Chapter 6

Long-term functional outcome after type A3 spinal fractures: operative versus non-operative treatment

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Submitted
Abstract

Introduction: The optimal treatment of the type A3 “burst” fracture remains a challenging issue. Literature regarding short-term functional outcome after operative and non-operative treatment of these fractures shows conflicting results. Regarding the long-term outcome, hardly any data is available. Some authors do however fear complications in the long term, like late onset pain and late onset neurological deficit.

Objective: To reveal the long-term (5 years) functional outcome after operative (dorsal stabilization) and non-operative treatment for a type A3 spinal fracture (Comprehensive Classification) without neurological deficit.

Methods: Functional outcome was measured by means of two disease-specific questionnaires: the Visual Analogue Scale Spine Score (VAS) and the Roland-Morris Disability Questionnaire (RMDQ).

Results: The 63 patients included (38 treated operatively, 25 treated non-operatively) were on average 37 years old at the time of injury. The mean VAS scores in the operatively and non-operatively treated groups were 82.6 and 80.8, respectively (NS). The mean RMDQ scores in the operatively and non-operatively treated groups were 3.3 and 3.1, respectively (NS). None of the patients required surgery for late onset pain or late onset neurological deficit.

Conclusion: Functional outcome appears to be good five years after operative as well as non-operative treatment of type A3 “burst” fractures. Both treatment modalities show equal outcomes. Since outcome after both treatments is comparable, other factors than the type of fracture should be taken into account when deciding which therapy should be chosen.
Introduction

The optimal treatment for the type A3 spinal fracture (Comprehensive Classification [25]) remains a subject of debate [9, 14, 19, 38, 39, 45]. This type of fracture, also referred to as “burst” fracture, is characterized by comminution of the vertebral body with centrifugal extrusion of fragments, whereas the posterior ligamentous complex is intact [25]. Advocates of operative treatment point out the benefits of surgical approaches, namely the improvement in spinal alignment, decreased deformity, early mobilization and improvement (or no further deterioration) in neurological function [2, 12, 15, 28]. On the other hand, non-operative treatment lacks the risks of surgery, like deep wound infection, iatrogenic neurological damage and implant failure [10, 27, 31, 37]. In addition, costs of non-operative treatment are lower [17, 34, 40, 45]. Concerning radiological results and short-term clinical results a large amount of literature is available [1, 18, 23, 46]. However, the results of treatment can be seen in a broader perspective than radiological results alone. In what way do patients participate in normal daily activities and do they experience back pain? The measurement of patients’ health status is referred to as functional outcome. Although studying radiological results is useful, there appears to be no relationship between functional outcome and radiological appearance (e.g. anterior wedge angle, vertebral height loss) [22, 27, 39, 44]. Some literature regarding short-term outcome is on hand [9, 12, 14, 19, 28, 38]. However, literature regarding long-term outcome is less available. Several authors fear complications in the long term, like progressive kyphosis resulting in back pain or even late onset neurological injury [5, 7, 42].

This study analyzes the long-term (5 years) functional outcome after operative and non-operative treatment for a type A3 “burst” fracture in patients without neurological deficits.

Methods

Patients

Patients aged between 18 and 60 (at the time of injury) who sustained a type A3 thoracolumbar (T7-L5) spinal fracture according to the Comprehensive Classification [25], without neurological deficit treated at the University Medical Centre Groningen were eligible for this study. To obtain the diagnosis, an X-ray and CT-scan were made, no standard MRI’s were made at that time. All patients were initially treated between 1996 and 2000. Exclusion criteria were previous
spinal disorders in the medical history, psychiatric illnesses, pathological fractures or insufficient command of the Dutch language. Medical files of all included patients were reviewed to obtain data on late onset pain or late onset neurological deficits.

**Treatment**
A senior staff member, taking into account radiological and clinical findings, made the decision whether an operative or non-operative procedure was preferred.

Operative treatment consisted of fracture reduction and fixation by means of dorsal instrumentation using the Universal Spine System (Synthes Cooperation, Bochum, Germany), combined with transpedicular cancellous bone grafting and dorsal spondylodesis following Dick and Daniaux [11, 13]. Fracture reduction, i.e. angular reduction and distraction, was acquired by indirect manipulation via pedicle screws as lever. Cancellous bone (taken from the dorsal iliac crest) was put transpedicularly in the reduced vertebral body and packed around the opened facet joints at the dorsolateral side afterwards as well [6, 11]. This spondylodesis was done at the level of the destructed endplate, for example only the upper segment in a type A3.1 fracture and both segments in type A3.3 fractures. No ventral operations, disectomies or laminectomies were performed. Postoperatively, all patients were transferred to a rehabilitation centre. They were allowed to walk after about 10 days in a reclination brace, which was worn for 9 months. In the final 3 months, patients only wore the brace during daytime. After 9 months the implants were removed. Non-operative treatment was initialized in our hospital and continued in a rehabilitation centre. Treatment consisted of 6 weeks of bedrest (or strykerframe), followed by a reclination brace. Patients were mobilized with the guidance of a physiotherapist or an occupational therapist. After 3 months weight bearing exercises were introduced. The brace was worn for 9 months, the first 6 months night and day, the last 3 months only during the daytime. Patients were allowed to drive a car or ride a bicycle after 3 and 9 months, respectively.

