# DIFFERENTIATED APPROACH TO THE TREATMENT OF PATIENTS WITH FRACTURES OF LOWER THORACIC AND LUMBAR VERTEBRAL BODIES AND TRAUMATIC SPINAL STENOSIS

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**Objective.** To analyze clinical effectiveness of repositioning decompression of the dural sac and to justify a differentiated approach to the decompression for traumatic spinal stenosis caused by damages of lower thoracic and lumbar vertebral bodies.
**Material and Methods.** A total of 103 adult patients with injuries of the lower thoracic and lumbar spine accompanied by traumatic spinal canal stenosis were treated: 76 patients were included in the study group and 27 — in the control group. All patients underwent decompressive-stabilizing surgery with transpedicular fixation. In the study group, the priority was given to indirect repositioning decompression (more 50 %), in the control group — decompressive laminectomy (100 %).
**Results.** In the study group, long-term results of treatment were assessed as good in 38 (79.2 %) cases, satisfactory — in 8 (16.7 %), and poor — in 2 (4.2 %). In the control group, good results were obtained in 13 (72.2 %) patients, satisfactory — in 4 (22.2 %), and poor — in 1 (5.6 %).
**Conclusion.** Differentiated approach to decompression of the dural sac in patients treated for lower thoracic or lumbar spine injuries and traumatic spinal canal stenosis allowed avoiding laminectomy in 53.9 % of patients in the study group and performing anterior decompression consisting of subtotal corpectomy 1.9 times less often than in the control group.
**Key Words:** spine, injury, decompression, ligamentotaxis, stenosis.

Please cite this paper as: *Afaunov AA, Kuzmenko AV, Basankin IV. Differentiated approach to the treatment of patients with fractures of lower thoracic and lumbar vertebral bodies and traumatic spinal stenosis. Hir. Pozvonoc. 2016;13(2):8–17. In Russian.*
DOI: http://dx.doi.org/10.14531/ss2016.2.8-17.

Injuries to the lower thoracic and lumbar spine accompanied by traumatic spinal canal stenosis are commonly unstable. They are often accompanied by injury or compression of the spinal cord and roots manifesting in relevant neurological symptoms. In spinal cord compression, the neurological deficit may be absent in the first hours after trauma, but soon manifests as progressing paresis or plegia [5–7, 10, 20].

At present, the general principles of treatment of unstable injuries in the lower thoracic and lumbar spine requiring decompression of the dural sac, reposition of the injured spine, reliable stabilization and plastic reconstruction of the supporting ventral structures of the injured spinal motion segments (SMSs) have been formulated quite clearly [2, 5, 7, 11, 15, 16]. Majority of the authors have recognized transpedicular fixation (TPF) as the optimal means to perform reposition and stabilization [1, 2, 4, 7, 10]. For the reconstruction of ventral structures of the injured SMSs anterior corporodesis using autologous bone grafts and various implants of container type and/or implants with osteoinductive properties is recommended [2, 4, 6, 7, 13, 14, 17, 22].

Meanwhile, there is no consensus on decompression of the dural sac. In particular, the possibilities of repositioning decompression of the dural sac based on the effect of ligamentotaxis are either underestimated or overestimated [2, 12, 18, 19, 23]. The range of clinical situations in which this option of decompression can be effective has not been identified up to now. Laminectomy for injured SMSs is practiced widely, without any differentiated rationale. In addition, majority of the authors recognize low effectiveness of laminectomy in patients with anterior compression of the dural sac and the harm to the supporting function of the spine caused by laminectomy. There is also no consensus on the indications for open anterior decompression and the sequence order to perform open anterior decompression during staged treatment [6, 7, 9–11, 21]. The lack of a generally accepted point of view on these issues confirms the relevance of further research in this direction.

The purpose of the study is to analyze the clinical effectiveness of repositioning decompression of the dural sac and justify a differentiated approach to decompression in injuries of the lower thoracic

and lumbar vertebral bodies associated with traumatic spinal stenosis.

## Material and Methods

The treatment outcomes of 103 patients aged 17 to 68 years with injuries of the lower thoracic and lumbar spine accompanied by traumatic spinal stenosis were retrospectively and prospectively analyzed. The study group included 76 patients (57 men and 19 women) and the control group included 27 patients (17 men and 10 women).

