Patients were initially treated by either immobilization with
strict bed rest or early mobilization. Mobilization took place
with or without a brace depending on the level of the fractured
vertebra and comfort of the patient. When a patient went from
immobilization to ambulation, this was regarded as a change in
treatment policy.

Neurological examination was performed at admission, on
daily basis at the ward visits and when the patient was dis-
charged. The examination was carried out by emergency resi-
dents, surgical residents, or nurse practitioners.

Our primary outcome is the level of mobility 6 weeks and 3
months after admission. The level of mobility is determined
by the New Mobility Score developed by Parker and Pal-
mer.\textsuperscript{20} A score of 0 indicates the impossibility of mobilizing
independently, while a maximum score, 9, indicates a com-
plete independent state of functioning. A score of ≥6 indi-
cates a sufficient level of mobility of an independently
living patient.

Our secondary aim is to identify factors that influence the
level of mobility. To identify these factors, we registered the
type of treatment, involvement of the middle column, compres-
sion rate of the vertebral body, diameter of the spinal canal,
existing comorbidity, and the level of mobility at admission.
The involvement of the middle column, compression rate, and
spinal canal diameter were determined by a trained radiologist
using CT imaging of the spine.

**Statistical Analysis**

Factors related to a sufficient level of mobility, the ability to
function independently after a vertebral fracture, where
identified using a univariate analysis with use of the chi-
square ($\chi^2$) test. To identify factors predicting a sufficient
level of mobility, we performed a multivariate analysis
(logistic regression), including all factors related to the level
of mobility with a $P < .10$ in the univariate analysis. Analysis
was performed with the use of SPSS for Windows
version 17.0 (SPSS Inc., Chicago, IL, USA). The level of
significance in all analyses was $P < .05$.

**Results**

From January 1, 2009, until December 31, 2010, 117 patients
with a vertebral fracture were admitted to our hospital. We
included 106 of them in our study. The inclusion is shown in
Figure 1.
Demographics

Baseline characteristics of the patients are shown in Table 1. We included 106 patients with 143 vertebral fractures. Most of these fractures, 77%, were located in the thoracolumbar junction and the range of vertebra involved is shown in Figure 2. Majority (76%) of the fractures were due to a low-energy trauma. In 5%, a high-energy trauma caused the fractures, and 21% of the patients developed a fracture without any prior trauma. The majority (72%) of the patients had a sufficient level of mobility at admission. In 3 patients, a preexistent isolated nerve peroneus lesion was present at the time of admission. There were no new neurological deficits in any of the patients.

A complication was registered in 67% of the patients. Most common complication was the development of a delirium (17%). Other complications were pulmonary complications (9%), urinary tract infections (9%), and surgical site infections (7%).

During our study, the in-hospital mortality was 2%. The 30-day mortality reached 6%. During the 3-month follow-up, 12 (11%) patients died with a 1-year mortality of 14%. The cause of death was unknown in most cases, 1 patient died of a cardiac arrest and 1 patient died on the consequences of a polytrauma.

A total of 18 (17%) patients did have a history of osteoporosis prior to the fracture; all patients were treated for the osteoporosis. Treatment of osteoporosis is part of the treatment for vertebral fractures. Therefore, all patients who were not evaluated for osteoporosis prior to the fracture did get an invitation for osteoporosis screening and dual-energy x-ray absorptiometry scan.

A total of 67 patients responded to this invitation. The T-scores varied between −4.9 and +2.0, range −2.9. Based on the National Guidelines Osteoporosis (revised version 2011), all patients aged 50 years and older, with a vertebral fracture detected in the x-ray at the emergency department, were treated with calcium, vitamin D, and a bisphosphonates. Accumulating screening prior or after fracture, 85 (81%) patients underwent screening and treatment for osteoporosis.

