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# RETROSPECTIVE ANALYSIS OF PATIENTS WHO UNDERWENT SURGICAL TREATMENT FOR SPINAL TUMOR BETWEEN 1999 AND 2022

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ABSTRACT

**Objective:** To present our results of spinal tumor surgery and to compare them with the current literature.

**Materials and Methods:** We retrospectively evaluated 281 patients with spinal tumors who had been operated in our department between 1999 and 2022; regarding their preoperative, intraoperative and postoperative clinical and histopathological characteristics in detail and compared our results with current literature.

**Results:** Male patients were predominant and the mean age of patients with metastatic spinal tumors was significantly higher than those with primary tumors. 63% of spinal tumors were primary and the remaining 37% were metastatic. Ependymoma, schwannoma, and meningioma were the most common histological types, whereas metastatic spinal tumors mostly arise from lung, prostate and breast cancers. The most common anatomical locations of spinal tumors were the lumbosacral (51.6%) and thoracic (43.8%) regions. Total excision was higher in primary tumors, whereas gross total and subtotal excisions were higher in metastatic tumors. Intraoperative neuromonitoring was used in 40.2% of all surgeries. Improvement rates in postoperative physical examination were higher in metastatic spinal tumors. Most patients in the primary spinal tumor group did not exhibit any motor or sensory deficits during both pre- and postoperative periods.

**Conclusion:** Most spinal tumors is primary and benign in nature. An adequate number of excisions could be achieved with appropriate surgical techniques, and total excision must be aimed in primary spinal tumors.

**Keywords:** Spinal tumor, spinal cord, microsurgery, outcome

## INTRODUCTION

Spinal tumors have high morbidity rates. The morbidity rate decreases when early diagnosis and appropriate treatment methods are applied[1]. As a treatment; surgical approaches, chemotherapy and radiotherapy are performed[2,3]. In parallel with technological advances, diagnostic possibilities have also increased. In addition, with the advancement of technology, the development of microsurgery and the widespread use of electrophysiological examinations intraoperatively have made the surgical procedure more reliable and easier and has increased the success rate in surgical treatment[4]. The anatomical location of spinal tumors, histological type, their changing growth rates and the neurological status of the patient at admission are the most important parameters that determine the prognosis of the disease[5]. Today, thanks to the use of intraoperative neuromonitoring, the development of preoperative and intraoperative radiological imaging techniques, the widespread use of microsurgery and the development of microsurgical techniques, clinical outcomes of spinal tumor surgery are much better than in previous times[3,4,6,7]. In this study, the data of 281 patients who were operated in our clinic with the diagnosis of spinal tumor between 1999-2022 were analyzed. Patients were examined in detail in preoperative (age, gender, complaints in admission, neurological examination, radiological imaging), intraoperative (surgical technique, extent of resection, use of intraoperative neuromonitoring), postoperative (examination, pathology result) periods. We aimed to contribute to the literature by analyzing our results and comparing with previous series.

## MATERIALS AND METHODS

The patients who were admitted to our hospital between 1999 and 2022, who were evaluated by the neurosurgery clinic and who were diagnosed with spinal tumors and operated on as a result of the evaluation, were included in our retrospective study. Between these dates, 389 patients who were operated after physical and radiological examinations were identified. The histopathological diagnosis of 71 of these patients were not reported as spinal tumor. Detailed data of 37 patients could not be reached. So, the study was carried out with 281 patients with spinal tumors.

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**Inclusion Criteria:**

- Patients who were operated for spinal tumor
- Patients who were clinically and radiologically followed up by our department.

**Exclusion Criteria:**

- Patients who had the diagnosis without spinal tumor
- Patients who were lost in follow-up period
- Patients without detailed data.

**Ethical Approval**

The study protocol was approved by the University of Health Sciences Turkey, Gülhane Scientific Researches Ethical Board in conformity with the Declaration of Helsinki (approval number: 2022/123, approval date: 14.09.2022).

