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OPTIMIZATION OF SURGICAL TREATMENT OF COMPLICATED INJURIES OF THE THORACOLUMBAR SPINE: A CLINICAL AND RADIOLOGICAL STUDY.

Isakov B.M

Andijan State Medical Institute, Uzbekistan

Annotation: Thoracolumbar spine injuries complicated by spinal canal stenosis, neurological deficit and segmental instability represent a serious problem in neuroorthopedics.

Objective. To evaluate the clinical and radiological outcomes of optimized surgical approaches in the treatment of complicated thoracolumbar junction injuries.

Materials and methods. A retrospective analysis of 145 patients operated on between 2020 and 2024 was performed. Patients were divided into two groups: Group A (n = 112) — posterior fixation with laminectomy without canal reconstruction; Group B (n = 33) — spinal canal reconstruction using anterior decompression or transpedicular removal of fragments. Neurological status (Frankel scale), kyphotic angle (Cobb angle), residual canal stenosis, ODI index, and VAS pain scale were assessed.

Results. In group B, there was a significant improvement in the neurological status (78.8% vs. 54.3%; $p<0.05$), correction of kyphosis (on average 18° vs. 11°; $p<0.05$) and reduction of residual canal stenosis. Functional indicators were also better according to the VAS and ODI scales.

Conclusion. Individualized surgical approach with spinal canal reconstruction provides better clinical and radiological results in complicated thoracolumbar spine injuries compared to standard posterior fixation.

Key words: spinal trauma, thoracolumbar junction, decompression, spinal canal reconstruction, neurological deficit, posterior fixation.

Materials and methods.

This study was performed in a retrospective format and is based on the analysis of medical records of 68 patients treated in a specialized neurosurgical department from January 2020 to December 2024. The study was approved by the local ethics committee.

Inclusion criteria:

- Traumatic fractures of the thoracolumbar spine (T11-L2);
- Spinal stenosis of more than 30% according to CT;
- The presence of neurological deficit (Frankel A-D scale);
- Angular deformity (kyphosis) more than 20°;
- Surgery within 14 days from the moment of injury.

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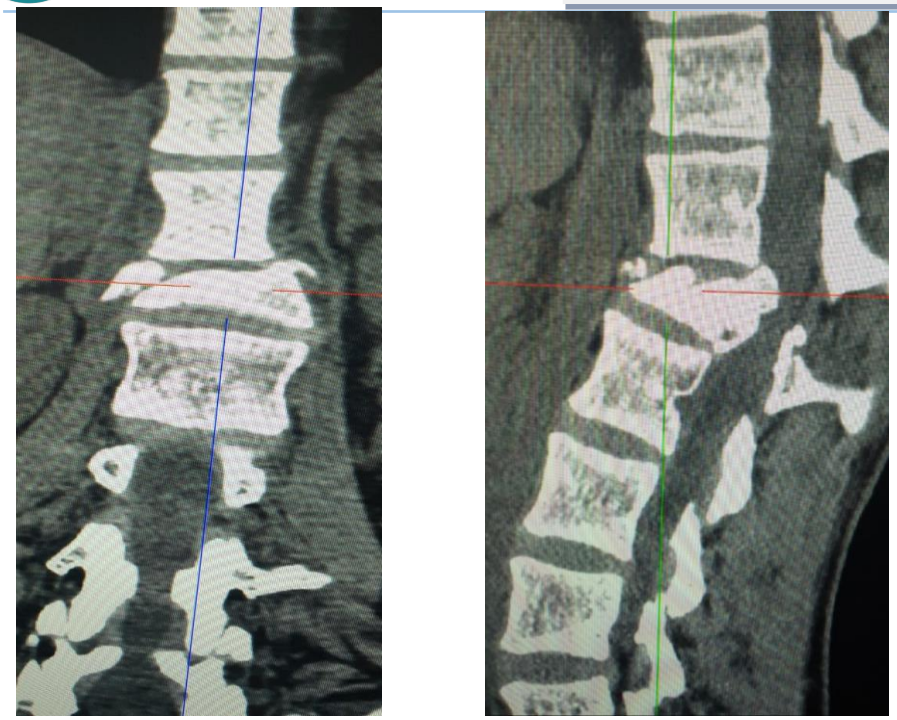

Fig. 1. Compression fracture of the body of the L1 vertebra, grade III.

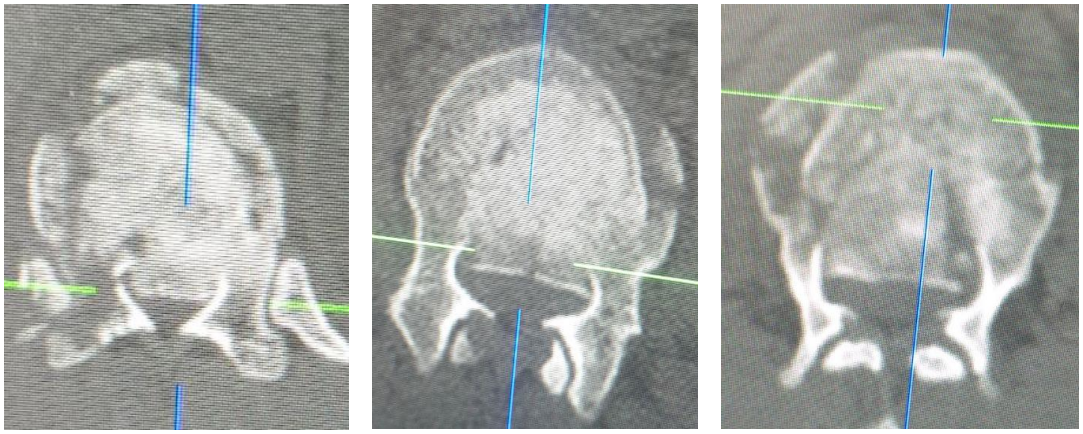

Fig. 2. Variants of spinal canal stenosis.

