Abstracts

Abstract chapter 1

Some aspects of the ancient history of the treatment of spinal fractures are described. Conservative and operative treatments are discussed, for example the operative techniques of bitibial traction and fixation with Harrington rods. This treatment was performed in our hospital during many years. The epidemiology of trauma patients is described in general and the epidemiology of spinal trauma patients, including the studied group of patients of this study, is described more in detail. ICD-9, ISS and RLOG features are discussed. The incidence of spinal fractures showed only a marginal increase in the last three decades. Operative treatment, reduction and fixation, with the internal fixator, combined with transpedicular cancellous bone grafting and dorsal spondylodesis is the actually performed treatment in our study group, with only minor variants in the years 1988 to 1996. After treatment schemes, as well as follow-up schemes has been unchanged during the years, which gave us the opportunity to study 183 patients with thoracolumbar fractures who were operatively treated in this period.

Abstract chapter 2

The clinical records, operation records, X-rays and CT-scans of 160 operatively treated patients with A-type and B-type spinal fractures were evaluated in a retrospective study. The preoperative diagnosis was compared with the postoperative diagnosis. Analysis of characteristics of patients with A-type fractures (without the unrecognised B-type fractures), initially unrecognised B-type (uB) fractures, and B-type fractures (without the unrecognised B-type fractures) was performed. We analysed the age of the patients, the respective
fracture levels, neurological deficit, anterior wedge angles (AWA), anterior corporal height (ACH), posterior corporal height (PCH), and the percentage of frontal corporal collapse (FCC). The \( t \)-test was used for statistical analysis. The mean age of patients in each group did not show a significant difference. The group of unrecognised B-fractures had a more caudal fracture level than the recognised B-type fractures. The fracture levels of the A-group and the uB-group patients showed no difference using the \( t \)-test. The percentage of patients with spinal fractures with neurological deficit is 16% in the A-type fracture group, 12% in the uB-fracture group and 50% in the B-type group. The preoperative classification of patients in the A-group and in the uB-group showed that patients in the uB-group have more than proportional relatively simple preoperative A-fractures. The mean PCH of the uB-group was higher than the PCH of the A-group. Thirty percent of B-type fractures are misdiagnosed when plain X-rays and CT scans with 2D reconstructions are used as the only preoperative diagnostic tools. A large PCH with a normal interspinous distance should raise the suspicion of a B-type lesion. A large AWA does not point to a ligamentary B-type fracture.

**Abstract chapter 3**

In internal posterior fixation of thoracolumbar fractures combined with transpedicular cancellous bone graft and posterior fusion of the intervertebral facet joints at the level of the destroyed end plate it is still uncertain as to whether significant vertebral body collapse and loss of correction of the regional angle (RA) and the intervertebral angle (IVA) occur (after removal of the implants). These questions were investigated in a retrospective study of 183 consecutive patients, 18-65 years old, with a spinal fracture between the 9th thoracic and the 5th lumbar vertebral body (inclusive), treated operatively between 1988 and 1996 (27% had objective neurological deficit, 37% had multiple injuries). According to the Comprehensive Classification, 128 type A, 32 type B and 21 type C-fractures were identified preoperatively. Changes in AWA, IVA and RA were measured preoperatively, and within 1 month, 9 months and 24 months postoperatively. The effect of implant failure was also evaluated. The normality of the distribution was tested using the Kolmogorov-Smirnov (K-S) test. The one-sample runs test and the \( t \)-test were used to evaluate angle changes. The reduced vertebral body did not collapse after 9 months, when most of the patients (170) underwent removal of the implants, but significant changes in IVA were found after implant removal. Correction of the RA was statistically significant before implant removal, but the RA 2 years after surgery equalled the preoperative value. Changes at the level of the intervertebral space contributed to the loss in the RA. Broken pedicle screws
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(10.9% of the patients) resulted in significant changes in the AWA and RA before implant removal.

Abstract chapter 4

Although multiple studies concluded operative decompression of a traumatic narrowed spinal canal is not indicated because of spontaneous remodelling, instrumental decompression is frequently used as part of the operative treatment of spinal fractures.

To investigate the process of remodelling we studied the diameter of the spinal canal in 95 patients with burst fractures of the thoracolumbar junction (T9-L2). To measure and compare the spinal canal’s diameter we used either CT-scans or radiographs, made preoperatively, postoperatively, after 9 months and after 24 months. In lateral plain radiographs we found that the initial percentage of cases with bony canal narrowing preoperatively of 76.5 is reduced to 18.4% postoperatively, to 8.2% at 9 months, and to 2.4% at 24 months. In CT-scans in a selection of patients the mean residual diameter of the spinal canal was 53% preoperatively and 78% at 24 months. The posterior segmental height increases during operation and decreases in the respective periods after operation.