**Functional outcome measurement**
Functional outcome was measured by two disease-specific questionnaires: the Visual Analogue Scale Spine Score (VAS) and the Roland-Morris Disability Questionnaire (RMDQ) [21, 35]. The VAS, developed to be used in spinal fracture patients, consists of 19 items measuring restriction in activities due to back-related problems. Patients are asked
to value the functional outcome in these 19 items on a 10 cm visual scale. Higher scores indicate better results, converted to percentages of the maximum score (0-100). In previous studies, it has proven to be a reliable and valid instrument [21, 24, 29, 39, 40].

The RMDQ is a health status measure designed to be completed by patients to assess physical disability due to back pain. Twenty-four statements regarding back-related activities can be ticked as positive (restricted) or negative (not restricted). Scores can vary from 0 to 24, a lower score indicating less impairment [35]. The Dutch version of the RMDQ was used [36].

Statistical analysis
Statistical analysis was carried out using SPSS 11.0 (SPSS inc. Chicago, Illinois). Categorical data were analyzed by applying chi-square tests. Since RMDQ and VAS scores in the operative group were skewed, the Mann-Whitney test was used to compare means between the operative and non-operative group. In order to analyze the influence of follow-up time and age on the outcome, a linear regression analysis was performed with VAS and RMDQ scores as dependent variables and age and follow-up time as independent variables. A p-value of 0.05 was considered significant.

Results
Patients
Seventy-six patients met the inclusion criteria. From this group of 76 patients (46 treated operatively, 30 treated non-operatively), 2 had died (8 and 9 years after treatment, due to unrelated causes) and 7 were lost to follow-up. Sixty-seven patients were sent two postal questionnaires and an informed consent agreement. Sixty-three patients returned the questionnaires (follow-up rate 63/67=94%) and comprised the study group.

No differences were found in age, gender, follow-up time or fracture classification and distribution between respondents and non-respondents.

Details of the study group (n=63) were as follows:
- Patients treated operatively: Twenty-six out of the 38 patients were males (68%) (see Table 1). Fracture levels ranged from T9 to L5, most fractures (74%) occurred at the thoracolumbar junction (T12/L1). Five patients had multiple spinal fractures, the most severe was registered, the others were not taken into account.
- Patients treated non-operatively: Fifteen out of the 25 patients were males (60%) (see Table 1). Fracture levels ranged from T7 to L5, most fractures (60%) occurred at the thoracolumbar junction (T12/L1). Four patients had multiple spinal fractures, the most severe was registered, the others were not taken into account.

Table 1 Details of the study group (n=63)

<table>
<thead>
<tr>
<th></th>
<th>operative</th>
<th>non-operative</th>
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</thead>
<tbody>
<tr>
<td>n</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>gender (♂ : ♀)</td>
<td>26 (68%) : 12 (32%)</td>
<td>15 (60%) : 10 (40%)</td>
</tr>
<tr>
<td>age (years)</td>
<td>mean (S.D.) range 37.2 (11.8) 18-56</td>
<td>37.4 (12.2) 19-58</td>
</tr>
<tr>
<td>follow-up (years)</td>
<td>mean (S.D.) range 5.7 (2.9) 2.5-10.6</td>
<td>4.8 (2.9) 2.1-10.4</td>
</tr>
<tr>
<td>etiological factors</td>
<td>accidental falls (n) 13</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>traffic accidents (n) 12</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>sports injuries (n) 10</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>occupational (n) 3</td>
<td>2</td>
</tr>
<tr>
<td>comprehensive</td>
<td>A3.1 15 (40%)</td>
<td>22 (88%)</td>
</tr>
<tr>
<td>classification</td>
<td>A3.2 18 (47%)</td>
<td>3 (12%)</td>
</tr>
<tr>
<td></td>
<td>A3.3 5 (13%)</td>
<td>0</td>
</tr>
</tbody>
</table>

When comparing the operative and non-operative group, no differences were found in gender, age, follow-up time or fracture distribution. The operative group consisted of significantly more type A3.2 and A3.3 fractures and less type A3.1 fractures ($p<0.01$).

