



SURGICAL TREATMENT OF SPINAL CORD TUMORS

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ABSTRACT

This article examines contemporary approaches to the surgical treatment of tumors of the spinal cord and its surrounding structures. It discusses the principal types of spinal cord tumors, their clinical manifestations, diagnostic methods, and indications for surgical intervention. Particular attention is given to modern neurosurgical technologies, including microsurgical tumor resection, intraoperative neurophysiological monitoring, neuronavigation, and minimally invasive surgical techniques. Potential postoperative complications, rehabilitation strategies, and the importance of a multidisciplinary approach to patient management are also considered. The choice of surgical strategy depends on the tumor's anatomical location, histological type, extent of spread, and the patient's neurological status. Accurate preoperative diagnosis and individualized surgical planning are essential for determining the appropriate extent of resection while minimizing the risk of neurological injury. Advances in microsurgical techniques and intraoperative monitoring have improved the ability to remove selected spinal cord tumors while preserving neurological function. Nevertheless, complete tumor removal is not always feasible, particularly when the lesion infiltrates functional neural tissue or is closely associated with critical spinal cord pathways. In such cases, partial resection, postoperative surveillance, radiotherapy, or other oncological



treatments may be considered according to the histological diagnosis and clinical circumstances. Postoperative rehabilitation plays an important role in restoring mobility, improving functional independence, and preventing complications associated with neurological impairment. Long-term follow-up, including neurological assessment and magnetic resonance imaging, is necessary to monitor recovery and detect possible tumor recurrence. A coordinated multidisciplinary approach involving neurosurgeons, neurologists, oncologists, radiologists, rehabilitation specialists, and other healthcare professionals, when indicated, is essential for optimizing treatment outcomes and improving patients' quality of life.

Introduction: Spinal cord tumors represent a heterogeneous group of neoplasms that may affect the neural tissue itself, the meninges surrounding the spinal cord, or other structures within the spinal canal. These conditions remain an important concern in modern neurosurgery because even slowly growing tumors can compress neural structures, cause motor and sensory disturbances, and significantly reduce patients' quality of life. The clinical significance of spinal cord tumors depends on their anatomical location, size, growth pattern, and biological characteristics. Some neoplasms develop slowly and have a favorable prognosis following complete surgical removal. Others exhibit infiltrative growth or represent secondary tumors that have spread from primary malignancies in other organs. Differences in tumor biology and anatomical relationships substantially influence treatment selection and expected outcomes. Advances in neurosurgery have considerably improved the diagnostic and therapeutic management of these conditions. The use of operating microscopes, high-resolution neuroimaging, neuronavigation, and intraoperative neurophysiological monitoring helps surgeons identify tumor boundaries, plan operative approaches, and reduce the risk of injury to critical neural structures. The aim of this article is to examine contemporary surgical methods for treating spinal cord tumors, identify the principal indications for surgery, and discuss the specific features of postoperative recovery and rehabilitation.

Main part: Spinal cord tumors are classified into several major groups according to their anatomical location and relationship to the spinal cord and surrounding structures. Extramedullary tumors develop outside the substance of the spinal cord. They may arise within the spinal canal, including from the meninges or nerve roots. Common examples include meningiomas and schwannomas. Meningiomas originate from the meninges and frequently demonstrate relatively slow growth. Schwannomas develop from Schwann cells associated with peripheral nerve sheaths. Many of these tumors have relatively well-defined boundaries, which