Injuries of SMSs in patients were graded according to the classification by Magerl, Aebi, Nazarian, which was included in the AO/ASIF universal classification of fractures in 1996. According to this classification, group A fractures include injuries of thoracic and lumbar vertebral bodies with remaining structures of the posterior supporting complex. Group A, in turn, includes 3 groups and 9 subgroups depending on the nature of the injury. Thus, type A2 fractures were identified in 18 patients (23.7 %) among patients of the study group, type A3 – in 58 (76.3 %); type A2 fractures were identified in 6 (22.2 %) among patients in the control group and type A3 – in 21 (77.8 %).

Injuries of the spine in the study and control groups were localized at the levels T9 to L5. A large part of the study group of patients had injuries at the level of T12–L1 – 47 (61.8 %). Similar to the study group, the most frequent injuries of the spine in patients of the control group were localized at the level of T12–L1 – 17 (63.0 %) cases. Injuries to one SMS among patients of the study group were observed in 57 (75.1 %) cases, of two SMSs – in 19 (24.9 %). Among patients in the control group injuries to one SMS were observed in 20 (7.1 %) cases, two SMSs – in 7 (25.9 %). Traumatic spinal stenosis was diagnosed in all patients of the study and control groups and was measured by CT and (or) MRI data and comprised 25 to 100 %.

Traumatic spine and spinal cord injuries (TSCIs) with neurological deficit of varying severity was observed in 58 (76.3 %) and isolated injuries of the spine without neurological disorders were in 18 (23.7%) of the 76 patients of the study group. Of the 27 patients of the control group, 21 (77.8 %) had TSCIs and 6 (22.2 %) had uncomplicated injuries.

The neurological deficit severity was assessed by the Frankel's grade (Table 1).

Neurological disorders in 3 (5.2 %) patients of the study group and in 1 (4.8 %) in the control group tended to regress in the first days after trauma; neurological status remained without clinically significant dynamics up to the operation in 53 (91.4 %) patients of the study group and in 19 (90.5 %) in the control group; 2 (4.0 %) patients of the study group and 1 (4.0 %) of the control group had signs of aggravated neurological deficit in the preoperative period.

In the acute phase of TSCI, 34 (58.6 %) patients of the study group and 13 (61.9 %) of the control group were operated, 19 (32.8 %) patients of the study group and 6 (28.6 %) in the control group were operated in early period of TSCI and 5 (8.6 %) patients of the study group and 2 (9.5 %) of the control group – in the intermediate period of TSCI.

Ten (55.6 %) patients of the study and 3 (50.0 %) of the control group with uncomplicated injuries of the spine were operated during acute or early period of TSCIs. Another 8 (54.4 %) patients of the study group and 3 (50.0 %) of the control group were operated in periods corresponding to the intermediate period of TSCI.

All patients underwent preoperative examination, including identification of complaints, anamnesis, trauma symptoms, orthopedic and neurological status, common clinical blood and urine tests, radiography, CT, and MRI in the case of a neurological deficit. The quantitative parameters of displacements of the supporting structures of injured SMSs were determined using conventional spondylometric criteria. Special attention was paid to the characteristics of traumatic stenosis of the spinal canal. Dimension parameters of the spinal canal at the level of injured SMSs were assessed mainly from bone structures, since the soft tissue structures were not determined in all the patients because of absence of MRI scans in these patients. To clarify the indications for an open anterior decompression, except for cases of a relatively small size of spinal canal stenosis that does not threaten with development of neurological deficits, myelography was performed, which in most cases was made intraoperatively, during and after TPF. All digital data were subjected to statistical processing with the determination of standard errors of the average values.

The average value of traumatic stenosis of the spinal canal in 58 patients of the study group with TSCIs was 52.3 ± 3.8 % and in 18 patients with uncomplicated injuries from the study group – 44.2 ± 4.1%. It was 54.7 ± 4.2 % in 21 patients with TSCIs from the control group and 45.3 ± 4.6 % – in 6 patients with isolated injuries.

Immediate morphological causes of traumatic stenosis of the spinal canal were studied by CT and/or MRI, which revealed the following types of stenosis:

The first type is stenosis with one large fragment of a vertebral body:

a) without reversion (with reversion of less than 15°);

b) with reversion (≈15° and higher).

The second type is stenosis with two free large fragments of a vertebral body:

a) without reversion (with reversion of less than 15°);

b) with reversion (≈15° and higher).

The third type is a stenosis with several small fragments of a vertebral body.