Table 1. Baseline Characteristics.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td></td>
</tr>
<tr>
<td>&lt;69</td>
<td>9 (8.5)</td>
</tr>
<tr>
<td>70-79</td>
<td>42 (39.6)</td>
</tr>
<tr>
<td>80-89</td>
<td>48 (45.3)</td>
</tr>
<tr>
<td>90 and &gt;90</td>
<td>7 (6.6)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>28 (26.4)</td>
</tr>
<tr>
<td>Female</td>
<td>78 (73.6)</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
</tr>
<tr>
<td>Low (CCI &lt; 3)</td>
<td>86 (81.1)</td>
</tr>
<tr>
<td>High (CCI ≥ 3)</td>
<td>20 (18.9)</td>
</tr>
<tr>
<td>Columns involved</td>
<td></td>
</tr>
<tr>
<td>Anterior column</td>
<td>50 (47.2)</td>
</tr>
<tr>
<td>Anterior and middle column</td>
<td>54 (50.9)</td>
</tr>
<tr>
<td>Anterior, middle, and posterior column</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>Level of mobility at admission</td>
<td></td>
</tr>
<tr>
<td>Sufficient (NMS 6 or higher)</td>
<td>63 (72.4)</td>
</tr>
<tr>
<td>Insufficient (NMS 0-5)</td>
<td>24 (27.6)</td>
</tr>
<tr>
<td>Treatment policy at admission</td>
<td></td>
</tr>
<tr>
<td>Immobilization</td>
<td>73 (68.9)</td>
</tr>
<tr>
<td>Early ambulation</td>
<td>32 (30.2)</td>
</tr>
<tr>
<td>Vertebroplasty</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Definitive treatment policy</td>
<td></td>
</tr>
<tr>
<td>Immobilization</td>
<td>11 (10.4)</td>
</tr>
<tr>
<td>Early ambulation</td>
<td>91 (85.8)</td>
</tr>
<tr>
<td>Vertebroplasty</td>
<td>4 (3.8)</td>
</tr>
</tbody>
</table>

Abbreviations: CCI, Charlson Comorbidity Index; NMS, New Mobility Score.

a Based on the Charlson Comorbidity Index.18
b Based on the New Mobility Scale.20

Figure 1. Inclusion scheme.

Figure 2. Distribution of involved vertebrae.
of the patients had a fracture involving the anterior column. Reasons to change the treatment were due to the need for early ambulation and to facilitate mobilization. Progressive kyphosis requiring surgical intervention was not recorded. No patients underwent operative procedures regarding the vertebral fracture during the 3-month follow-up.

The majority of the complications we registered occurred in patients who were treated with immobilization (80%). After the change to early ambulation, no new complications occurred, and no neurological damage was registered.

**Primary Outcome: Level of Mobility**

We determined the level of mobility at 6 weeks and 3 months after admission. The majority of the patients showed a sufficient level of mobility at these times. The results are displayed in Table 3.

**Factors Related to a Sufficient Level of Mobility**

Univariate analysis showed that age, level of comorbidity, immobilization, and level of mobility at admission are related to the level of mobility after 6 weeks. Multivariate analysis showed that age <80 years is an independent predictor of a sufficient level of mobility after 6 weeks.

For the level of mobility after 3 months, a sufficient level of mobility 6 weeks after admission predicts a sufficient level of mobility. No independent predictor was found in multivariate analysis. All significant factors included in the analysis are shown in Table 3.

**Discussion**

The nonoperative treatment of elderly patients with a vertebral fracture leads to a sufficient level of mobility 6 weeks and 3 months after admission. In our population, only age <80 years old is an independent predictor for a sufficient level of mobility 6 weeks after admission. The level of mobility at 6 weeks predicts the level of mobility 3 months after admission.

