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Decompressive-Stabilizing Surgical Interventions for Unstable Complicated Injuries of the Thoracolumbar Spine in Emergency Medical Care

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Abstract: Recently, the incidence of spinal cord injuries has tended to increase, and complicated forms of damage are common among them. The tactics of performing decompressive and stabilizing surgical interventions in the conditions of emergency neurosurgical care requires special attention when choosing a method for stabilizing the damaged vertebral motion segment. Objective of the study. Improving the results of surgical treatment of thoracolumbar spine fractures in the acute period of injury. Material. According to the results of examination of 339 patients with spinal injuries, 126 (37.1%) patients underwent surgical treatment. The duration of the operation ranged from 6 hours to 3 days. During the examination, MCT and MRI studies were used to clarify the type and nature of damage to the spine and spinal cord. The patients underwent closed reposition of the fracture, decompressive laminectomy and stabilization of the damaged segment of the spine. Results. Good results were obtained in 66 (52.3%), satisfactory in 57 (45.2%) and unsatisfactory in 5 (3.9%) patients. Conclusions. When choosing a method of surgical treatment, the results of MSCT and MRI studies should be taken into account. Surgical interventions should be performed in the early stages after injury. In complicated spinal injuries, decompression of the spinal cord and stabilization of the damaged segment of the spine are mandatory.

Keywords: spine, spinal cord, injury, decompression, stabilization, ligamentotaxis, TPF.

Relevance. The issues of surgical treatment of spinal cord injury (SCI) are one of the urgent problems of modern neurosurgery. Recently, the frequency of SCI has tended to increase and complicated forms of injuries are often encountered among them (1, 2, 3, 5).

According to literary data, the proportion of spinal fractures among all types of skeletal trauma ranges from 2 to 18% of cases and there is a steady upward trend. Damage to the spinal cord and its roots among all spinal injuries is about 20%. Disability due to SCI fluctuates around 80%, 2/3 of which are people of working age (Galley R.L. et al., 1995; Ryabukha N.P. et al., 1995; Loboda V.A., 2000; Taylor S. et al., 1984).

The above literature data show not only the prevalence and severity of spinal cord injury, but also the importance of the problem of treating victims at all stages of surgical care (Dulaev A.K. et al., 2000; Simonova I.A., Kondakov E.N., 2003).

The main conditions for adequate surgical treatment of complicated spinal injury in the acute period are emergency decompression of the spinal cord and its roots, elimination of deformation, stabilization of damaged vertebral segments and prevention of degenerative-dystrophic changes in the spine and spinal cord (Bersnev V.P. et al., 1998; Nikitin G.D. et al., 1998).

In connection with the development of neurosurgery, more and more attention is paid not only to the elimination of the vertebral-medullary conflict, but also to the creation of stability and support capacity in the damaged segment, the creation of correct anatomical relationships to exclude the development and progression of neurological disorders. The presence of unstable damage creates a risk of secondary displacement or aggravation of the displacement of the vertebrae and therefore requires reliable immobilization of the spine or surgical stabilization of its damaged segment. (Tsivyan Ya.L., 1966, 1971; Selivanov V.P., Nikitin M.N., 1971; Lutsik A.A., 1995).

While the need for decompression in case of compression of the spinal cord and its roots must be carried out without fail, the choice of the method and way of stabilization and correction of post-traumatic deformation remains controversial (2, 3, 5). The tactics of performing decompressive-stabilizing surgical interventions in the conditions of emergency neurosurgical care require special attention when choosing a method for stabilizing the damaged spinal motor segment.

The main causes of spinal cord injury are falls from height and road traffic accidents. Moreover, if the share of injuries as a result of falls from height accounts for 34.5% of cases, then the share of road traffic accidents accounts for 20.4% of cases (Loboda V.A., 2000; Dragun V.M., 2001).

According to many authors (Kondakov E.N. et al., 1989; Usikov V.D. et al., 1996; Bersnev V.P. et al., 1998; Lavrukov A.M. et al., 2000, Simonova I.A., Kondakov E.N., 2003), the greatest proportion of spinal injuries occurs in the transitional - thoracolumbar spine - up to 65% of cases. Among them, the Th12, Th12-L1 and L1 vertebrae are most often damaged. The transition of the fixed section to the mobile section of the spine leads to the occurrence of unstable and complicated injuries. This type of spinal injury requires emergency neurosurgical care, which consists of decompressive and stabilizing surgical interventions.

Objective of the study. Improving the results of surgical treatment of thoracolumbar spine fractures in the acute period of injury.

Materials and methods. From 2015 to 2020, 339 patients with injuries to the thoracic and lumbar spine were treated in the neurosurgical department of the Andijan branch of the RRCEM. Of these, 126 (37.1%) patients underwent surgical treatment. The age of patients ranged from 18 to 65 years, the main contingent was 18-45 years old - 76 (60.3%) patients. Among the examined patients, 72 were men (57.1%), 54 were women (42.8%). When distributed by the mechanism of spinal injury: domestic (fall from height) - 102 cases (80.9%), road traffic accidents - 17 (13.4%), industrial injury - 5 (3.9%) and street - 2 (1.5%) cases. According to the adopted protocol for the provision of emergency medical care of the Ministry of Health of the Republic of Uzbekistan from 2000, patients underwent a neurological examination, X-ray, MSCT and MRI studies.