**Outcome Measures**

Patients' age (mean age and age groups), gender, presenting symptom (pain, motor deficit, paresthesia, incontinence), tumor location (anatomical location, location according to dura mater), tumor histological type, type of excision, use of intraoperative neuromonitorization (IONM), Type of surgery (emergency, elective), presence of bone metastases, and postoperative status of the patients (no change, improvement, no improvement, or worsening) were included in the analyses. Total resection refers to the absence of residual tumor on initial postoperative magnetic resonance imaging (MRI) studies, gross total resection refers to the removal of at least 95% of the tumor on intraoperative view at the end of operation and the initial postoperative MRI. The subtotal resection was defined as the resection of 80-95% of the tumor. Partial resection was defined as resection of tumor between 20 and 80%. Histological types of tumors were divided into primary and metastatic spinal tumors. Tumor type in primary tumors and primary tumor origin (lung, prostate, breast, etc.) in metastatic tumors were recorded. The location of spinal tumors was classified first anatomically (cervical, thoracic and lumbosacral) and then according to dura mater (intradural intramedullary, intradural extramedullary, extradural, intradural + extradural, bone and soft tissue involvement). First of all, demographic characteristics, location, clinical and intraoperative characteristics of spinal tumors were defined. These features were then compared between primary and metastatic tumors.

**Statistical Analysis**

Statistical analyzes were performed using SPSS version 21.0 (Chicago, USA) package program. The conformity of the variables to the normal distribution was examined using visual (histogram and probability graphs) and analytical methods (Kolmogrov-Smirnov, Shapiro-Wilk test). Descriptive statistics were expressed as mean and standard deviation in normally distributed numerical data, median and minimum-maximum values in non-normally distributed data, and numbers and percentages in nominal data. Normally distributed numerical variables were used between the two groups, the "Independent groups t-test" was used. Numerical variables that were not normally distributed were analyzed using the "Mann-Whitney U test" between the two groups. Chi-square analysis and Fisher exact test were used to compare nominal data. Values below $p<0.05$ were considered statistically significant in the statistical analyzes in the study.

## RESULTS

The mean age was 43.1±13.6 years (2-83 years). 61.6% of the patients were male and 38.4% were female. The male/female ratio was 1.6/1 (Table 1). Six (2.1%) patients were children (younger than 18 years old), and 275 patients were adults. The most common symptoms of patients were pain (neck pain and back pain) (62.3%), motor deficit in legs and arms (34.2%), paresthesia/hypoesthesia (19.6%) and incontinence (anal or urinary) (10%), respectively. The most common location of spinal tumors was lumbosacral region (51.6%). In the cervical region, it was very rare (9.3%). 17.1% of the patients had spinal tumor at multiple levels. 39.5% of spinal tumors were intradural extramedullary, 17.4% intradural intramedullary, 32% extradural, 1.1% intradural + extradural, and 10% bone and soft tissue locations (Table 2). Of the spinal tumors, 63% were primary and 37% were metastatic. The most common primary

**Table 1.** Age and gender distribution of patients

| | Number (%) |
|---|---|
| **Age** | 43.1±13.6 (Mean age) |
| 0-18 years | 6 (2.1) |
| 19-30 years | 23 (8.2) |
| 31-45 years | 156 (55.5) |
| 46-60 years | 60 (21.4) |
| 61+ | 36 (12.8) |
| **Gender** | |
| Female | 108 (38.4) |
| Male | 173 (61.6) |

**Table 2.** Locations of tumors

| | Number (%) |
|---|---|
| **Anatomical location** | |
| Cervical | 26 (9.3) |
| Thoracic | 123 (43.8) |
| Lumbosacral | 145 (51.6) |
| **Location based on dura mater** | |
| Intradural | 163 (58.0) |
| Extramedullary | 111 (39.5) |
| Intramedullary | 49 (17.4) |
| Extradural | 90 (32.0) |
| Intradural + extradural | 3 (1.1) |
| Bone and soft tissue involvements | 28 (10.0) |
| Multi-level involvement | 48 (17.1) |