We conclude a significant spontaneous remodelling of the spinal canal follows the initial surgical reduction. Two years after operation bony narrowing of the spinal canal is only recognisable in 2.4% of the patients in plain lateral radiographs. The remodelling of the spinal canal can be seen in plain radiographs, although not as accurate as in CT-scans.

Abstract chapter 5

In order to study the effect of dorsal spondylodesis on intervertebral movement in patients treated for thoracolumbar fractures, we measured the sagittal range of motion (ROM) in the segments above and below the fractured vertebral body two years after operation. Between 1991 and 1996, 82 consecutive patients with a fracture of the thoracolumbar spine (T12, L1, L2 and L3) were treated operatively. Eighteen T12, 42 L1, 17 L2 and 5 L3 fractures were included. The range of motion of two segments above and two segments below fracture level was measured on plain flexion and extension radiographs. The data were compared to normal values and to the zero distribution with the K-S test. At all fracture levels the ROM of the segment adjacent to the disturbed endplate of the fractured body was zero. All other evaluated segments showed significant loss of ROM (p<0.05) compared to normal values, except segment L1-L2 in
L3 fractures. Dorsal spondylodesis at the level of the disturbed endplate in thoracolumbar spinal fractures is effective. More than 50% loss of motion in the two adjacent levels is equivalent to complete loss of ROM in a second segment.

Abstract chapter 6

The aim of this study is to develop insight in the impairments in operatively treated spinal fracture patients, and also in their ability to participate in daily living, return to work and quality of life as defined by the WHO. Nineteen patients operated for a type A fracture of the thoracolumbar spine (T9-L4) between 1993 and 1998 in the University Hospital Groningen, aged between 18 and 60 years, without neurological deficit, were included in the study. Operative treatment consisted of fracture reduction and internal fixation using the Universal Spine System, combined with transpedicular cancellous bone grafting and dorsal spondylodesis. Restrictions in body function and structure are measured in radiographs and in functional capacity tests, like lifting tests and ergometry. Restrictions in activities are studied with the Visual Analogue Scale Spine Score and the Roland Morris Disability Questionnaire. Restrictions in participation/quality of life are analysed with the Short Form 36 and described in the return to work status.

The radiological results are comparable to the literature. The reduction of the anterior wedge angle is followed by a gradual partial loss of intervertebral angle and regional angle. The maximum oxygen uptake (VO$_2$-max) is reduced in only 8.3% of the patients. Arm and trunk lift is within the normal range in 87% and 80% of the patients respectively, but only 53% of the patients is able to perform a leg lift within the normal range.

A mean RMDQ score of 4.0 positive items (SD 6.0) was found and the mean VAS Spinal Score was 79.4 (SD 25.0), both better than in other series. No significant differences to the values of a comparable (healthy) age group could be identified in any variable of the SF36. A high correlation was seen between RMDQ, VAS Spine Score and the SF36 categories. No correlation was found between AWA and RA, and functional capacity tests or questionnaire scores.

87% of the patients with paid labour before the trauma had returned to work at follow-up. About 50% of the patients had to change the intensity of their labour or the kind of work after the injury and treatment. In this matter leg (muscle) performance seems a more important factor than overall condition (VO$_2$-max).
Abstract chapter 7

Important issues of this thesis, with consequences for future management of spinal fractures are:

- Ligamentary lesions in the complex spinal injury are not appreciated enough by Plain X-rays and CT-scans only, although these lesions should have major influence on the choice of treatment. Probably additional MRI investigation, at the right time, will help to overcome this problem.

- Radiological results of the studied treatment modality confirm earlier data in the literature. The reduced AWA stays about the same, but because of complete loss of IVA the RA finally equals the preoperative value.

- Spontaneous remodelling of the narrowed spinal canal can be shown not only in CT scans, but in plain transverse radiographs as well.

- Dorsal spondylodesis in spinal fracture treatment is effective, as measured in flexion-extension radiographs after 2 years: ROM is zero.

- Additional loss of ROM in the adjacent segments accounts for 50% at each segment. In the near future we expect that we can measure intersegmental ROM with the SpinalMouse®. We have tested this apparatus and publication of the data is prepared.

- Functional tests and back specific questionnaires (RMDQ, VAS Spine Score) supply important information about functional outcome in spinal fracture patients. General condition is very well, but leg muscle performance is bad. This is important for further development of rehabilitation programs.