During the neurological examination of patients, no disorders in the neurological status were found in 89 patients (70.6%), signs of lower paraparesis and dysfunction of the pelvic organs were found in 26 patients (20.6%) and 11 patients (8.7%) had conduction-type sensitivity disorders, lower paraplegia and dysfunction of the pelvic organs by the delay type.

During the X-ray and MSCT examination, fractures of the vertebral bodies of varying severity were detected. The results of the X-ray and MSCT examination are presented in Table 1.

Table 1. Distribution of patients by level of injury.

Sex	Damage level						Total
	Th10	Th11	Th12	Th12-L1	L1	L2	
Men	3	7	28	23	9	2	72
Women	3	9	19	7	16	-	54
Всего:	6	16	47	30	25	2	126

As can be seen from the data presented in Table 1, the main contingent consisted of patients with injuries of the Th12, Th12-L1 and L1 vertebrae – 92 (73.0%) patients. Injuries at the level of 1 vertebra were detected in 96 (76.1%) and at 2 levels in 30 (23.9%) patients. According to the degree of vertebral body compression: degree II was detected in 87 (69.0%), degree III in 29 (23.0%) and degree IV in 9 (7.1%) patients. According to the data of radiological examination methods, fractures of the spinous, transverse processes and vertebral arches were detected in 31 (24.6%) patients. Compression-comminuted fractures with the introduction of bone fragments into the spinal canal were detected in 27 (21.4%) patients. Moreover, the degree of spinal canal stenosis reached up to 50%. In 1 (0.7%) case, displacement of the damaged vertebra in the frontal plane was noted.

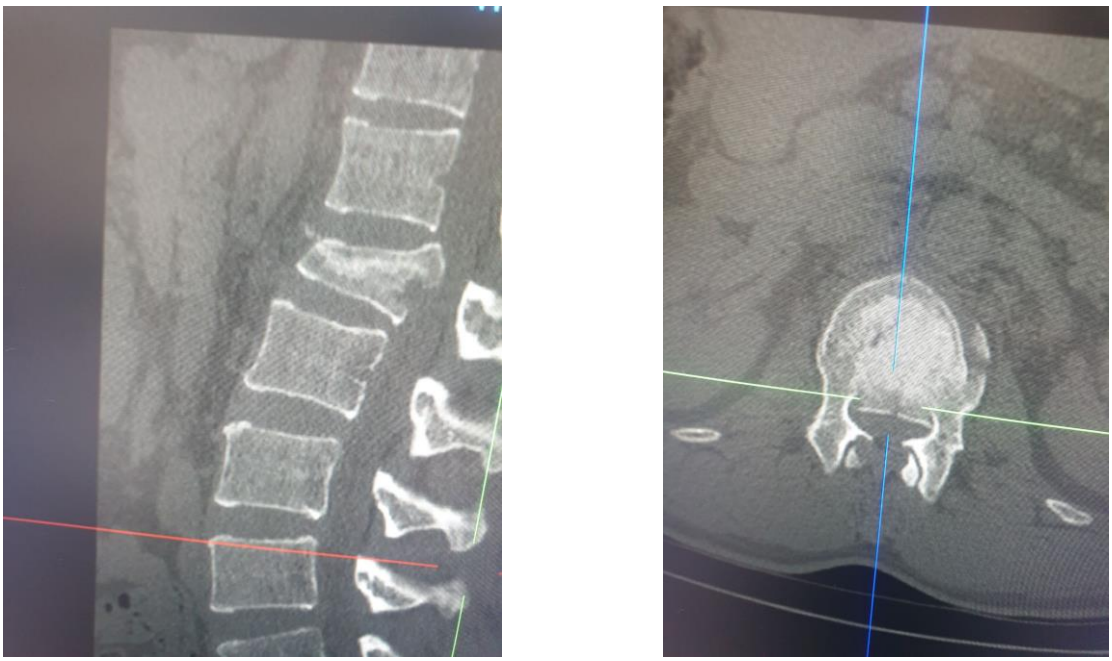

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Fig. 1. MSCT of patient V. a) Compression fracture of the L1 vertebral body, grade III; c) sagittal section of the compressed vertebral body, spinal canal stenosis due to a displaced bone fragment.

MRI examination was performed on 37 patients (29.3%). MRI examination revealed compression of the spinal cord by Urban's wedge and bone fragments in 23 patients (18.2%) and in one case a complete anatomical rupture of the spinal cord.

Fig. 2. 3D reconstruction of the damaged segment of the spine. a) direct projection, c) lateral projection. The patients underwent the following types of surgical interventions:

1. Stabilization of the damaged segment of the spine TPF – 87 (69.0%) patients;
2. Hemilaminectomy, revision of the spinal canal with removal of bone fragments, stabilization of the spine TPF – 29 (23.0%) patients;
3. Decompressive laminectomy, revision of the spinal canal, meningomyeloradiculolysis, stabilization of the spine – 10 (7.9%) patients.