tumors were ependymoma (13.8%), schwannoma (10.7%) and meningioma (8.2%) (Table 3). In metastatic tumors, lung (7.1%), prostate (4.9%) and breast (4.2%) cancer metastases were most common (Figures 1-3). Extent of resection was total in 32.7%, gross total in 35.6%, subtotal in 20.6%, and partial in 11% of patients. IONM was used in 40.2% of the patients. We not used IONM in patients with metallic clips, cardiac pacemakers, biomechanical metallic implants, cerebral lesions or injuries, skull defects, and history of epilepsy. Most of the surgeries (72.2%) were elective and less (27.8%) were emergency. 24.2% of patients had bone metastases. Motor deficit or incontinence was present in 33.8% (n=95) of the patients before surgery (Figures 4, 5). When the patients with motor deficit or incontinence were examined, no change was observed in the physical examination in 55.7% of these patients after the operation, while improvement was observed in the physical examination in 37.8% of them. Patients with preoperative motor deficit or incontinence but no change in physical examination findings after surgery comprised 18.9% of the operated patients, and patients with improvement in physical examination findings comprised 12.8% of the operated patients. In 6 patients, physical examination findings worsened after surgery. Patients with spinal tumors were divided into 2 groups as primary and metastatic according to the origin of tumor. The mean age of patients with metastatic spinal tumor was significantly higher (p=0.010). However, no significant difference was observed in terms of gender (p=0.805) (Table 4). Patients with primary and metastatic tumors were compared according to their presenting symptoms. While motor deficit (p<0.001) and incontinence (p<0.001) were significantly higher in metastatic tumors; paresthesia was more common in primary tumors and it is statistically significant (p<0.001). However, there was no significant difference between primary and metastatic tumors in terms of pain at presentation (p=0.112). Primary and metastatic tumors were also compared according to their locations. While lumbosacral (p=0.009), intradural (p<0.001), extramedullary (p<0.001), intramedullary (p<0.001) locations are significantly more common in primary tumors, thoracic (p=0.004), extradural (p<0.001) locations in metastatic tumors squeezed harder. In addition, bone and soft tissue involvement was significantly higher in metastatic spinal tumors (p=0.020). While 7.9% of primary spinal tumors were presented in multiple levels, 32.7% of metastatic tumors were at multiple levels. Multi-level involvement was significantly higher in metastatic spinal tumors (p<0.001). Primary and metastatic tumors were compared in terms of intraoperative characteristics. While the frequency of total excision (p<0.001) was significantly higher in primary tumors, the frequency of gross total (p=0.020) and subtotal (p<0.001) excision was higher in metastatic tumors. The frequency of the use of IONM (p<0.001) was significantly higher in metastatic tumors. In addition, the frequency of emergency surgery (p<0.001) and bone metastasis (p<0.001) was significatly higher in metastatic tumors (Table 5). Primary and metastatic

**Table 3.** Distribution of spinal tumors based on histo-pathological diagnosis

| | Number (%) |
|---|---|
| **Primary** | 177 (63.0) |
| Ependymoma | 39 (13.8) |
| Schwannoma | 30 (10.7) |
| Meningioma | 23 (8.2) |
| Astrocytoma | 12 (4.2) |
| Lipoma | 8 (2.8) |
| Osteosarcoma | 6 (2.1) |
| Arteriovenous malformation | 5 (1.8) |
| Ewing Sarcoma | 5 (1.8) |
| Neurofibroma | 5 (1.8) |
| Osteoblastoma | 5 (1.8) |
| Plasmocytoma | 5 (1.8) |
| Multiple myeloma | 4 (1.4) |
| PNET | 4 (1.4) |
| Teratoma | 4 (1.4) |
| Arachnoid cyst | 3 (1) |
| Aneurysmal bone cyst | 3 (1) |
| Dermoid Tumor | 3 (1) |
| Endodermal cyst | 2 (0.7) |
| Epidermoid tumor | 2 (0.7) |
| Intraosseous hemangioma | 2 (0.7) |
| Osteochondroma | 2 (0.7) |
| Ganglioneuroma | 1 (0.4) |
| Hemangioblastoma | 1 (0.4) |
| Leiomyosarcoma | 1 (0.4) |
| Myeloid sarcoma | 1 (0.4) |
| Paraganglioma | 1 (0.4) |
| **Metastatic tumors** | 104 (37.0) |
| Lung CA | 20 (7.1) |
| Prostate CA | 14 (4.9) |
| Breast CA | 12 (4.2) |
| Lymphoma | 10 (3.5) |
| RCC | 8 (2.8) |
| Colon Ca | 6 (2.1) |
| HCC | 4 (1.4) |
| Rectum CA | 4 (1.4) |
| Thyroid CA | 4 (1.4) |
| Gastric adenocarcinoma | 3 (1) |
| Malignant melanoma | 2 (0.7) |
| Malignant epithelial tumor | 1 (0.4) |
| Ovarian CA | 1 (0.4) |
| Unknown origin | 15 (5.3) |

HCC: Hepatocellular carcinomas, PNET: Primitive neuroectodermal tumor tumors were compared in terms of postoperative neurological examination. In metastatic tumors, the proportion of patients with improvement (p<0.001) and no change (p<0.001) in physical examination findings was higher, whereas in primary spinal tumors, most patients did not change before and after surgery (p<0.001) (Table 6).