may permit surgical removal while preserving adjacent neural structures. However, the feasibility and safety of resection depend on the tumor's precise location, size, relationship to nerve roots, and involvement of surrounding tissues. Intramedullary tumors arise directly within the spinal cord tissue. These include ependymomas, astrocytomas, and several other neoplasms. Surgical treatment of intramedullary tumors is particularly challenging because the lesions may lie close to functionally important neural pathways. The possibility of complete resection depends on the histological type, the clarity of the tumor boundaries, and its relationship to the surrounding spinal cord tissue. In selected cases, complete removal may be achievable, whereas infiltrative lesions may require a more conservative surgical strategy to preserve neurological function. Metastatic tumors develop when malignant cells spread from a primary tumor located elsewhere in the body. They may involve the vertebral bodies, extend into the spinal canal, and compress the spinal cord or nerve roots. In these cases, treatment depends on the extent of the oncological disease, the severity of neurological impairment, spinal stability, and the tumor's sensitivity to radiotherapy and systemic anticancer treatment. Surgical intervention may be required to decompress neural structures, stabilize the spine, or obtain tissue for histopathological examination. The overall treatment plan should be individualized according to the patient's general condition, prognosis, and therapeutic goals. The clinical presentation of spinal cord tumors depends on the level of involvement, the rate of tumor growth, and the degree of compression affecting the spinal cord or nerve roots. Common clinical manifestations include persistent or progressively worsening back pain, pain radiating into the extremities, numbness, reduced sensation, muscle weakness, impaired coordination, gait disturbances, increased muscle tone, and changes in reflexes. In advanced or severe cases, patients may develop dysfunction of the urinary bladder or bowel. The symptoms may develop gradually, particularly in patients with slowly growing tumors. Progressive compression of the spinal cord can eventually lead to persistent neurological deficits, making early recognition and diagnosis particularly important for preserving motor and sensory function. Rapidly progressive limb weakness, sudden deterioration in walking ability, or new bladder or bowel dysfunction requires urgent medical assessment because these symptoms may indicate significant spinal cord compression. Timely diagnosis and appropriate treatment are essential to reduce the risk of irreversible neurological injury.

Magnetic resonance imaging (MRI) is the principal imaging method used to diagnose spinal cord tumors. It provides detailed information about the tumor's location, size, extent, and relationship to the spinal cord and surrounding soft tissues. MRI with contrast enhancement is frequently used to characterize lesions more accurately and clarify their boundaries. Computed tomography (CT) may be added when involvement of the vertebral structures, bone destruction, or spinal stability requires further assessment. A comprehensive neurological examination includes evaluation of muscle strength, sensation, reflexes, coordination, gait, and pelvic organ function. These findings help determine the severity of neurological impairment and establish a



baseline for subsequent monitoring. When metastatic disease is suspected, additional investigations may be required to identify the primary malignancy and determine the extent of disease dissemination. The selection of these investigations depends on the patient's medical history, clinical findings, and imaging results.

Definitive determination of the histological tumor type generally requires examination of tissue obtained during surgery or through a biopsy when the procedure is considered appropriate and sufficiently safe. Histopathological and, when indicated, molecular findings are important for establishing the diagnosis and selecting further treatment. In some circumstances, particularly when imaging findings are characteristic and surgery is not indicated, management may proceed without an immediate biopsy. Surgical intervention is one of the principal treatment methods for many spinal cord tumors. However, the decision to operate must be made individually after considering the tumor's characteristics, the patient's neurological status, and the anticipated benefits and risks of the procedure. The principal indications for surgery may include progressive compression of the spinal cord or nerve roots, worsening motor or sensory deficits, significant tumor-related pain, and the need to obtain tissue for a definitive diagnosis. Surgery may also be indicated when complete or substantial tumor removal is feasible with an acceptable risk of neurological complications. In patients with metastatic involvement of the vertebral column, surgical treatment may be necessary when there is spinal instability, substantial epidural compression, or a need for mechanical stabilization. The decision should take into account the overall oncological prognosis and the availability of alternative treatments.

Complete surgical removal may be possible for certain benign tumors with clearly defined boundaries. However, when a tumor infiltrates the spinal cord or is closely associated with functionally important neural structures, attempting radical resection may cause serious neurological injury. In such cases, partial resection followed by surveillance or additional treatment may provide a safer approach. Microsurgical resection is one of the principal methods used to treat many primary spinal cord tumors. The procedure is performed using an operating microscope and specialized microsurgical instruments, allowing detailed visualization of the operative field. Depending on the tumor's location, the surgeon obtains access to the spinal canal through an appropriate surgical approach. After identifying the lesion, the surgeon carefully separates it from surrounding structures and removes as much tumor tissue as can be safely resected. The primary objective is to relieve compression of the spinal cord and nerve roots while preserving their structural and functional integrity. The extent of resection depends on the tumor's histological type, boundaries, vascularity, and degree of involvement of the surrounding neural tissue. Although complete removal may provide durable disease control in selected cases, preservation of neurological function remains a fundamental priority. Therefore, the maximum safe extent of resection is generally more important than pursuing complete removal at the expense of critical neural structures.



