

## **APPLICATION OF MODIFIED LADDER LAMINECTOMY IN SPINAL CORD TUMOR REMOVAL**

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**Abstract:** Spinal cord tumors are one of the most pressing problems in neurosurgery. Spinal cord tumors account for 2% of all neoplasms and 3% of nervous system pathology in adults[V.V. Stupak, S.V. Shabanov, I.V. Pendyurin, S.S. RabinovichResults of surgical treatment of patients with extramedullary hourglass tumors]. Most often, spinal cord tumors are observed in the socially active group of people aged 30–50 years, which determines the greater relevance of this problem.[V.V. Stupak, S.V. Shabanov, I.V. Pendyurin, S.S. RabinovichResults of surgical treatment of patients with extramedullary hourglass tumors]. Standardization of neurological examination and formulation of neurological conclusion in spinal trauma is a pressing issue in neurotraumatology, neurosurgery and neurooncology.Improvements in diagnostic methods and visualization of spinal cord structures, the development of microsurgical techniques and minimally invasive approaches have made it possible to significantly expand the indications for surgery and improve treatment results. But even differentiated choice of surgical approaches is required, which should ensure optimal visual control over the progress of tumor removal and the state of nerve structures with minimal displacement of the spinal cord.Thus, the search for new solutions and tactical and technical approaches in the treatment of spinal cord tumors, in particular intramedullary spinal cord tumors, has not lost its significance and is a subject for discussion in neurosurgical communities.