None of the patients required surgery for late onset pain or late onset neurological deficit.

**Functional outcome**

No differences were found between operative and non-operative patients concerning VAS and RMDQ scores (see Table 2).

The distribution of VAS and RMDQ scores is shown in Figure 1 and Figure 2.

Table 2 VAS and RMDQ scores for the treatment groups

<table>
<thead>
<tr>
<th>treatment</th>
<th>VAS</th>
<th>RMDQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>median</td>
</tr>
<tr>
<td>operative</td>
<td>82.6</td>
<td>94.1</td>
</tr>
<tr>
<td>non-operative</td>
<td>80.8</td>
<td>84.0</td>
</tr>
</tbody>
</table>
Fig. 1 Box-plot graph showing the VAS scores in both treatment groups. The graph illustrates the median (inner black line), the upper and lower quartiles (the box), the range of data excluding outliers (the whiskers) and outliers (○ displaying outliers).

Fig. 2 Box-plot graph showing the RMDQ scores in both treatment groups. The graph illustrates the median (inner black line), the upper and lower quartiles (the box), the range of data excluding outliers (the whiskers) and outliers (○ displaying outliers).
When comparing patients with type A3.1 fractures to those with type A3.2 fractures, no significant differences were found between VAS and RMDQ scores (80 versus 86 and 3.5 versus 2.7, respectively).

Within the patients with a type A3.1 fracture, no significant differences were found in VAS and RMDQ scores between those treated operatively and those treated non-operatively (80 versus 80 and 4.0 versus 3.1, respectively). Regression analysis showed no correlation between age or follow-up time and VAS and RMDQ scores. A strong correlation was found between VAS and RMDQ scores (Spearman’s rho -0.84, p<0.01).

**Discussion**

This study was conducted to compare the functional outcome after operative (dorsal stabilization) and non-operative treatment in patients with type A3 spinal fractures. Literature comparing functional outcome after operative and non-operative treatment for type A3 spinal fractures is available. However, these studies mostly focus on short-term results [9, 12, 14, 19, 28, 38]. Papers comparing long-term outcome (approximately 5 years or over) are reasonably scarce [3, 22, 39, 45]. Although our data were obtained in a retrospective, cross-sectional setting, a closer look at the results reveals some interesting information.

**VAS scores**

No difference was found between the operatively and non-operatively treated group with respect to the mean VAS scores. As such, both groups seem to suffer equal disability. In previous studies, VAS scores in healthy individuals were found to be 92-93 [21, 29]. Comparing our data to these numbers, VAS scores in our collective were lower, indicating that both groups suffer from some disability compared to healthy subjects. However, this disability seems to be quite low. Previously, Siebenga et al. found mean VAS scores of 81 and 61, measured 4 years after operative and non-operative treatment for a type A3 fracture, respectively [39]. Our non-operatively treated patients perform better. This difference might be explained by two patients developing late neurological deficits in Siebenga’s non-operative group. Furthermore, in contrast to our series, Siebenga’s cohort of non-operatively treated patients comprised a few type A3.3 fractures. Outcomes comparable to ours were found by Resch et al. [33]. Four years after operative and non-operative treatment of type A fractures (mainly type A3), a Hannover spine score of 85 was reported [33]. This outcome measure is fairly comparable to the
VAS spine score [8, 20]. In another study, a Hannover spine score of 82 was found, nine years after dorsal instrumentation for type A3 fractures [2]. Our results are comparable. In a paper concerning late outcome after non-operatively treated type A fractures (follow-up 16 years) a mean VAS score of 58 points was found [32]. Our patients seem to do better, an explanation might be found in the fact that the afore-mentioned study included subjects with neurological injuries. As known from literature neurological deficit in spinal fracture patients affects the outcome in a negative manner [26]. Similar to our series no late onset neurological deterioration occurred [32].

RMDQ scores
Impairment measured by the RMDQ seems reasonably low in both the operatively and non-operatively treated group (mean scores 3.3 and 3.1, respectively). A RMDQ score of 12.5 was reported in an age-matched sample of subjects with non-specific low back pain (duration of onset 1-6 weeks) [41]. Our patients do remarkably well compared to this figure. Wood et al. found in a prospective setting regarding “burst” fractures a RMDQ score of 8 in operatively treated patients along with a RMDQ score of 4 in those treated non-operatively [45]. Our data are comparable with respect to the non-operative group. Concerning the operatively treated group, our patients display a lower RMDQ score (indicating less impairment). An explanation might be found in the presence of dorsal instrumentation which can give rise to mechanical complaints and pain. In our treatment protocol implants are removed. Wood et al. did not mention so, hence possibly the presence of implants resulted in back pain. Others found an average RMDQ score of 3 after operative treatment for a type A3 fracture and a RMDQ score of 9 after non-operative treatment [39]. Our results are comparable concerning the operative group, but in the non-operative group these numbers contrast to our data. A possible explanation might be the late onset neurological deficit which occurred in two patients in the non-operative group [39]. Kraemer et al. found a RMDQ score of 8, measured 4 years after operative as well as non-operative treatment for “burst” fractures [22]. Our patients show considerably lower impairment, an explanation is not at hand.