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**Table 2. Radiological Characteristics.**

<table>
<thead>
<tr>
<th>Radiological Characteristics</th>
<th>Number of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior–posterior height ratio</td>
<td></td>
</tr>
<tr>
<td>&lt;15%</td>
<td>25 (23.6)</td>
</tr>
<tr>
<td>15-30%</td>
<td>29 (27.4)</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>31 (29.2)</td>
</tr>
<tr>
<td>No data</td>
<td>23 (21.7)</td>
</tr>
<tr>
<td>Central–posterior height ratio</td>
<td></td>
</tr>
<tr>
<td>&lt;15%</td>
<td>9 (8.5)</td>
</tr>
<tr>
<td>15-30%</td>
<td>38 (35.8)</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>56 (52.8)</td>
</tr>
<tr>
<td>No data</td>
<td>3 (2.8)</td>
</tr>
<tr>
<td>Posterior–posterior height ratio</td>
<td></td>
</tr>
<tr>
<td>&lt;15%</td>
<td>75 (70.8)</td>
</tr>
<tr>
<td>15-30%</td>
<td>23 (21.7)</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>5 (4.7)</td>
</tr>
<tr>
<td>No data</td>
<td>3 (2.8)</td>
</tr>
<tr>
<td>Compression of spinal canal</td>
<td></td>
</tr>
<tr>
<td>&lt;10%</td>
<td>63 (59.4)</td>
</tr>
<tr>
<td>10-30%</td>
<td>14 (13.2)</td>
</tr>
<tr>
<td>&gt;30%</td>
<td>6 (5.7)</td>
</tr>
<tr>
<td>No data</td>
<td>23 (21.7)</td>
</tr>
</tbody>
</table>

*All values are viewed as percentages deviated from normal. 22,23

*Posterior height of the fractured vertebra compared to the posterior height of the vertebra one level above.

**Radiological Characteristics**

In our population, 53% of the patients had a fracture involving both middle and anterior columns. A CT scan was performed in 78% of the patients. From the patients who did not underwent a CT scan, 3 patients underwent a magnetic resonance imaging. The other patients underwent evaluation by conventional x-ray images. An additional CT scan was not performed because the fracture existed a couple of days, patients delay on visiting the emergency department, and only a very minimal impaction of the anterior column on the x-ray evaluation.

In most cases, the anterior wedge was more than 30%. In 50% of the patients, the central depression was more than 30%. The posterior depression was relatively small, less than 15% in the majority of the patients. The Arbeitsgemeinschaft für Osteosynthesefragen (AO) classification following the AO Spine guidelines was an A-type fracture in all cases. Most of the patients with isolated anterior column damage did have an A0 or A1 fracture. In patients with both anterior and middle column evolvement, A2 and A3 fractures were present. 21 A complete overview of all radiological measures is shown in Table 2.
The level of mobility after early ambulation is equal to the level of mobility after immobilization. Where immobilization may lead to complications, early ambulation was not associated with new complications or neurological damage.

Based on these advantages, the treatment of elderly patients with a fracture involving both middle and anterior columns can be changed from immobilization to early ambulation. Therefore, the diagnosis of middle column damage by CT scan becomes less relevant in determining the treatment policy. Consequently, a diagnostic protocol with a limited role for CT imaging in elderly patients with a thoracolumbar spine fracture may be possible.

**Limitations**

The most important limitation is the number of patients lost to follow-up. Of the 106 patients included in our study, 58% proceeded to the follow-up 3 months after admission. This loss is partially explained by the number of patients who died during the follow-up. A total of 15 patients died, which correlates with 30% of the people lost in the follow-up. Analysis showed that the majority of the patients lost to follow-up are the patients with the best and worst levels of functioning. Therefore, our analysis excludes the extremes of both sides of the spectrum, and our results can be applied to the average patient with a vertebral fracture. We expect that a reanalysis of our data including the patients who are lost to follow-up due to these reasons would not lead to other results.

Another limitation is the duration of the follow-up. We evaluated only the levels of functioning shortly after the admission. To draw conclusions about the effects on a longer term follow-up, a longer period is needed.

An additional restriction is the use of the Parker Mobility Scale to evaluate the level of mobility. A validated questionnaire for elderly patients with a vertebral fracture is not available but the use of a more common questionnaire could have made comparison between studies more easier.

