



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

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The authors retrospectively studied, by questionnaires, the long-term (5 years) functional outcome after operative (posterior instrumentation : 38 cases) and non-operative treatment (25 cases) for type A3 spinal fractures (Comprehensive Classification) without neurological deficit. A possible bias of this study was the fact that the operative group included 60% A3.2 and A3.3 fractures, versus only 12% in the non-operative group. Two disease-specific questionnaires were used : the Visual Analogue Scale Spine Score and the Roland-Morris Disability Questionnaire. At follow-up the mean VAS scores were 82.6 and 80.8 in the operatively and non-operatively treated group, respectively ; the difference was not significant. The mean RMDQ scores were 3.3 and 3.1 in the operatively and non-operatively treated groups, respectively ; again the difference was not significant. Functional outcome appeared to be equally good five years after operative or non-operative treatment of type A3 “burst” fractures.

**Keywords :** functional outcome assessment ; spinal fracture ; operative treatment ; non-operative treatment.

### INTRODUCTION

The optimal treatment for type A3 spinal fractures (Comprehensive Classification) (14) remains a subject of debate (5,9,21,23,27). 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 poste-

rior ligamentous complex is intact (14). Advocates of operative treatment point out the benefits of a surgical approach, namely the improvement in spinal alignment, decreased deformity, early mobilization and improvement (or no further deterioration) in neurological function (1,7). On the other hand, non-operative treatment avoids the risks of surgery, such as deep wound infection, iatrogenic neurological damage and implant failure (18,26). In

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addition, costs of non-operative treatment are lower (22,27). Traditionally, results of treatment have focused on radiological aspects. However, the results of treatment can be seen in a broader perspective than radiological results alone, for example in terms of resulting functional outcome. Although studying radiological results is useful, there appears to be no systematic relationship between functional outcome and radiological appearance (e.g. anterior wedge angle, vertebral height loss) (12,23,26). Some data are available in literature regarding short-term outcome (5,7,9,21). However, literature data regarding long-term outcome are scarce. Several authors fear complications on the long term, like progressive kyphosis resulting in back pain or even late onset neurological injury (3,25). This study analyzes the mid-term (5 years) functional outcome after operative (posterior instrumentation) and non-operative treatment for type A3 "burst" fractures in patients without neurological deficit.

## METHODS

### Patients

Patients aged between 18 and 60 years at the time of injury, who sustained a type A3 thoracolumbar (T7-L5) spinal fracture according to the Comprehensive Classification (14), without neurological deficit and were treated at the University Medical Centre Groningen, were eligible for this study. The diagnosis was based on radiographs and CT-scans; MRI was not used routinely at that time. All patients were initially treated between 1996 and 2000. The mean follow-up period was 5.7 years in the operative group, and 4.8 years in the non-operative group. 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. Two questionnaires were used (see below).

### Treatment

Taking into account radiological and clinical findings, a senior staff member made the decision whether an operative or a non-operative treatment was preferred in every individual case. Operative treatment consisted of

fracture reduction and fixation by means of posterior instrumentation (Universal Spine System, Synthes Corporation, Bochum, Germany), combined with transpedicular cancellous bone grafting and posterior spondylodesis according to Dick and Daniaux (6,8). Fracture reduction, i.e. angular reduction and distraction, was obtained by indirect manipulation via pedicle screws used as levers. Cancellous bone from the iliac crest was inserted transpedicularly into the reduced vertebral body and packed around the opened facet joints and posterolaterally (4,6). This spondylodesis was performed at the level of the destructed endplate, for example only the upper segment in type A3.1 fractures, and both segments in type A3.3 fractures. No anterior operations, discectomies or laminectomies were performed. Post-operatively, 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 wore the brace only during daytime. The implants were removed after 9 months. Non-operative treatment was initialized in the hospital and continued in a rehabilitation centre. Treatment consisted of 6 weeks of bed rest (or on a Stryker frame), followed by a reclination brace. Patients were mobilized under the guidance of a physiotherapist or an occupational therapist. After 3 months, weight bearing exercises were introduced. The brace was worn for 9 months, day and night during the first 6 months, only during the day during the last 3 months.

### Functional outcome measurement

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) (10,20). The VAS, developed for use 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 (10,13,17,22,23). 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 (20). The Dutch version of the RMDQ was used (19).