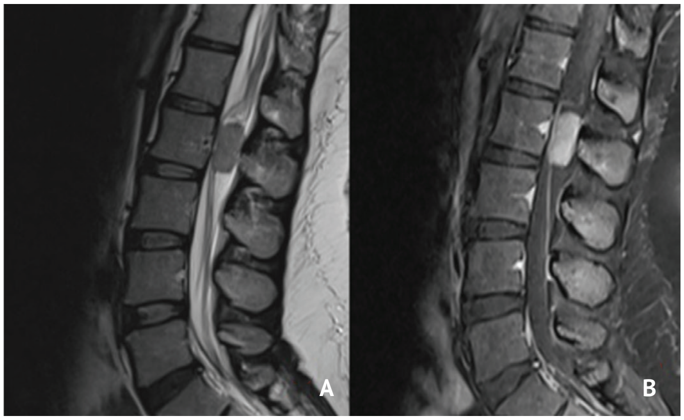


**Figure 1.** Intradurally located ependymoma at L2 level, MRI sections **A)** T2-weighted MRI, sagittal section, **B)** T1-weighted MRI, sagittal section after IV contrast injection
MRI: Magnetic resonance imaging, IV: Intravenous

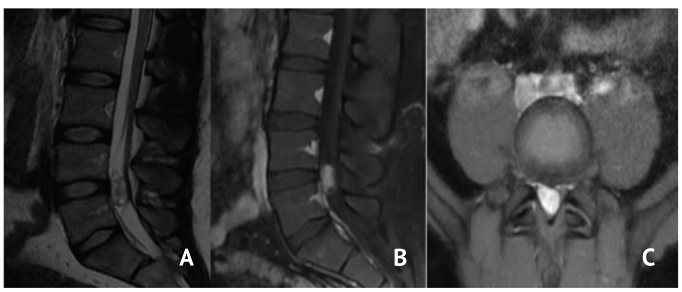


**Figure 2.** Intradural schwannoma at L4-L5 level, MRI sections **A)** T2-weighted MRI, sagittal section, **B)** T1-weighted MRI, sagittal section after IV contrast injection, **C)** T1-weighted MRI, axial section after IV contrast injection
MRI: Magnetic resonance imaging, IV: Intravenous

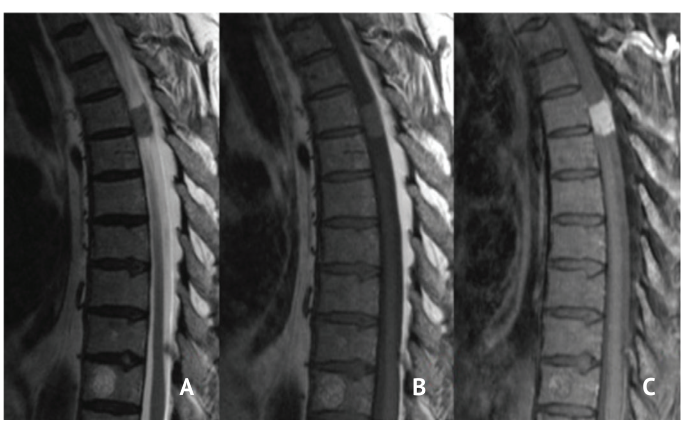


**Figure 3.** Intradural extramedullary meningioma at T4 level, MRI sections **A)** T2-weighted MRI, sagittal section, **B)** T1-weighted MRI, sagittal section, **C)** T1-weighted MRI, sagittal section after IV contrast injection
MRI: Magnetic resonance imaging, IV: Intravenous