**Keywords:** clinical observations, degenerative-dystrophic diseases, muscles, complex exercises, rehabilitation.

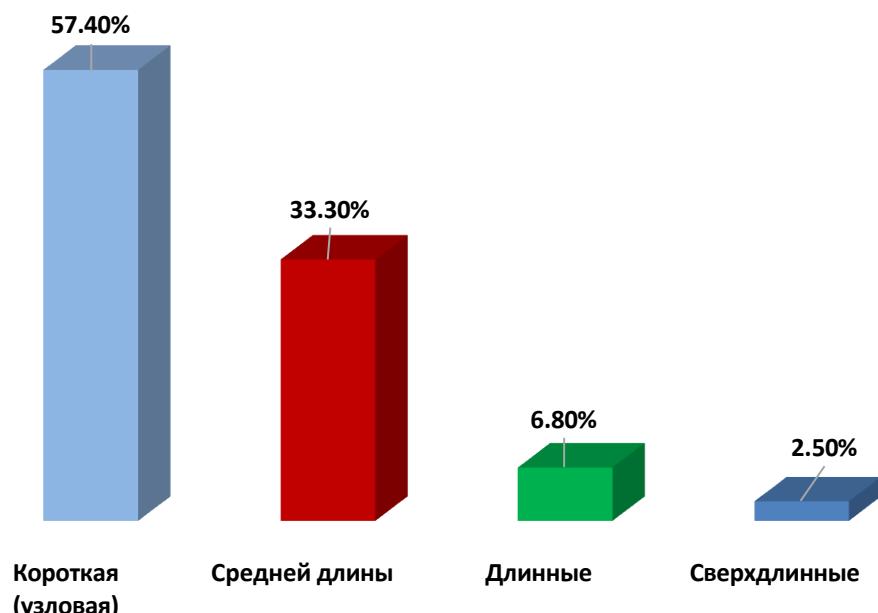
### **Introduction**

PA search of literature sources in the Pubmed, Medline and eLibrary databases revealed the presence of isolated studies devoted to the study of the long-term results of surgical treatment of intradural spinal cord tumors, the fact of which demonstrates that spinal tumor surgery is one of the most challenging areas in neurosurgery [Abd-El-Barr MM, Huang KT, Moses ZB, et al. Recent advances in intradural spinal tumors.*Neuro Oncology*. 2017. Forthcoming. doi:10.1093/neuonc/nox230.]. The growth of a tumor from the spinal cord tissue causes “caution” during its removal and limits its radicality. Only radical removal of the tumor with maximum preservation of spinal cord functions currently makes it possible to achieve a virtual cure for the patient. Surgical treatment of spinal tumors is always accompanied by a high risk of damage to neural structures or disruption of the blood supply to the spinal cord, which, in turn, can lead to profound disability of the patient. Surgical interventions for spinal cord tumors vary depending on the location relative to the spinal cord cross-section, the size of the tumor and the level of localization relative to the spine. There are many surgical approaches to tumor removal, including laminectomy methods. Hard-to-reach localization, abundant vascularization, often malignant nature of vertebral tumors, large tumor sizes, destabilization of the spine after surgery make their surgical treatment difficult. One of the unsolved problems of vertebral surgery is the

radical removal of tumors, especially those spreading to more than 4 vertebrae, when tumor resection can only be achieved by laminectomy of each affected vertebra. The main tasks that require a solution are maintaining the stability of the spinal column support and reducing the traumatic effect on the spinal cord during tumor removal. Namely, in the surgical treatment of long and super-long tumors, the new modified laminectomy method has not yet been used. The results of surgical intervention are influenced by the size and density of the tumor, the degree of compression and direction of displacement of the brain, and the spread of the tumor relative to the spine.

**Purpose of the study:** To analyze and compare the results of surgical treatment of patients using ladder laminectomy and standard laminectomy methods for long and super-long spinal cord tumors. To introduce into medical practice a single modified new laminectomy method, which will serve as the main method of total, one-stage removal of long and super-long tumors, preserving neural structures, support of the spinal column with minimal trauma to the roots and elimination of neurological deficit in the postoperative period.

**Materials and methods of research:** In the period from 2010 to 2021, 162 patients were operated on in the neurosurgery department of the 1st clinic of the Samarkand State Medical Institute patients with spinal cord tumors. Of these, 70 were men, 92 were women, aged mostly from 16 to 71 years.



**Fig. 1. Distribution of patients by tumor spread into the spinal canal.**

**Research results:** Among patients, in order to unify the approach to assessing neoplasms in relation to the long axis of the spinal column and spinal cord, we proposed a classification according to the following tumor forms, according to this classification: 93 patients had a nodular or short tumor (a neoplasm at the level of one or two vertebrae); 54 patients had a tumor of medium length (at the level of 3-4 vertebrae); 11 patients had long tumors (at the level of 5-6 vertebrae); 4 patients had super-long tumors (the tumor spread along the long axis of the spinal canal and spinal cord at the level of more than 6-7 vertebrae) (Fig. 1). In all cases with types 1, 2 and 3 tumor spread, standard laminectomy with resection of the base of the spinous process of the vertebrae was performed. In addition, 18 patients with type 3 and 1 patient with type 4 underwent standard laminectomy.

The remaining 12 patients with long and superlong tumors underwent ladder laminectomy. Ladder laminectomy is a resection of the spinous processes and arches starting from the level of the pole of long and superlong spinal cord tumors that extend to more than four vertebrae, 1st 3rd and so on through one vertebra, which is a significant difference from standard laminectomy methods, where each affected vertebra is resected, which threatens destabilization

of the spinal column and high trauma.