**Table 1**

Classification of patients according to severity of neurological deficit based on the Frankel's scale, n (%)

| Groups | A | B | C | D | E |
|---|---|---|---|---|---|
| Study (n = 76) | 21 (27,6) | 12 (15,8) | 16 (21,1) | 9 (11,8) | 18 (23,7) |
| Control (n = 27) | 9 (33,3) | 4 (14,8) | 5 (18,5) | 3 (11,1) | 6 (22,2) |

The indicated types of traumatic stenosis of the vertebral canal cause anterior compression of the dural sac.

In patients of the study group with neurologic deficit, one large fragment of a vertebral body without reversion caused traumatic spinal canal stenosis in 13 (22.4 %) cases. The same cause of spinal stenosis was observed in 3 (14.3 %) cases of 21 patients in the control group with neurological deficit (Fig. 1).

One large fragment with reversion (≈15° and higher; Fig. 2) caused traumatic stenosis in 11 (18.9 %) patients of the study group and in 5 (23.8 %) in the control group with neurological deficit.

Traumatic stenosis with two free fragments of the vertebral body without reversion were found in 10 (17.2 %) cases of patients with TSCIs in the study group and in 3 (14.3 %) cases in the control group (Fig. 3).

Traumatic stenosis with two free fragments of a vertebral body, with reversion (≈15° and higher) – in 5 cases (8.6 %) in patients with TSCIs of the study group and in 3 (14.3 %) – in patients with TSCIs in the control group (Fig. 4).

Spinal stenosis with several small fragments of a vertebral body in patients with TSCIs in the study group was found in 19 (32.7 %) cases, in patients with TSCIs in the control group – in 7 (33.3 %) cases (Fig. 5).

In patients without neurological deficit in the study group in 6 (33.3 %) cases and in the control group in 2 (33.3 %) cases, the cause of traumatic spinal canal stenosis was one large fragment without reversion. In 4 (22.2 %) cases of uncomplicated injury in the study group the cause of spinal stenosis was one large fragment with reversion (≈15° and higher). In the control group there was 1 (16.7 %) patient with the indicated type of stenosis. In the study group spinal stenosis with two free fragments without reversion was found in 2 (11.1 %) cases without neurological complications; similar patients were not detected in the control group. Stenosis with two bone fragments of a vertebral body with reversion in the study group of uncomplicated injuries was in 3 (16.7 %) patients and in the control group – in 2 (33.3 %).

Traumatic stenosis with several small fragments of a vertebral body in the study group of patients without neurological deficits were found in 3 cases (16.7 %), in the control – in 1 (16.7 %; Table 2).

All patients underwent decompression and stabilization surgery on the spine using TPF. The first stage was TPF of traumatic SMSs. Sintez (Saint Petersburg), DePuy Spine, and Stryker spinal systems with 4-screw configurations and a bisegmental spinal stabilization were used. At the second stage, all patients underwent anterior corporodesis based on that the vertebral body injuries in patients caused irreversible harm to the ventral parts of injured SMSs and their supporting ability. To clarify the indications for an open anterior decompression of the dural sac, in most cases the first surgical stage included intraoperative myelography during and after TPF. Visual data of myelography were obtained simultaneously on the monitor of an electron-optical image converter. Based on the results of intraoperative myelography it was decided in five cases to perform open anterior decompression immediately after the completion of TPF. In some cases, with quite small sizes of stenosis of the spinal canal that do not threaten with development of neurological deficits, myelography was not performed.

Decompression of the dural sac was the main difference between therapeutic approaches in patients of the study and control groups.

Indirect repositioning decompression was preferred in patients of the study group. The surgical techniques provided maximal distraction efforts on the fibroligamentous structures of the middle osteoligamentous column of injured SMSs. Intraoperative manipulations conformed to methods for reforming vertebral canal at comminuted fractures [3] and consisted in forced segmental traction with instrumental restoration of the correct angles in the operated SMSs with an insignificant controlled change towards kyphosis to 5°. Laminectomy during TPF was performed in 35 (46.1 %) of the 76 patients with anterior compression of the dural sac; in cases of increasing neurologic symptoms or severe initial neurological deficit (Grades A and B on the Frankel's scale), with the exception of 4 (5.3 %) patients with complete irreversible spinal cord injury confirmed by MRI before surgery. During the second stage of a ventral procedure, differentiated approach of open anterior decompression consisting of subtotal corpectomy was performed for cases of ineffective repositioning decompression, persistent anterior compression of the dural sac with clinical manifestations and non-eliminated spinal stenosis of more than