**Interpretation**

We saw that a nonoperative treatment of elderly patients with a thoracic or lumbar vertebral fracture leads to a sufficient level of mobility. This observation is stated by the results from the previous studies.\(^2\)\(^-\)\(^13\) These studies have shown that

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**Table 3. Level of Mobility and Factors Predicting the Level of Mobility.**

<table>
<thead>
<tr>
<th>Level of mobility</th>
<th>Number of Patients (%)</th>
<th>Sufficient</th>
<th>Insufficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Weeks</td>
<td>83 (78.3)</td>
<td>46 (55.4)</td>
<td>37 (44.6)</td>
</tr>
<tr>
<td>3 Months</td>
<td>61 (57.5)</td>
<td>39 (63.9)</td>
<td>22 (36.1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sufficient</th>
<th>Insufficient</th>
<th>UV, P</th>
<th>MV, P</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;80</td>
<td>30 (65.2)</td>
<td>11 (29.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥80</td>
<td>16 (34.8)</td>
<td>26 (70.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>43 (95.5)</td>
<td>29 (78.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3 (6.5)</td>
<td>8 (21.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immobilization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28 (60.9)</td>
<td>32 (86.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>18 (39.1)</td>
<td>5 (13.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of mobility At admission</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sufficient</td>
<td>34 (82.9)</td>
<td>18 (64.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insufficient</td>
<td>7 (17.1)</td>
<td>10 (35.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; NS, nonsignificant (P > .05); RR, relative risk UV: univariate analysis, MV: multivariate analysis (cox regression).
nonoperative treatment gives results comparable to operative treatment with regard to the level of mobility and the degree of pain reduction. These studies also stated that most of the people could return to work after a period of time. This is comparable with our finding that the majority of the elderly patients with a vertebral fracture return to a sufficient level of mobility. Although the majority of our patients do not have a job anymore, after the conservative treatment, they are able to return to prefracture activities of daily living. Our finding that age <80 years predict a good level of mobility 6 weeks after admission has, as far as we are aware, not been reported in the literature before. We pointed out that the prolonged immobilization in elderly patients with a vertebral fracture with middle column damage is often changed to mobilization.

Most of the changes in treatment policy occurred with patients with immobilization. Treatment was mostly changed from immobilization to ambulation. These changes were mostly made in cases where patients had fractures through both the anterior and the middle column. The majority of these patients regained a sufficient level of mobility. The finding that early ambulation leads to results comparable to those after prolonged immobilization is also stated by the results of Cantor et al and Mumford et al. The level of mobility after early ambulation is an important outcome. An outcome that is equally important is the safety of early mobilization of elderly patients with a vertebral fracture.

Our data showed that immobilization leads to complications. More than 50% of the patients with immobilization had a complication, mostly pneumonia or severe pain when lying down. After the change in the treatment, we did not record new complications. The complications that already existed, like a pneumonia, were treated in the same way as during the period of immobilization. The patients recovered from all existing complications during the period of mobilization.

Furthermore, we did not register any neurological deterioration. This is remarkable because a patient with middle column damage has an increased risk of nerve damage. With these findings in mind, the advantages of mobilization over the complications associated with immobilization, we suggest that early mobilization is a safe alternative for immobilization in the conservative treatment of elderly patients with vertebral fractures.

The most important use of the CT scan is to determine the stability of the fracture by determining middle column damage because fractures with involvement of the middle column are potentially unstable. In our study population, we found that middle column damage does not have to lead to immobilization but can safely be treated with ambulation. Therefore, determining the damage to the middle column as a single parameter becomes less important. Since the value of the CT scan as we use it now seems to be restricted, the use of the CT scan of elderly patients with a thoracic or lumbar spine fracture may be changed.

The integrity of the posterior wall of the vertebral column can become more important and may be the crucial point in the future to decide whether operative stabilization is needed or whether the conservative treatment, with early mobilization, may be the treatment of choice.

Declarations of Conflicting Interests
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