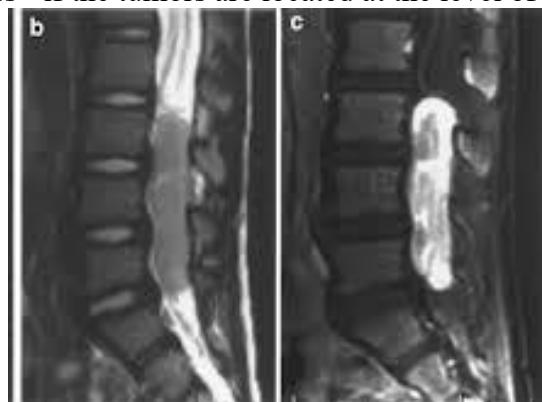


**Fig. 2. Intradural extramedullary "nodular" tumor at the Th12-L1 level**

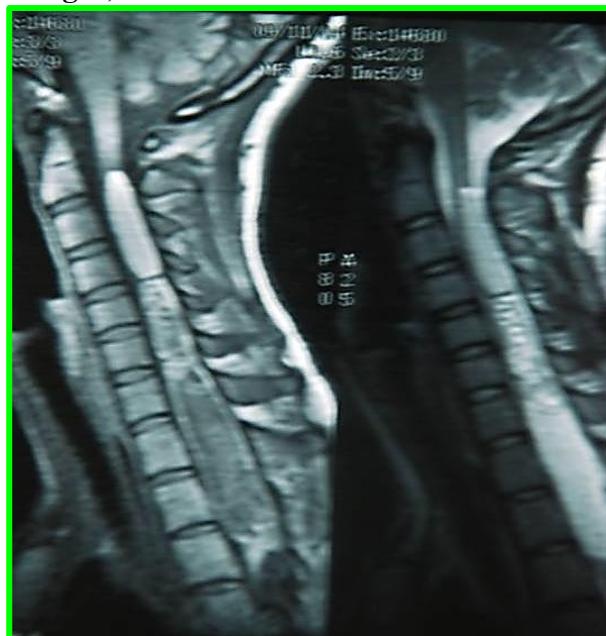
After skeletonization of the spinous processes and vertebral arches, a flap of supraspinous and interspinous ligaments is cut out on a pedicle for posterior autotendoplasty at the end of the operation. This method ensures total, one-stage removal of long and superlong tumors, preserving neural structures, support of the spinal column with minimal trauma to the roots and elimination of neurological deficit in the postoperative period. Microneurosurgical techniques and instruments are used to remove tumors.



**Fig. 3.** Nodular or short tumors - if the tumors are located at the level of one or two vertebrae.



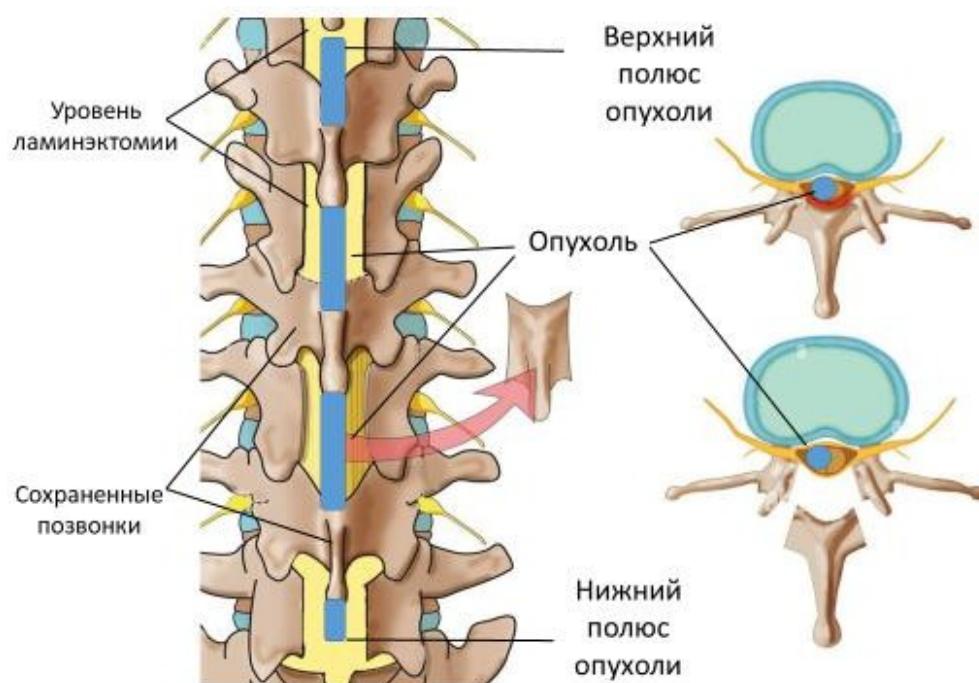
**Fig. 4.** Tumors of medium length, when tumors are located at the level of 3-4 vertebrae.