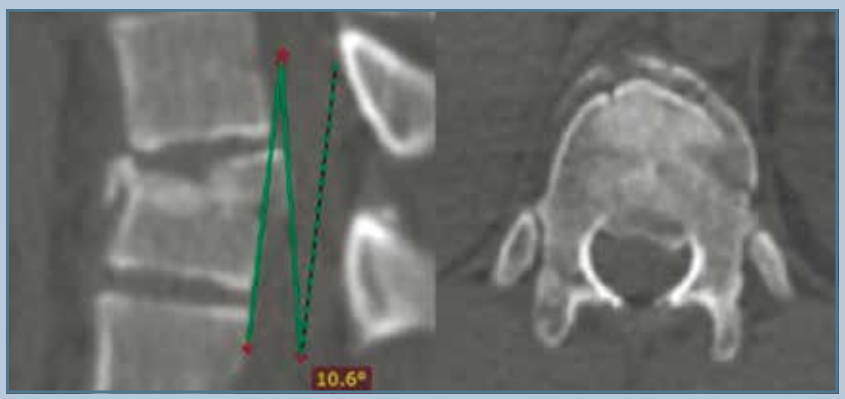


Fig. 1
Traumatic stenosis of the spinal canal with one large fragment of vertebral body without reversion

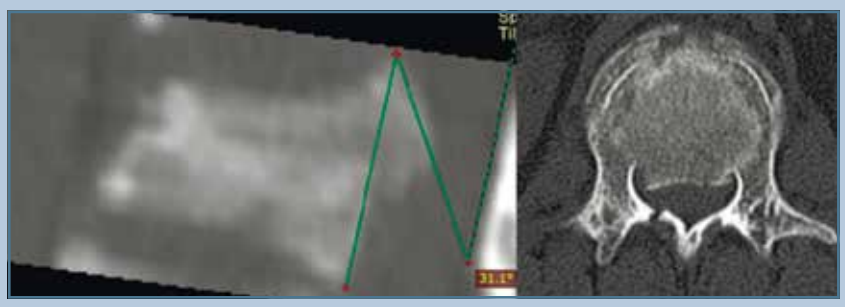

Fig. 2
Traumatic stenosis of the spinal canal with one large fragment of vertebral body with reversion ≈15° and higher

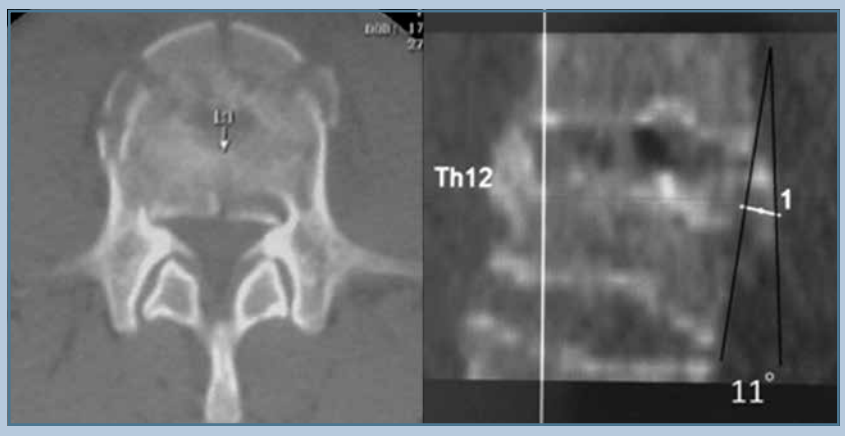


Fig. 3
Traumatic stenosis of the spinal canal with two large fragments of vertebral body without reversion

40 % above the level L2 and more than 50 % below L2. A total of 23 (30.2 %) patients were subjected to open anterior decompression in the study group.

Decompressive laminectomy was performed in patients in the control group during TPF in all cases. Intraoperative techniques ensuring the implementation of closed reformation of the spinal canal due to ligamentotaxis was not used for the case of open anterior decompression, which was performed in the control group in 12 (57.1 %) cases during the anterior stage for the same indications as in the study group, but much more frequently. Thus, in this paper, we have examined treatment outcomes for similar groups of a total of 103 patients that differed by the treatment approach.