Laminectomy involves removing part or all of the lamina, the posterior bony portion of a vertebra, to gain access to the spinal canal. It may be used during the surgical treatment of selected tumors located within the spinal canal. Laminoplasty is a technique in which the lamina is repositioned or reconstructed after surgical access has been established. Depending on the anatomical level, extent of surgery, and anticipated risk of postoperative spinal instability, laminoplasty may be considered as an alternative to laminectomy in selected patients. The choice of surgical approach depends on the location and extent of the lesion, the number of vertebral levels involved, and the patient's anatomical characteristics. In some cases, additional spinal stabilization may be necessary after tumor removal, particularly when the operation compromises structural stability or the tumor has already caused substantial vertebral destruction.

Neuronavigation is a technology that allows preoperative imaging data to be correlated with anatomical structures during surgery. It helps the surgeon orient themselves within complex anatomical regions and plan an appropriate approach to the tumor. This technology can be particularly useful for deep-seated or anatomically complex lesions. By improving spatial orientation, neuronavigation may help guide surgical access and support accurate localization of the target. Nevertheless, its effectiveness depends on the specific clinical situation, available imaging, and the accuracy of intraoperative registration. Neuronavigation does not replace direct anatomical visualization, intraoperative judgment, or the expertise of the neurosurgical team.

Intraoperative neurophysiological monitoring is an important development in modern neurosurgery. During surgery, electrical responses from the nervous system are assessed to monitor selected neural pathways and functional systems. Depending on the procedure, monitoring may include motor evoked potentials, somatosensory evoked potentials, and other techniques selected according to the structures at risk. Changes in these signals may indicate potential compromise of neural function and prompt the surgical team to reassess the operative approach. Monitoring is particularly valuable during the removal of intramedullary tumors and lesions located near functionally important spinal cord pathways. It can support intraoperative decision-making and help reduce the risk of neurological injury. However, intraoperative neurophysiological monitoring cannot eliminate all surgical risks. Its findings must be interpreted in the context of the patient's condition, anesthetic factors, technical limitations, and the overall operative situation.

The choice of surgical strategy depends on the tumor's biological characteristics, anatomical location, and relationship to surrounding neural structures. For meningiomas and selected schwannomas, the principal objective is to achieve complete removal when this can be accomplished safely while preserving neurological function. Clearly defined tumor boundaries may facilitate resection and contribute to favorable long-term outcomes. Nevertheless, the relationship between the tumor and adjacent nerve roots, blood vessels, and other structures must be carefully considered. For spinal cord ependymomas, the objective is generally maximal



safe resection. In selected cases, complete removal may be possible because the tumor has a relatively distinct boundary from the surrounding spinal cord tissue. The final treatment plan depends on the histological diagnosis, the extent of resection, and the findings of postoperative assessment. For astrocytomas, particularly those demonstrating infiltrative growth, radical resection may be limited by the risk of damaging functional neural tissue. In such circumstances, the decision to perform partial resection, continue observation, or provide additional treatment should be based on the tumor's biological characteristics, histopathological findings, neurological status, and imaging results. In metastatic lesions involving the spinal canal or vertebral column, surgery may be directed toward spinal cord decompression, mechanical stabilization, pain relief, and preservation or restoration of neurological function. Depending on the clinical circumstances, surgery may be combined with radiotherapy and systemic anticancer treatment. Thus, the optimal surgical approach must be selected individually rather than applying the same operative strategy to all spinal tumors.

Despite advances in surgical technology, operations involving spinal cord tumors are associated with potential complications. Their occurrence depends on the tumor's location and size, its biological characteristics, the patient's preoperative neurological condition, and the extent of the surgical procedure. Possible complications include temporary or permanent deterioration in motor and sensory function, injury to neural structures, bleeding, postoperative hematoma, infection, cerebrospinal fluid leakage, spinal instability, and tumor recurrence. Neurological deterioration may result from direct injury, manipulation of neural tissue, postoperative swelling, or other procedure-related factors. Cerebrospinal fluid leakage may occur when the dura mater is opened and does not heal adequately. Structural instability may develop after extensive bone removal or as a consequence of pre-existing vertebral destruction. Tumor recurrence remains an important consideration, particularly when complete resection is not feasible or when the tumor has biological characteristics associated with a higher risk of progression. Risk reduction requires careful preoperative planning, appropriate microsurgical techniques, the use of neurophysiological monitoring when indicated, meticulous operative management, and systematic postoperative observation. Early recognition and management of complications are essential for improving recovery and limiting long-term disability.