**Fig. 5.** Long tumors, when tumors are located at the level of 5-6 vertebrae.

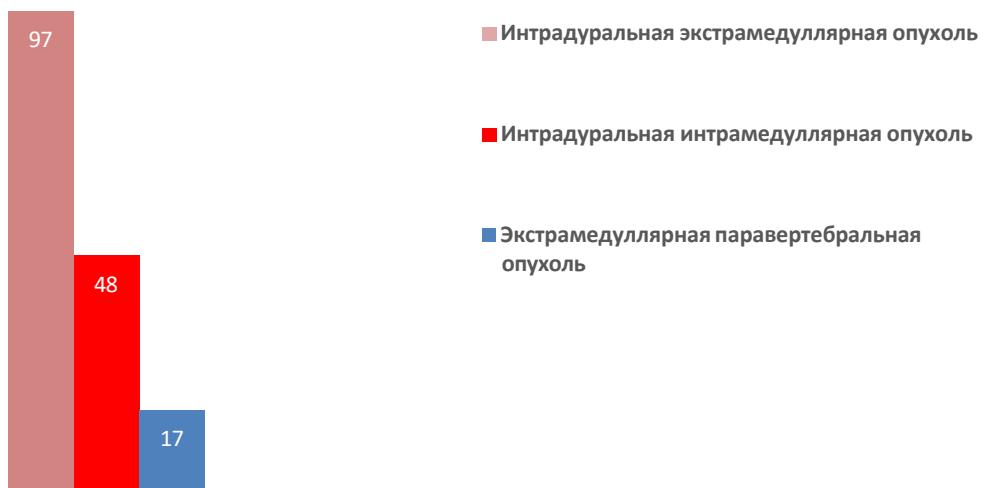


**Fig. 6. Super-long tumors, if the tumors extend along the length of the spinal canal and spinal cord at a level of more than 6-7 vertebrae.**



#### **Schematic representation of the ladder method of laminectomy.**

For comparison of results patients aged from 19 to 71 years were taken, the majority of whom are women from 21 to 66 years old, men from 25 to 71 years old, of which 97 patients were diagnosed with intradural extramedullary SM tumor, 48 intradural intramedullary, 17 patients with paravertebral extramedullary SM tumor (Fig. 7), with localization in the cervical region 34.9%, thoracic 55.2%, lumbar 9.8%. According to histological data: 58 patients had schwannomas, 56 meningiomas, 13 ependymomas, 8 astrocytomas, 7 dermoid cysts, 6 hemangioblastomas, 13 neurofibromas (Fig. 8).



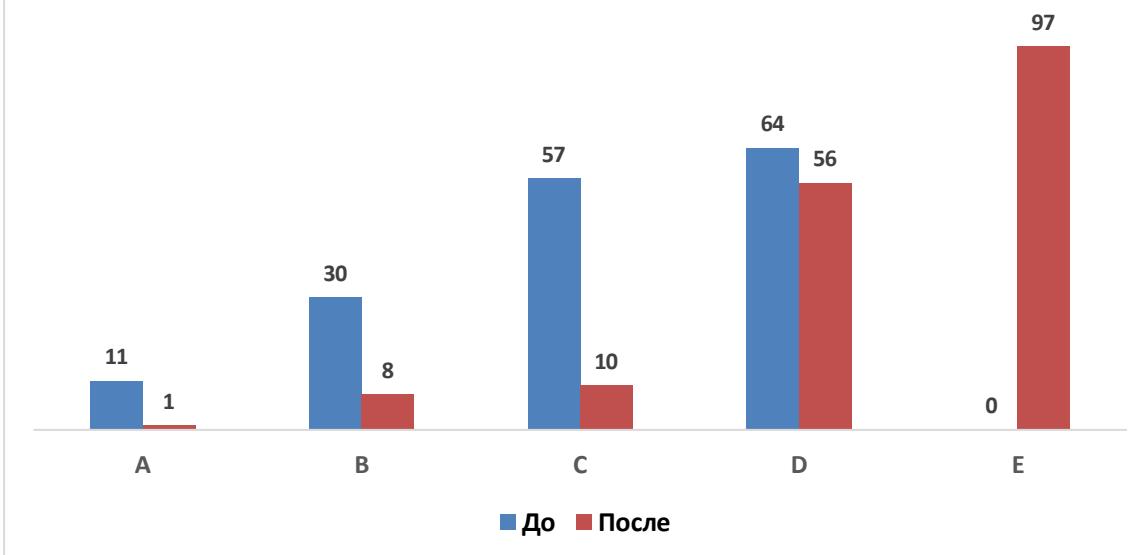
**Fig. 7. Graph of distribution of patients relative to the spinal cord**