Exclusion criteria:

• Pathological and osteoporotic fractures;

• Previous operations at the same level;

• Polytrauma with unstable hemodynamics.

Groups and surgical tactics:

Patients were divided into two groups:

• Group A (n = 33): Posterior transpedicular fixation with laminectomy, without removal of retropulsed fragments.

• Group B (n = 112): Combined interventions, including reconstruction of the spinal canal. Two approaches were used:

- Anterior decompression (minithoracotomy or retroperitoneal approach);
- Posterior transpedicular approach with removal of bone fragments and repositioning.

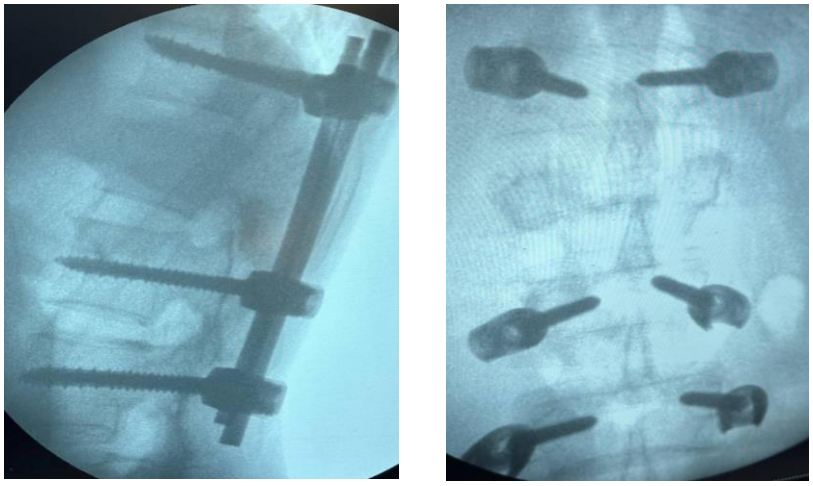

Fig. 3. Stabilization of the damaged segment of the spine using the TPF system.

Outcome assessment:

• Neurological status was assessed using the Frankel scale at admission, after surgery and at 12 months.

• Radiological assessment included CT and MRI at admission, after surgery and dynamically at 12 months.

• Angular deformity was assessed using the Cobb method.

• Functional status — using the Oswestry scale (ODI) and the visual analogue pain scale (VAS).

Statistical analysis:

Data processing was performed using the SPSS v.26.0 package. Student's t-test and the Mann-Whitney test were used to compare quantitative variables. Categorical data were analyzed using the χ^2 test. Differences were considered statistically significant at $p < 0.05$.

Results

Comparative characteristics of groups:

Basic demographic and clinical characteristics in the groups were comparable ($p > 0.05$).

Neurological outcomes:

After 12 months, positive dynamics according to the Frankel scale were noted in:

• Group A: 19 of 33 patients (57.5%)

• Group B: 86 of 112 patients (76.7%)

($p = 0.028$)

Radiological parameters:

• Average correction of kyphosis according to Cobb:

- Group A: 11.3° ± 3.2°
- Group B: 18.1° ± 3.7° ($p < 0.01$)

• Residual spinal stenosis at 12 months:

- Group A: 22.4% ± 6.8%
- Group B: 8.9% ± 3.1% ($p < 0.001$)

Functional results:

• Mean VAS score:

- Group A: 3.9 ± 1.2
- Group B: 2.6 ± 1.1 ($p < 0.01$)

• Mean ODI score:

- Group A: 34.5 ± 9.8
- Group B: 23.2 ± 8.7 ($p < 0.01$)

Complications:

Postoperative complications were reported in 2 patients in Group A (2.2%) and 4 patients in Group B (12.1%) ($p = 0.52$). No cases of metal structure failure were detected.

Discussion

Complicated injuries of the thoracolumbar junction require a comprehensive approach to surgical treatment, especially in case of severe narrowing of the spinal canal and neurological disorders. The obtained results confirm the advantage of techniques including reconstruction of the spinal canal and targeted decompression.

With standard posterior fixation (Group A), a moderate level of recovery was achieved, however, in Group B, where more aggressive decompression methods were used (including transpedicular removal of fragments or anterior approach), a significant improvement in both neurological and biomechanical parameters was noted. This confirms the importance of restoring canal patency to improve the prognosis.

Correction of kyphosis and reduction of residual stenosis in group B provided more favorable functional outcomes according to the ODI and VAS scales. Despite the greater technical complexity of the interventions, the complication rate was comparable between the groups, indicating an acceptable safety profile of these operations with the appropriate experience of the surgeon. The limitations of the study are the retrospective design, moderate sample size, and heterogeneity of the techniques used in group B, but the differences identified are statistically and clinically significant.

Conclusions.

1. Early use of TPF systems in complicated thoracolumbar injuries allows for effective restoration of the spinal anatomy and improvement of neurological function.

2. The use of modern neuroimaging methods ensures accurate diagnostics and selection of the optimal surgical approach.

3. In severe fractures and dislocations with damage to the integrity of the spinal canal, emergency reconstructive surgery using TPF systems is indicated.

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