## Results

Immediate outcomes of treatment in patients of both groups were studied within the period of 3 months after the surgical treatment. The quality of the dural sac decompression was assessed by the size of the remaining stenosis on CT or MRI after surgical treatment. In patients subjected to laminectomy, the quality of decompression was determined by the value of the residual dislocations of the fragments of the

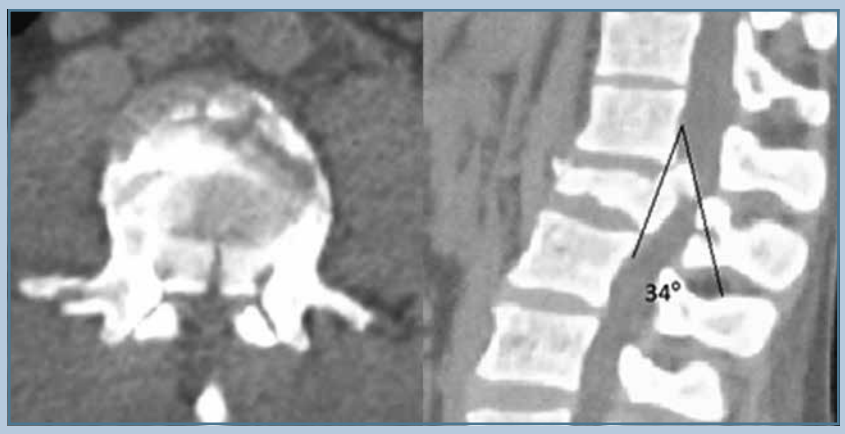


Fig. 4
Traumatic stenosis of the spinal canal with two large fragments of vertebral body with reversion ≈15° and higher

Fig. 5
Traumatic stenosis of the spinal canal with several small fragments of vertebral body

Table 2
Classification of patients according to morphological causes of the spinal canal stenosis, n

| Causes of the spinal canal stenosis | | Study group | Control group | Total |
|---|---|---|---|---|
| Stenosis with one large vertebral body fragment | | | | |
| without reversion | with neurological deficits | 13 | 3 | 24 |
| | without neurological deficits | 6 | 2 | |
| with reversion of 15° and more | with neurological deficits | 11 | 5 | 21 |
| | without neurological deficits | 4 | 1 | |
| Stenosis with two free fragments of vertebral body | | | | |
| without reversion | with neurological deficits | 10 | 3 | 15 |
| | without neurological deficits | 2 | – | |
| with reversion of 15° and more | with neurological deficits | 5 | 3 | 13 |
| | without neurological deficits | 3 | 2 | |
| Stenosis with multiple bone fragments of a vertebral body | | | | |
| with neurological deficits | | 19 | 7 | 30 |
| without neurological deficits | | 3 | 1 | |

fractured vertebral body into the lumen of the spinal canal. In the study group, the value of these dislocations comparable with the sagittal size of the spinal canal in percentages and its comparison with initial spondylometric parameters of traumatic stenosis were critical for the evaluation of the effectiveness of indirect repositioning decompression.

The effectiveness of repositioning reformation of the spinal canal was analyzed in patients of the study group depending on the morphological causes of traumatic stenosis and period since trauma. The obtained averaged data are presented in Table 3.

Table 3 shows that traumatic stenosis due to the effect of ligamentotaxis is eliminated effectively in types of stenosis 1a, 2a in early stages, that is, in the dural sac compression with large fragments of the vertebral body without reversion. The values of correction in these patients are 23.1 and 23.4 %, respectively. These indicators in most cases were sufficient for decompression of the dural sac avoiding the need to perform anterior decompression. In other cases of traumatic stenosis and also with increasing period after trauma to 10–12 days or more, the value of achieved correction of traumatic stenosis reduced significantly. A total of 30.2 % of patients in the study group had open anterior decompression during anterior surgical stage.

In the control group, the average value of traumatic stenosis was 54.7 ± 4.2 % before surgery in patients with TSCIs, 45.3 ± 4.6 % – in the patients with isolated injuries. After performing a posterior stage of TPF, residual dislocations of the fragments of the injured vertebral body into the lumen of the spinal canal did not change significantly resulting in the need to perform an open anterior decompression of the dural sac during ventral surgical stage in 57.1 % of cases.

Early outcomes of treatment were followed up in all operated patients. The evaluation was carried out according to generally accepted criteria [1, 2, 7, 8, 12, 20, 21, 23].

In the study group, good outcomes were obtained in 61 (80.3 %) patients, satisfactory – in 13 (17.1 %), and poor – in 2 (2.6 %). Poor outcomes of treatment were associated with loosening of instrumentation in one case that required repeated fixation, in the second case – with persistent aggravation of neurological symptoms (from Grade C to Grade A on the Frankel's scale) after surgery. In the control group, good outcomes were obtained in 20 (74.1 %) patients, satisfactory – in 6 (22.2 %), and poor – in 1 (3.7 %) due to instrumentation destabilization (migration of the screws) that required reinsertion of screws and extending the length of fixation.

