International Journal of
Health Systems and Medical Science

ISSN: 2833-7433
Volume 1 | No 4 | Oct-2022

Principles of Diagnosis and Surgical Treatment of Injuries of the Thoraco-Lumbar Spine

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Annotation: For any acute spinal cord injury (SCI), a detailed study of the anamnesis and neurological examination of the patient is an unconditional procedure. Against the background of spondylography, multispiral computed tomography (MSCT), magnetic resonance imaging (MRI), the study of the objective status of the patient continues to be the main method for clarifying the nature of injuries of the spinal motion segment. One of the important stages in the surgical treatment of injuries of the thoracolumbar spine is the reliable stabilization of the damaged segment. A large number of various, fundamentally different, fixation systems for spinal stabilization have been proposed.

Keywords: spinal cord injury, spondylography, multispiral computed tomography, magnetic resonance imaging, spinal motion segment, fixation system, spinal stabilization.

Introduction. Many classifications have been proposed to determine the severity of spinal cord injury. The most common classification is ASIA/IMSOP, proposed in 1998, according to which patients are divided into five groups.

Having considered the features of clinical manifestations, it is necessary to analyze the evolution of diagnostic techniques that contribute to the formulation of an early and correct diagnosis [1,2].

The main tasks of diagnosing spinal cord injury are: 1. Verification of the clinical diagnosis; 2. Clarification of the nature of the spinal injury; 3. Determination of the classification type of damage, with an assessment of the risk of progression of spinal deformities and the development of severe neurological disorders [13].

The main thing in any acute SCI is, of course, a detailed study of the anamnesis and neurological examination of the patient. Spondylography continues to be the main method for diagnosing spinal injuries [11].

The most informative research methods are MSCT and MRI [10]. MSCT allows solving the following tasks with high reliability: 1. Assessment of the nature of damage to the bone structures of the vertebrae (body, arches, processes); 2. Assessment of the geometry of the spinal canal (diagnosis of stenosis and pathological bends, as well as assessment of their severity); 3. Evaluation of the relationship of structures in the intervertebral joints (diagnosis of subluxations, dislocations, and fracture-dislocations of bodies and articular processes) [4,10]. According to various authors, modern computer research gives the reliability of the results in the range of 96-97% [2,19].

MRI allows obtaining a multifaceted image of the spinal cord and revealing morphological changes in the small tissue structures of the spine. With absolute certainty, MRI allows us to state the fact of compression of the spinal cord and cauda equina roots not only by bone structures, but also by areas of damaged discs, epidural hematomas [16].

The substantiation of indications for surgical treatment of traumatic injuries of the spine and spinal cord has been described in the literature by many authors [1].

Lutsik A.A. considered an indication for surgery:

1. pronounced deformities of the spinal canal with compression syndromes;
2. partial or complete blockade of the cerebrospinal fluid;
3. with the progression of spinal cord dysfunction due to its early compression;
4. Clinical and angiographic signs of compression of the main vessels of the spinal cord.

There is a provision according to which, in case of injuries of the spine and spinal cord, a strict time factor is established, after which decompression interventions, as a rule, do not give the desired effect [8, 9, 11, 16]. As studies by Osterholm (1974) showed, 30 minutes after spinal cord injury there is an insignificant number of small hemorrhages in the gray matter of the spinal cord, which progressively increases in size and after 2 hours makes up 23% of the damaged area. After 1 day, about 70% of the gray matter is occupied by hemorrhages. These data allow us to substantiate the thesis about the urgency of surgical intervention for injuries of the spine and spinal cord. Babichenko E.I. in 1994, he pointed out that the first traumatic necrosis occurs at the site of application of the traumatic agent, while, as a rule, softening of the brain extends above or below this area by 1–1.5 segments.

In addition to changes in the cellular structure and pathways of the spinal cord, more importance is attached to hemodynamic disorders that develop as a result of injuries. A number of authors even distinguish specific vascular syndromes [6, 7]. In this aspect, it is necessary to have a clear idea of the features of the blood supply to the spinal cord. On the basis of anatomical, experimental and clinical-anatomical studies, two blood supply basins of the spinal cord are distinguished - upper and lower [5,12].

Anatomical specificity in the arterial blood supply of the spinal cord should be taken into account by surgeons when performing surgical interventions. [12].

In this regard, at present, it is necessary to take into account neurological symptoms in SCIT, in which there are indications for urgent decompression of the spinal cord and its vessels. Otherwise, growing ischemic disorders lead to irreversible pathological processes [16,10].

In the late period, the need for surgical treatment is justified both by the destabilization of the segments and by the development of glial and connective scars in the injury zone, which can lead to spinal cord compression [19].

Bersnev V.P. especially emphasizes that compression of the spinal cord in spinal cord injury is, first of all, compression of its main vessels.

Principles of surgical intervention for spinal cord injury:

1. early decompression of the spinal cord and its elements;
2. elimination of dislocations in the damaged segment;
3. Reliable stabilization of the damaged segment [6, 7].

Many methods of spinal cord decompression in acute trauma of the thoracolumbar spine have been proposed. In orthopedics and traumatology, methods of simultaneous closed vertebral reclination have long been used in patients with trauma to the thoracolumbar spine without neurological disorders [10, 16]. The principle of the closed reclination method consists in straightening a broken vertebra by forced extension of the spine, while tensile forces appear in the anterior sections of the spine, which are transmitted through the anterior longitudinal ligament and anterior portions of the fibrous rings to the anterior sections of the vertebral bodies.