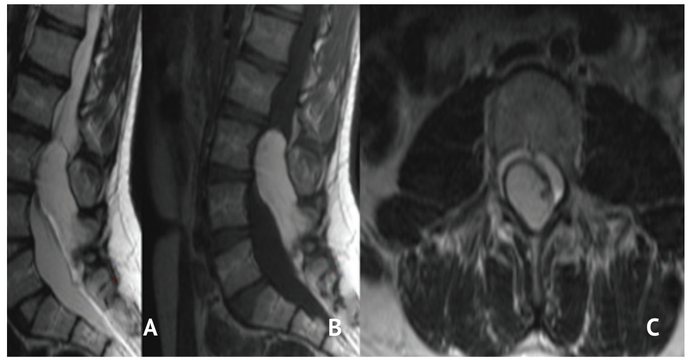


**Figure 4.** Lipoma at intradural location between L3-L5, MRI sections **A)** T2-weighted MRI, sagittal section, **B)** T1-weighted MRI, sagittal section, after IV contrast injection, **C)** T2-weighted MRI, axial section
MRI: Magnetic resonance imaging, IV: Intravenous

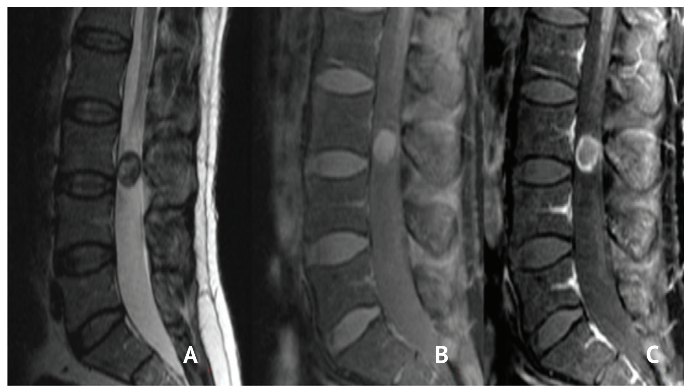


**Figure 5.** Intradural paraganglioma at L3-L4 level, MRI sections **A)** T2-weighted MRI, sagittal section, **B)** T1-weighted MRI, sagittal section, **C)** T1-weighted MRI, sagittal section after IV contrast injection
MRI: Magnetic resonance imaging, IV: Intravenous

**Table 4.** Comparison of primary and metastatic spinal tumors based on the age and gender of the patients

| Demographic feature | Primary tumor (n=177) | Metastatic tumor (n=104) | p value |
|---|---|---|---|
| **Age*** | 41.5±13.4 | 45.8±13.7 | 0.010† |
| 0-18 years | 6 (2.1) | 0 | |
| 19-30 years | 15 (9.8) | 8 (7.7) | |
| 31-45 years | 109 (61.6) | 47 (45.2) | |
| 46-60 years | 28 (15.8) | 32 (30.8) | |
| 61+ | 19 (10.7) | 17 (16.3) | |
| **Gender** | | | 0.805†† |
| Female | 69 (39.0) | 39 (37.5) | |
| Male | 108 (61.0) | 65 (62.5) | |

*Mean ± SD
†Independent Samples t-test, ††Chi-square test, SD: Standard deviation

**Table 5.** Comparison of primary and metastatic spinal tumors based on excision type, use of IONM, and bone mestatasis

| | Primary tumor (n=177) (%) | Metastatic tumor (n=104) (%) | p value |
|---|---|---|---|
| **Excision type** | | | |
| Total excision | 85 (48.0) | 7 (6.7) | **<0.001** |
| Gross total excision | 54 (30.5) | 46 (44.2) | **0.020** |
| Subtotal excision | 23 (13.0) | 35 (33.7) | **<0.001** |
| Partial excision | 15 (8.5) | 16 (15.4) | 0.074 |
| **IONM** | | | **<0.001** |
| Yes | 98 (55.4) | 5 (14.4) | |
| No | 79 (44.6) | 89 (85.6) | |
| **Type of surgery** | | | **<0.001** |
| Emergent | 3 (1.7) | 75 (72.1) | |
| Elective | 174 (98.3) | 29 (27.9) | |
| **Bone metastasis** | | | **<0.001** |
| Yes | 15 (8.5) | 53 (51.0) | |
| No | 162 (91.5) | 51 (49.0) | |

IONM: Intraoperative neuromonitorization

**Table 6.** Comparison of primary and metastatic spinal tumors based on clinical outcome

| Postoperative outcome | Primary tumor (n=177) | Metastatic tumor (n=104) | p value |
|---|---|---|---|
| Unchanged | 168 (94.9) | 71 (68.3) | **<0.001**†† |
| Improvement | 6 (3.4) | 30 (28.8) | **<0.001**†† |
| Worsening | 3 (1.7) | 3 (2.9) | 0.673ⱡ |