## Statistical analysis

Statistical analysis was carried out using SPSS 11.0 (SPSS Inc. Chicago, USA). 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. Two questionnaires and an informed consent were mailed to 67 patients. Sixty-three patients returned the questionnaires (response rate 63/67 = 94%) and formed the study group. Thirty-eight patients were treated operatively: 26 out of these were males (68%) (table I). 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. Twenty-five patients were treated non-operatively: 15 out of these were males (60%) (table I). 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.

When comparing the operative and the non-operative group, no differences were found in gender, age, follow-up time or fracture distribution. However, the operative group included a significantly higher proportion of type A3.2 and A3.3 fractures: 60% versus 12% in the non-operative group (*p* < 0.01). This was a weak point of this study. None of the patients required surgery for late onset pain or late onset neurological deficit.

### Functional outcome

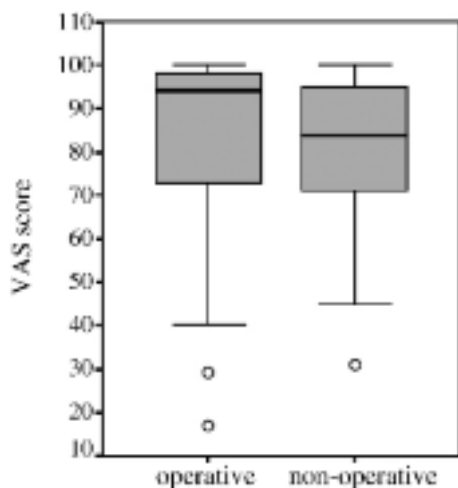
No differences were found at follow-up between operative and non-operative patients concerning VAS and RMDQ scores (table II) (fig 1 & 2). When comparing patients with type A3.1 fractures to those with type A3.2 fractures, no significant differences were found between VAS and RMDQ scores (80 versus 86 and 3.5 versus 2.7, respectively). Within the A3.1 fracture group, no significant

Table I. — Details of the study group (n = 63)

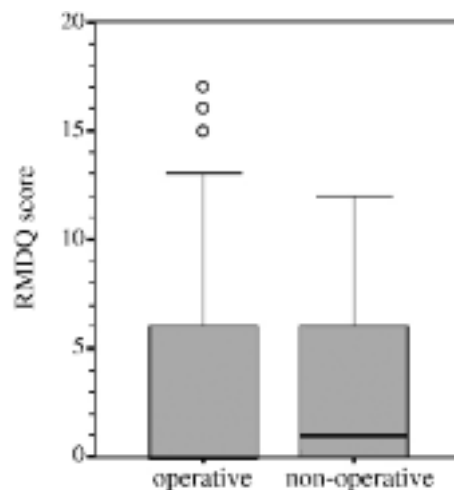
		Operative	Non-operative
n		38	25
Gender (♂/♀)		26 (68%) / 12 (32%)	15 (60%) / 10 (40%)
Age in years : mean / S.D. / range		37.2 / 11.8 / 18-56	37.4 / 12.2 / 19-58
Follow-up in years : mean / S.D. / range		5.7 / 2.9 / 2.5-10.6	4.8 / 2.9 / 2.1-10.4
Aetiological factors	accidental falls (n)	13	10
	traffic accidents (n)	12	11
	sports injuries (n)	10	2
	occupational (n)	3	2
Comprehensive classification	A3.1	15 (40%)	22 (88%)
	A3.2	18 (47%)	3 (12%)
	A3.3	5 (13%)	0

Table II. — VAS and RMDQ scores at final follow-up

Treatment	VAS				RMDQ			
	mean	median	SD	range	mean	median	SD	range
Operative	82.6	94.1	21.9	17-100	3.3	0	5.1	0-17
Non-operative	80.8	84.0	19.4	31-100	3.1	1.0	3.7	0-12
Differences not significant								



**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).

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 duration 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 and non-operative treatment in patients with type A3 spinal fractures. Literature data comparing short-term functional outcome after operative and non-operative treat-

ment for type A3 spinal fractures is available (5,7,9, 21). Papers comparing long-term outcome (approximately 5 years or more) are fairly scarce (2,12, 23,27). Although our data were obtained in a retrospective, cross-sectional setting, a closer look at the results revealed some interesting information.