There are many ways to reclination of the spine. The Davis method is known [13,14,15], which includes hanging the patient by the legs on a high block while lying face down, but the disadvantage of this method is that some patients find it difficult to endure a long forced position of the body, and this method does not provide control over the dynamics of extension .

There is also a Watson-Jones method of hyperextension of the spine, which includes laying the patient between two tables of different heights, while he supports himself on a higher table with the help of retracted shoulders. The patient's body weight is sufficient for reposition and therefore no traction or direct pressure is applied to the fracture area. Then a plaster corset is applied from the groin to the collarbones and after a few days light exercises are prescribed.

The disadvantage of this method is that there is no regulation of the reclination process; there is no control over the state of the dural sac and its contents during reclination; the most complete correction of the deformed section of the spinal column is not achieved; Also, an extensional plaster corset, which completes the manipulation, does not exclude secondary deformities of the vertebra.

Karpov S.P. in 1973, a method of spinal reclination was proposed by active mechanical action on the damaged area using an electric vibrator for 5-10 minutes, but the disadvantage of this method is that the deformity of the damaged section is not always corrected.

One of the important stages in the surgical treatment of injuries of the thoracolumbar spine is the reliable stabilization of the damaged segment. A large number of various, fundamentally different, fixation systems for spinal stabilization have been proposed. Most fixators are proposed for fixing the vertebrae by the elements of the posterior half ring (Tsivyan-Ramikha ties, Tsivyan plates, CITO, XNIITO-1, XNIITO-2 and others).

An analysis of the long-term results of closed reclination in complicated spinal cord injuries of the thoracolumbar region with posterior interspinous fixation [9,10] showed that in some cases kyphotic deformity of the spine may develop and even symptoms of spinal cord compression may appear, which may require repeated surgical intervention to eliminate compression, although rare.

In addition, if closed reclination is not possible (compression fractures of the bodies of the 4th degree, chronic fractures, comminuted fractures, fractures of the vertebral arches, with their introduction into the spinal canal, disk sequestration), a wide laminectomy is necessary and then it is impossible to reclin and stabilize the affected segment, since stabilization by the spinous processes is not feasible. That is, in very rare cases, it is possible to carry out a full decompression of the spinal cord.

The study of the physical foundations of the distribution of forces and loads in the spine led to the creation of the theory of three pillars. According to the theory of Denis F. (1983), the spine is a flexible single support system in which the main load (80%) is transmitted through the anterior sections of the spine (vertebral bodies and intervertebral discs) at different angles, and only part of the load is transmitted through the joints of the vertebrae, and this led to a better understanding of the distribution of forces in the vertebrae and the creation of fixation systems supported by the vertebral bodies. From the foregoing, it becomes clear that the main supporting complex of the spinal column is the vertebral bodies and the auxiliary supporting complex is the joints of the vertebrae.

Therefore, the development of transpedicular systems began in the 1960s. Several stages have been identified that played a significant role in the formation of new areas of transpedicular fixation:

1. Screw vertebral transarticular fixation / D. King, 1944 /
2. Screw pedicular fixation /H.Boucher, 1959/
3. Pedicular fixation with plates / Roy-Camille, 1970 /
4. External rod TPF - "Fixateur-Exteme" /F. Magerl, 1977/
5. Internal rod TPP - "Fixateur-Inteme" / W. Dick, 1982 /

In recent decades, there has been an active improvement of technologies and transpedicular systems in various functional areas - rigid plate and rod implants, semi-rigid structures, dynamic fixators, universal implants [3,4].

All these studies have made it possible to propose a classification of stabilization methods. Reliable stabilization of all three supporting columns of the spine in case of its injuries makes transpedicular fixation optimal in terms of biomechanics. The segmental nature of transpedicular fixation provides

vertebrologists with the opportunity to achieve good stabilization of only damaged parts of the spine (short fixation) and not to exclude intact vertebral segments from the kinematic chain of the spinal column [20,21]. The structural features of the pedicles of the vertebral arches make it preferable to use the TPF method in the lower thoracic and lumbosacral spine. With "fresh" fractures of the spine, effective reposition of the fracture can and should be done by simultaneous reclination of the spine on the operating table. In these cases, the transpedicular fixation system can only be used to stabilize the achieved shape of the fractured vertebra. If a week or more has passed since the injury, then the complete correction of post-traumatic spinal deformities with the help of one-stage reclination is problematic.

Thus, transpedicular fixation is considered not only as a method of reliable stabilization of the affected segment, but also as a method that reduces the possibilities for decompression of the contents of the spinal canal, and therefore has a number of advantages over other treatment methods.

Conclusion. It is possible to improve the method of closed spinal reclination developed by us, as well as expand the possibilities of open reclination, with the elimination of all compression factors and reliable stabilization, this greatly expands the possibilities of early full-fledged rehabilitation.

Most of the scientific articles published in the early 1990s reported on the successful use of transpedicular fixation. In recent years, the number of works devoted to errors and failures in the use of this method has increased.

According to Knop C., et all. 2001, only 70% of screws are correctly positioned at postoperative follow-up. In 25% of cases, the screws penetrate the lateral or medial wall of the pedicle, and about 5% of the screws unscrew spontaneously without fixing the structure. These data indicate that the problem of transpedicular fixation is far from perfect and requires further study.

The modern approach to the problem of acute injuries of the thoracolumbar spine consists in the analysis of clinical and radiological data. The most informative diagnostic methods are MSCT and MRI.

The analysis of domestic and foreign literature showed that a unified tactic for the surgical treatment of acute injuries of the thoracolumbar spine has not yet been determined.

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