Long-term outcomes of treatment were studied in the period of 12 to 24 months after completion of surgical treatment. During the indicated period 67 of the 103 patients were available for follow-up, which amounted to 65.1 % of the total number of patients. Particular attention was paid to the parameters that characterize the stability of injured SMSs and regression of neurological deficit in patients with TSCIs.

In the study group, after a year or more after surgery the outcomes were followed up in 48 (63.2 %) patients. Destabilization due to screw fracture prior to the completion of the formation of interbody bone block in injured SMSs was observed in one patient of the study group to whum repeated osteosynthesis was performed. One patient with screw fracture was not subjected to repeated osteosynthesis, since the failure was not clinically evident and was identified after the formation of a functionally adapted interbody bone block. In 46 patients of the study group, signs of destabilization were not identified. Thus, in the study group good outcomes were obtained in 38 (79.2 %) patients, satisfactory – in 8 cases (16.7 %), and poor – in 2 (4.2 %). Neurological manifestations of TSCIs regressing by one grade on the Frankel's scale was noticeable in 7 (14.6 %) of 48 patients and by two grades – in 2 (4.2 %). Neurological status did not change in 39 (81.3 %) patients.

In the control group, long-term outcomes of treatment were followed up in

18 (66.7 %) patients. Destabilization of instrumentation was found in 2 patients resulting in poor outcome in one case. The second patient underwent repeated osteosynthesis with extension of the length of fixation. In 16 patients, signs of destabilization in the long-term period were not observed. Thus, in the control group good outcomes were obtained in 13 (72.2 %) patients, satisfactory in 4 (22.2 %), and poor – in 1 (5.6 %) due to the destabilization of metal constructs after screw fracture.

Regression of neurological manifestations of TSCIs by one grade on the Frankel's scale was noted in 3 cases (16.7 %) of 18 patients in the control group, by two grades – in 1 case (5.6 %), there was no regression by three grades in both groups in any patient. Neurological status did not change in 14 (77.8 %) patients.

The total number of complications in the study group was 9.2 %, in the control – 18.5 %. They included: intraoperative liquorrhea at dural sac injury due to bone fragments (4.0 % in study group and 7.4 % in control group); iatrogenic injuries to the dural sac (1.3 in the study group and 3.7 % in the control group); wound liquorrhea in the early postoperative period (0 % in the study group and 3.7 % in the control group); traction myelopathy (1.3 % in the study group and 0 % in the control group); persistent radiculopathy (1.3 % in the study group and 0 % in the control group); instrumentation destabilization that required revision operations (1.3 in the study group and 3.7 % in the control group). The majority of complications were associated with laminectomy. In addition, in 6 (5.8 %) of 103 cases, there was intense epidural bleeding during laminectomy that increased total intraoperative blood loss to 300 ml or greater.

Below we present an example of repositioning decompression of the dural sac for TCSCIs in the lumbar spine.

Patient T., 45 years, was injured on February 6, 2009 via falling from a height. The patient was admitted to the Central District Hospital, a fracture of the L1 vertebra complicated with lower paraparesis with dysfunction of the pelvic organs was identified. Based on the severity of neurological disorders the fracture was classified as Grade C on the Frankel's scale. On the same day, she was admitted to the Regional Clinical Hospital No. 1 n.a. Prof. S.V. Ochapovsky, and underwent general clinical examination, CT and MRI of the thoracic and lumbar spine. The examination confirmed type A3.1 fracture of the L1 according to the classification of Magerl with traumatic spinal stenosis at the level of injury by 46 % (Fig. 6). The morphological cause of the stenosis was one fragment of the posterior upper part of the vertebral body without reversion (type 1a).

Surgery was performed 11 h after the trauma: TPF at the T12–L1 level using a 4-screw system. Repositioning decompression of the dural sac was performed and intraoperative myelography was used to control the quality of the operation (Fig. 7).

The postoperative period was without complications. Neurological symptoms regressed from the first day after surgery. CT control confirmed the achieved reformation of the spinal canal up to 26 % (Fig. 8) that, considering normalization of the neurologic status, did not require open decompression.