**Fig. 8. Distribution of patients according to histological data.**

According to clinical observations, in the preoperative period, 2% of patients had complete damage, lack of motor and sensory function in the limbs, which corresponds to the Frankel A scale; According to the Karnofsky scale 30% - the patient is bedridden, hospitalization is indicated, although a terminal state is not necessary. 11% of patients had a complete lack of motor function, but with preserved sensitivity (Frankel B); According to Karnofsky, 50% of patients often require assistance and medical care. 30% of patients suffered from severe motor impairments with preserved sensitivity (Frankel C); According to Karnofsky, 60% of patients sometimes need assistance, but mainly care for themselves. 57% mild movement impairments with normal sensitivity (Frankel D); According to Karnofsky, 80% Normal activity is possible with additional efforts, with moderate symptoms of the disease. The introduction of international standard assessment criteria allows us to obtain a more accurate idea of the results of surgical treatment. According to our observations: in patients aged 21 to 62 years, after the modified "ladder" method, the installation of vinyl chloride drainage with the use of tendoplasty for 10-12 days allowed us to achieve more favorable results, i.e. a reduction in neurological deficit according to Frankel from "A" to "E" in 60% of cases, from "A" to "D" in 35% of cases and from "A" to "C" in 5% of cases.

## Оценка неврологического состояния по шкале Frankel



In the postoperative period, the functional status was assessed according to McCormick, which showed:

57% of patients had minor neurological deficits in the form of mild spasticity, increased reflexes, etc., which did not particularly affect their daily functionality.

30% had moderate sensorimotor deficits that affected daily life and quality of life, pain syndrome, dysesthesia, and mild gait disturbances. However, the patient is “independent” in his daily activities.

In 11% of patients diagnosed with long intradural intramedullary tumor, more severe deficits were observed, the patient could ambulate with assistance or had significant bilateral hand function impairment, in fact, not completely independent.

2% of patients had severe deficit (paraplegia/tetraplegia). The patient is completely dependent on outside help.

According to the analysis of studies in patients undergoing modified ladder laminectomy, predominantly positive results were revealed, due to the fact that this method allows for total removal of the neoplasm while preserving the bone structures of the spinal cord. In addition, more than 90% of patients experienced accelerated regression of the degree of neurological deficit, total one-stage removal of spinal cord neoplasms and release of the spinal cord from compression, thus achieving restoration of the working capacity of patients with this pathology.

**Conclusions:** This study showed that differentiated surgical approaches for different lengths of spinal cord tumors are acceptable in order to minimize surgical trauma and maintain spinal stability, in particular, the "ladder" method of laminectomy allows to reduce the number of resected spinous processes and preserve the middle and posterior supports of the spinal column. The proposed technique provided the following advantages:

- achieving total one-stage tumor removal;
- refraining from resection of the spinous processes at each affected level of the vertebra;
- improving cerebrospinal fluid circulation in the subarachnoid space by eliminating compression by the neoplasm;
- elimination of neurological deficits in the pre- and postoperative period;
- minimal side effects.

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