Rehabilitation is an essential component of comprehensive care for patients undergoing surgery for spinal cord tumors. Its main objectives are to restore mobility, improve coordination, prevent complications associated with prolonged immobility, and maximize functional independence. The rehabilitation program may include therapeutic exercises, gait training, muscle strengthening, balance exercises, occupational therapy, and interventions aimed at improving everyday activities. Patients with persistent motor or sensory deficits may require individualized rehabilitation programs adapted to their functional limitations. When bladder or bowel dysfunction persists, specialized rehabilitation and supportive management may be necessary. The rehabilitation plan should be coordinated with the neurosurgical team and other



relevant healthcare professionals. The timing and intensity of rehabilitation depend on the patient's postoperative condition, the type and extent of surgery, neurological function, and any restrictions imposed by the treating team. Early mobilization may be beneficial when clinically appropriate, but all activities should be guided by the patient's safety and recovery status. Long-term follow-up includes clinical evaluation of neurological function and periodic MRI examinations. The frequency of follow-up imaging depends on the tumor's histological type, extent of resection, biological behavior, and estimated risk of recurrence.

Surgery is not always the only component of treatment for spinal cord tumors. Depending on the histological diagnosis, extent of resection, and clinical circumstances, additional treatment may be required. Radiotherapy may be used for selected malignant, residual, recurrent, or metastatic tumors. Advanced radiation techniques may be considered when accurate targeting of the lesion is important for limiting exposure of surrounding tissues. Chemotherapy and targeted therapy may be appropriate for specific tumor types, depending on their molecular characteristics and sensitivity to available treatments. The decision to use these therapies should be guided by the histological and molecular diagnosis, established treatment recommendations, and multidisciplinary assessment. Active surveillance may be appropriate for selected small, asymptomatic tumors when immediate surgery is not necessary and the anticipated risks of intervention outweigh its expected benefits. This approach requires an appropriate follow-up plan to identify changes in tumor size, symptoms, or neurological function. The selection of additional treatment should be coordinated by a multidisciplinary team that may include neurosurgeons, oncologists, radiation oncologists, neurologists, radiologists, and rehabilitation specialists. This approach helps ensure that treatment decisions reflect both tumor-related factors and the patient's overall health and functional goals.

Conclusion: The surgical treatment of spinal cord tumors is a complex field of modern neurosurgery that requires accurate diagnosis, individualized treatment planning, and the appropriate use of advanced technologies. The principal objectives of surgery are to relieve compression of neural structures, obtain tissue for histopathological assessment when necessary, achieve the maximum safe extent of tumor removal, and preserve neurological function. The use of microsurgical techniques, neuronavigation, and intraoperative neurophysiological monitoring can improve operative precision and support the protection of critical spinal cord pathways. However, the extent of resection must be determined according to the tumor's biological characteristics, anatomical relationships, and the potential consequences of surgical intervention. Postoperative rehabilitation, regular clinical and radiological follow-up, and additional anticancer treatment when indicated are equally important components of comprehensive patient management. A multidisciplinary approach allows treatment decisions to be adapted to the individual patient's needs and may contribute to improved functional outcomes and quality of life. In conclusion, successful management of spinal cord tumors depends on the integration of modern diagnostic methods, carefully selected surgical techniques, appropriate



postoperative rehabilitation, and long-term monitoring. Early recognition, evidence-based treatment, and coordinated specialist care remain essential for optimizing outcomes in patients with these challenging neurological conditions.

References:

1. World Health Organization. *WHO Classification of Tumours: Central Nervous System Tumours*. 5th ed. Lyon: International Agency for Research on Cancer; 2021.
2. National Institute for Health and Care Excellence (NICE). *Spinal Metastases and Metastatic Spinal Cord Compression*. NICE Guideline NG234; 2023.
3. Greenberg MS. *Handbook of Neurosurgery*. 9th ed. Thieme; 2020.
4. Engelhard HH, et al. Contemporary management of intramedullary spinal cord tumors. Reviews and clinical studies on the surgical management of intramedullary spinal cord neoplasms.
5. World Health Organization. Publications and guidance on the classification of central nervous system tumors and principles of histopathological diagnosis.