Movements and sensitivity recovered fully within three weeks. Given the nature of the L1 body fracture that interferes with a full structural recovery of the injured ventral SMS and its supporting ability even following TPF, after 6 weeks the patient was subjected to anterior corporodesis without opening the spinal canal by means of partial resection of ventral parts of injured SMSs within the upper and only partially the medium osteoligamentous columns (Fig. 9). The postoperative period was without complications. Follow up of the patient revealed good immediate and distant outcome of the treatment.

## Discussion

Comparison of treatment outcomes of the study and control group patients with traumatic spinal canal stenosis at the thoracolumbar level has shown that mandatory perfoming of laminectomy during TPF does not give advantages during neither short-term nor long-term periods of follow-up compared with its differentiated application. This can be said about patients with isolated spine injuries and patients with TSCIs, irrespective of the dynamics of neurological status in the preoperative period. At the same time, analysis of complications showed that laminectomy in the acute period of TSCIs is associated with the risk of secondary traction myelopathy, injury to the dural sac, wound liquorrhea and,

Table 3
Effectiveness of repositioning decompression of the dural sac in different types of traumatic stenosis, % (M ± m)

| Period of operative intervention | | type 1 | | type 2 | | type 3 |
|---|---|---|---|---|---|---|
| | | 1a | 1b | 2a | 2b | |
| Operated on before 10–12 days | before operation | 50,3 ± 6,1 | 53,7 ± 7,0 | 54,5 ± 4,2 | 55,6 ± 7,1 | 62,3 ± 3,6 |
| | after operation | 27,2 ± 2,2 | 45,4 ± 4,2 | 31,1 ± 3,2 | 47,9 ± 3,6 | 54,5 ± 3,8 |
| | amount of correction | 23,1 ± 1,9 | 8,3 ± 1,3 | 23,4 ± 1,6 | 7,7 ± 1,6 | 7,8 ± 1,1 |
| Operated after 12 days | before operation | 43,6 ± 4,7 | 48,4 ± 4,5 | 47,1 ± 3,7 | 49,2 ± 7,6 | 63,4 ± 5,1 |
| | after operation | 29,3 ± 3,4 | 38,9 ± 3,9 | 35,8 ± 3,0 | 41,1 ± 6,8 | 56,7 ± 3,9 |
| | amount of correction | 14,3 ± 3,1 | 9,5 ± 2,1 | 11,3 ± 3,0 | 8,1 ± 1,9 | 6,7 ± 2,0 |

as a consequence, the development of secondary meningitis with possible formation of an abscess in the surgical wound.

Taking into account the individual characteristics of thoracic and lumbar spine injuries, a differentiated approach to using TPF permits implementation of high therapeutic potential of this method. In 41 (53.9 %) patients of the study group, it was possible to avoid traumatic surgical techniques (laminectomy and open posterior decompression of the dural sac) to achieve a positive outcome of treatment that reduced the duration of surgery by an average of 23 min and intraoperative blood loss by 200–250 ml.

Clinical ineffectiveness of laminectomy in anterior compression of the dural sac was confirmed in the control group by that in 12 (57.1 %) cases, the anterior stage, performed secondarily, included an open anterior decompression of the dural sac consisting of subtotal corpectomy. In the study group, repositioning decompression of the dural sac was preferred during TPF and the need for an open anterior decompression during the anterior stage of surgical treatment was noted in 23 (30.2 %) patients, which is 1.9 times less than in the control group. The indications for an open anterior decompression of the dural sac in patients of the study and control groups were the same.

An analysis of treatment outcomes of patients with lower thoracic and lumbar spine injuries accompanied by traumatic spinal stenosis showed that under certain conditions the reformation of the spinal canal is sufficient for positive treatment outcomes and can be achieved by means of repositioning capabilities of TPF and the effect of ligamentotaxis. In such cases, there is no the need for open decompression of the dural sac by laminectomy or subtotal corpectomy.

Both in patients with TSCIs and in patients with isolated uncomplicated injuries of the spine in the presence of traumatic stenosis of the spinal canal, repositioning reformation may be the most effective in patients with compression of the dural sac with one bone fragment of the posterior portion of the injured vertebral body or with two large bone fragments without reversion in periods of up to 10 days from the date of injury. The effectiveness of repositioning decompression decreases in patients with anterior compression with one or two bone fragments with reversion of more than 15°. At the same time, repositioning decompression of the dural sac is commonly not effective in patients with compression with multiple small fragments and in all cases with periods after injury of more than 10–12 days. Anterior compression remaining after decompressive-stabilizing surgery through a posterior approach can be removed during anterior surgical stage through subtotal of corpectomy of the injured vertebra.