At follow-up no difference was found between the operatively and non-operatively treated groups with respect to the mean VAS scores. As such, both groups seemed to suffer equal disability. In previous studies, VAS scores in healthy individuals were found to be 92-93 (10,16). Comparing our final data to these numbers, VAS scores in our series were somewhat lower, around 80, indicating that patients in both groups suffered some disability compared to healthy subjects. However, this disability seemed to

be quite limited. Previously, Siebenga *et al* (23) found mean VAS scores of 81 and 61, measured 4 years after operative and non-operative treatment for a type A3 fracture, respectively. Our non-operatively treated patients performed better. This difference might be explained by two patients developing late neurological deficits in Siebenga's non-operative group. Reinhold *et al* (18) studied late outcome, 16 years after non-operatively treated type A fractures (follow-up 16 years), and found a mean VAS score of 58 points. Again, our patients seemed to fare better; an explanation might be found in the fact that the aforementioned study included subjects with neurological injuries. As known from literature, neurological deficit in spinal fracture patients affects the outcome in a negative manner (15). Similar to our series Reinhold *et al* (18) noted no late onset neurological deterioration.

Impairment measured by the *RMDQ* was reasonably low in both the operatively and non-operatively treated group (mean scores 3.3 and 3.1, respectively). An *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) (24); our patients did remarkably well compared to this figure. Kraemer *et al* (12) found an *RMDQ* score of 8, measured 4 years after operative as well as non-operative treatment for burst fractures. Our patients showed considerably lower impairment, an explanation is not at hand. Recently, an *RMDQ* score of 3.2 was reported, 10 years after non-operative treatment for type A3 fractures (11). Our results were comparable.

Studies trying to find out the most favourable treatment for type A3 fractures show contradictory results. Concerning short-term outcome, Denis *et al* (7) found operative treatment to give superior outcome over non-operative treatment, measured 3 years post-injury. In their 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. 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 (5). Other authors

found similar outcomes 1-2 years after operative and non-operative treatment for burst fractures (9,21).

Regarding long-term outcome, only two multi-centre prospective randomized trials have been published, which show conflicting results (23,27). One study reported better results for those patients treated operatively, with more favourable VAS and *RMDQ* scores and higher RTW rates (23). In contrast, similar outcomes (as measured by the SF-36 and Oswestry disability questionnaire) and similar RTW rates were reported by Wood *et al* (27), four years after treatment of thoracolumbar burst fractures. Yet *RMDQ* scores showed better outcomes in patients treated non-operatively. However, this study was not completely comparable, as anterior procedures were also used besides posterior stabilization. Similar to our findings, other authors found equal outcomes for operative and non-operative treatment 4-6 years after burst fractures (2,12).

The duration of follow-up did not correlate with functional outcome. This indicates that the functional outcome over 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* (1) who could not demonstrate a correlation between outcome and duration of follow-up time (3 to 9 years in their series) after operative treatment for type A3 fractures (1). As in our series, no difference was found in outcome between the sub-classifications (i.e. A3.1, A3.2, A3.3). Also Weinstein *et al* (26) found no correlation between the length of follow-up time and outcome in non-operatively treated burst fractures.

We could not demonstrate differences in outcomes 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 (3,25). When comparing our long-term VAS and *RMDQ* scores to the literature, patients seemed to do reasonably well. Considering our results, one can conclude that functional outcome on the long term appears equal for both treatment modalities and is independent from age and duration of follow-up. 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 deficits. 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. It is noteworthy that costs for non-operative treatment are considerably lower than those for operative treatment (22,27).

Certain limitations are present in this study. Data were obtained in a retrospective, cross-sectional setting, which has several weaknesses compared to prospective study designs. It appears difficult to set up prospective studies in spinal fracture research, which is confirmed by the fact that only two long-term prospective studies are available. The retrospective design of this study might have introduced a bias, considering that the operative group included more type A3.2 and A3.3 fractures (60% versus 12%) 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 definitive judgement concerning long-term outcome after type A3 fractures, larger, prospective studies are needed. To assess outcome in a broad manner, physical capacity tests should be considered as well besides questionnaires (13,17).

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