Operative versus non-operative
Studies trying to find the most favourable treatment in type A3 fractures show contradicting results. Concerning short-term outcome, Denis et al. found operative treatment to give superior outcome over non-operative treatment, measured 3
years post-injury [12]. In his series, 17% of patients treated non-operatively developed neurological problems versus no deterioration in the operative group. In addition, return to work (RTW) was better in those treated operatively. A prospective study by Öner et al., using MRI-scans, found better results (measured by using Denis’ pain scale) for operative treatment at 2 year follow-up [12, 28]. In contrast, a recent study comparing outcome 3 years after treatment of L1 “burst” fractures reported less pain (on Denis’ scale) and higher RTW in non-operatively treated neurologically intact patients [9, 12]. Other authors found equal outcomes 1-2 years after operative and non-operative treatment for “burst” fractures [14, 19, 38].

Regarding long-term outcome, two multi-centre prospective randomized trials have been published, which show conflicting results [39, 45]. One study reported better results for those patients treated operatively, according to more favourable VAS and RMDQ scores plus higher RTW rates [39]. In contrast, equal outcomes (as measured by the SF-36 and Oswestry disability questionnaires) and similar RTW rates were reported by Wood et al., four years after treatment of thoracolumbar “burst” fractures [16, 43, 45]. However, RMDQ scores showed better outcomes in those patients treated non-operatively [45]. Comparable to our findings, other authors found equal outcomes for operative and non-operative treatment 4-6 years after “burst” fractures [3, 22].

The duration of follow-up time did not correlate with functional outcome. This indicates that the functional outcome involving the period of our follow-up time (2 to 10 years) does not alter considerably. This is in accordance with a study by Andress et al., who could not demonstrate a correlation between outcome and duration of follow-up time (3 to 9 years in his series) after operative treatment for type A3 fractures [2]. As in our series, no difference was found in outcome between the sub-classifications (i.e. A3.1, A3.2, A3.3) [2]. Also Weinstein et al. found no correlation between the length of follow-up time and outcome in non-operatively treated “burst” fractures [44]. We could not demonstrate differences in outcome 5 years after operative and non-operative treatment of type A3 fractures. Long-term complications, such as late onset neurological deficit or late onset pain as reported in literature did not occur [5, 7, 42]. None of our patients required surgery for late onset pain or late onset neurological deficit. When comparing our long-term VAS and RMDQ scores to literature, patients seem to do reasonably well, and outcome does not seem to deteriorate on the long term for neither group. Considering our results, one can
conclude that functional outcome in the long term is equal for both treatment modalities and is independent from age and duration of follow-up time. As such, benefits and drawbacks of both treatment modalities should carefully be taken into account when deciding which treatment is preferred in patients with type A3 fractures without neurological deficit. Both approaches are relatively safe and major complications are rare, so other factors like co-morbidities, (in)direct costs and short-term clinical complications, such as urinary tract infections, pressure sores or pulmonary embolism, should play a role in decision making. In this light, it is noteworthy that costs for non-operative treatment are considerably lower than those for operative treatment [8, 17, 34, 40, 45].

**Limitations**

Certain limitations are present in this study. Data were obtained in a cross-sectional setting, which has several weaknesses compared to prospective study designs. Furthermore, the small size of the study group might have introduced a type 2 statistical error [4]. When considering the results found, it should be kept in mind that the operative group consisted of more patients suffering from type A3.2 and A3.3 fractures and less type A3.1 fractures. On the other hand, those patients who had sustained a type A3.1 fracture did not show different VAS or RMDQ scores compared to those who had sustained a type A3.2 fracture. To make a definite judgement concerning long-term outcome after type A3 fractures, larger, prospective studies are needed. To assess outcome in a broad manner, besides questionnaires physical capacity tests could be considered as well [24, 30].

**Conclusions**

Functional outcome appears to be good five years after operative (dorsal stabilization) as well as non-operative treatment of type A3 spinal fractures. Both treatment modalities show equal outcomes. We did not observe late onset neurological problems or late onset pain requiring surgery. When making a decision on the treatment for a patient with a type A3 spinal fracture without neurological deficit, factors other than the type of fracture should be taken into account.
References