During surgical interventions, a picture of spinal cord contusion was noted in 5 (3.9%) patients and a complete anatomical break in 1 (0.7%) patient.

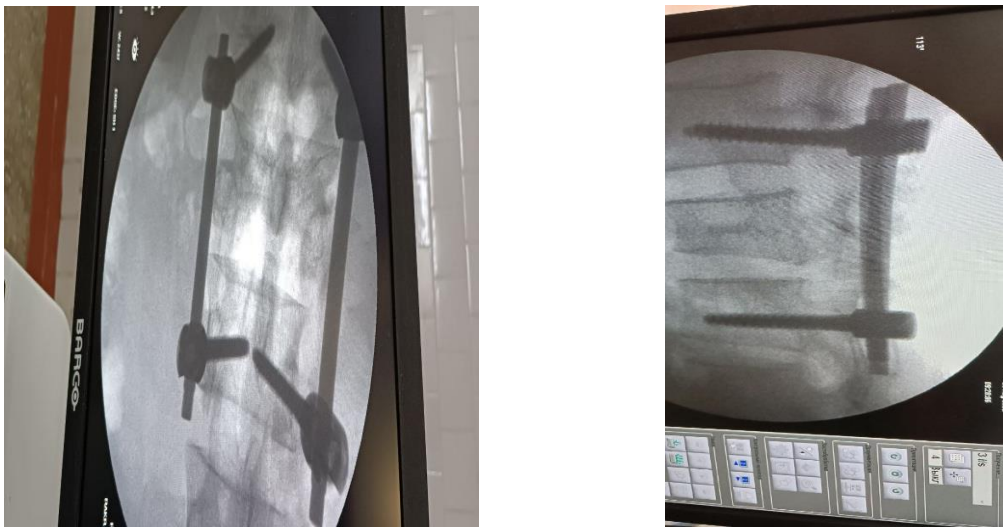

Fig. 3. Stabilization of the injured spinal segment with a 4-screw TPF design.

Results. Analyzing the clinical efficacy of various technical variants of TPF for injuries accompanied by traumatic stenosis of the spinal canal, we assessed the possibilities of repositioning the injured spinal joints and decompressing the dural sac for various types of displacements, taking into account the time elapsed since the injury, regression of post-traumatic neurological deficit, as well as the stability of fixation of the injured spinal joints

A good result was considered to be stabilization of the injured spine with restoration of anatomical relationships and support ability; residual kyphotic deformity not exceeding 10°, narrowing of the spinal canal lumen - up to 20-25% at a level above L2 and up to 30-35% below L2 without clinical manifestation; absence of pain syndrome with full activation of the patient; in patients with neurological deficit — normalization of neurological status or significant regression of neurological disorders. A satisfactory result is stabilization of the spine with restoration of support ability in the presence of kyphotic deformity in the injured segments of 10-25°; possible occurrence of pain syndrome after moderate loads; in the neurological status with SSCI — possible partial restoration of lost functions or preservation of neurological deficit at the preoperative level. An unsatisfactory result is the development of instability in the injured SDS, lack of support ability of the spine, the presence of deformity with local kyphosis of more than 25°, unresolved stenosis of the spinal canal of more than 40% above the level of L2 and more than 50% below L2, worsening of neurological disorders. The immediate treatment results were monitored in all the operated patients: good ones were obtained in 59 (69.4%), satisfactory ones — in 33 (38.8%), and unsatisfactory ones — in 3 (3.5%). Unsatisfactory treatment results were associated in two cases with destabilization of the metal structure, which required dismantling the metal structure in one case and prolonging fixation higher by one more level in the other. In one case, persistent (deterioration from level C to A according to the ASIA/ISCSCI scale) increase in neurological symptoms was observed after the operation. Remote treatment results one year after the surgical interventions were monitored in 52 (61.1%) patients: good ones — in 31 (59.6%), satisfactory ones — in 16 (30.7%), and unsatisfactory ones — in 3 (5.7%). In 1 patient, a fracture of one of the screws of the metal structure, cutting through of the adjacent screw with the development of severe kyphotic deformity were detected; in another 1 patient, loosening of the fastening nuts of the polyaxial metal structure led to kyphotic deformity.

Conclusions.

1. Patients with injuries of the spine and spinal cord should be examined using modern methods of radiation diagnostics (MSCT, MRI);
2. Complicated injuries of the spine require emergency decompressive and stabilizing surgical interventions;
3. Patients with spinal cord injury require DLE at the level of at least 2-3 vertebrae and meningomyeloradiculolysis with subsequent stabilization of the TPF;
4. Unstable injuries of the spine are an indication for stabilization in order to prevent secondary damage to the spinal cord;
5. Early surgical interventions contribute to the restoration of lost functions of the damaged spinal cord.

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