Thus, when choosing the approach of the dural sac decompression in each specific case it is necessary to consider the specified technical capabilities of reforming the spinal canal. An individual approach to preoperative planning for each patient is needed in clinical practice considering morphological causes of vertebromedullar or vertebroradicular conflict, the technical possibilities of its removal using a given approach, the time after the trauma, the nature and dynamics of neurological deficit, and the level of injury to the spinal column.

## Conclusions

1. Traumatic stenosis of the spinal canal in the lower thoracic and lumbar spine having the same quantitative spondylometric indicators and clinical manifestations may have quite different morphological causes.

2. During TPF the potential of repositioning decompression of the dural sac without opening the spinal canal is determined by the morphological causes of traumatic stenosis and time after injury.

3. Repositioning decompression of the dural sac is most effective for compression with one bone fragment of the posterior portion of the traumatic vertebral body or with two large bone fragments without reversion in periods of 10 days from the date of injury.

4. In the treatment of uncomplicated TSCIs of the lower thoracic and lumbar spine with subcritical stenosis of the spinal

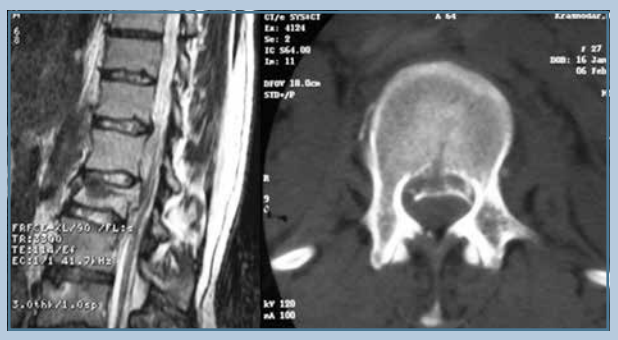

Fig. 6
MRI and CT of a patient T. aged 45 after trauma

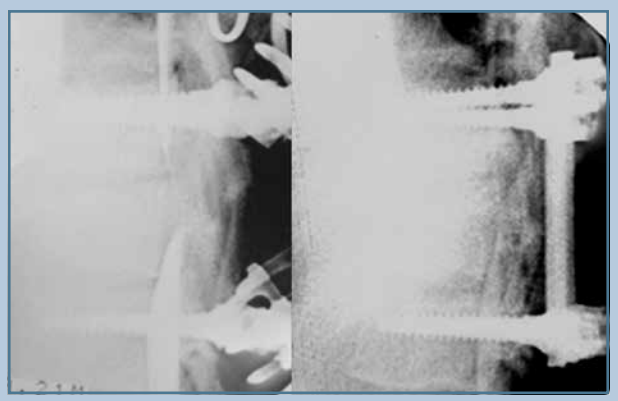

Fig. 7
Intraoperative myelography of a patient T. aged 45 years

canal, repositioning decompression of the dural sac is clinically effective to 23 % and sufficient to achieve positive outcomes.

5. During decompression and stabilization surgery in patients with injury to vertebral bodies in the lower thoracic or lumbar spine and traumatic spinal stenosis, a differentiated approach to decompression of the dural sac in the study group allowed avoiding a laminectomy in 53.9 % of cases and performing anterior decompression consisting of subtotal corpectomy 1.9 times less than in the control group.

Fig. 8
CT of a patient T. aged 45 after operation

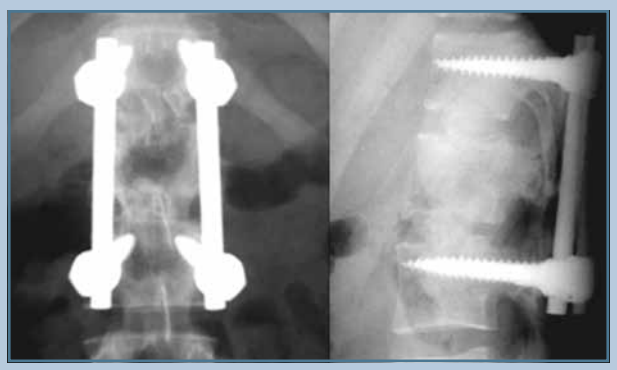

Fig. 9
Radiograms of a patient T. aged 45 after completion of surgical treatment

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*Received 12.11.2015*

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