†Chi-square test, ⱡFisher exact test

## DISCUSSION

After the use of laminectomy in spinal tumor resections in 1887, great developments were achieved in the diagnosis and treatment of spinal tumors[2,8]. Spinal tumors can be primary tumors originating from spinal cord, meninges or bone cells, as well as metastatic lesions that can invade the spinal cord and surrounding tissues. Most primary tumors are histopathologically similar to primary intracranial tumors, however, they are much rarer[7,9]. Since clinical symptoms are not specific, a significant portion of patients can be diagnosed as degenerative spinal disease, cervical spondylopathy or intervertebral disc herniation. Today, spinal tumors can be easily recognized by MRI. However, since specific intraspinal tumors are associated with mortality, physicians should be aware of the characteristics associated with spinal tumors[10]. Therefore, our study aimed to describe the demographic, clinical and intraoperative characteristics of a large case series operated for spinal tumors. In our study, the mean age of the patients was 43.1 years (between the 4$^{th}$ and 5$^{th}$ decades) (Table 1). In addition, there was a male predominance among the patients. Temiz et al.[11] reported that spinal tumors affect men more and the male/female ratio is 2/1. In this study, it was stated that the frequent follow-up of metastatic tumors in males increased male dominance in spinal tumors. In our study, however, no such gender difference was observed between primary and metastatic tumors. The prevalence of male sex in some types of primary spinal tumors has been previously reported. It is known that especially schwannoma and ependymomas are more common in males. Therefore, male dominance may have been observed in our study. Asiltürk et al.[12] analyzed 96 patients who were operated for spinal tumors, and the mean age was reported as 49.3±22.7 years. In this study, the male/female ratio was reported as 1.1. Materljan et al.[13], on the other hand, stated that the mean age was 49 years in their series in Croatia. In the study of Dang et al.[14], it was reported that 70% of spinal tumors were observed between the ages of 18-59. In our study, 85.1% of spinal tumors were between the ages of 19-60 years. It was very rare between 0-18 years (2.1%). Studies on the demographic characteristics of spinal tumors often consist of case series. However, more accurate definitions can be made in population-based studies. In the population-based study of Schellinger et al.[15], 3,226 spinal tumors were reached, and the age of occurrence of these tumors was 51 years. However, in the study, it was reported that 55% of the cases were women, which was attributed to the fact that the most common primary tumors were meningiomas and that meningiomas were observed more frequently in women. In our study, however, the most common primary tumors were not meningiomas, on the contrary, ependymoma and nerve sheath tumors, which were reported to be more common in males, were more common. The fact that spinal tumors are asymptomatic and do not cause specific symptoms may delay the diagnosis. Instead of spinal tumor diagnosis, diagnoses that cause similar complaints such as spondylopathy or discopathy can be considered. In our study, the main symptoms in spinal tumor patients were pain (62.3%), motor deficit (34.2%), paresthesia (19.6%), and incontinence (10%). In the study of Asiltürk et al.[12], it was stated that the most common complaint at presentation was pain or radicular pain. Similarly, Dang et al.[14] reported that pain (77.6%) and neurological symptoms (45.2%) were frequently observed, but only primary spinal tumors were included in this study. In the study of Kelley et al.[16], the most common symptoms were pain (79.4%) and neurological symptoms (31.1%). In this study, primary spinal bone tumors were evaluated. It is known that primary spinal cord tumors are frequently located intradurally. In a review by Grimm and Chamberlain[17], it was stated that 60% of primary spinal tumors were intradural extramedullary (30% meningioma, 30% peripheral nerve sheath tumor), and 40% were intradural intramedullary (60% ependymoma, 40% glioma). In our study, similar to these data, it was observed that 61.6% of primary spinal tumors were extramedullary and 26.6% were intramedullary. Primary spinal tumors were very rarely located extradurally (5.1%). Among the primary tumors, it is well known that schwannomas and meningiomas from nerve sheath tumors are observed more frequently in the intradural extramedullary localization, while ependymomas are more frequently observed in the intradural intramedullary region. Although spinal cord tumors are not common, the development of neurological complications during surgery is a major concern. IONM is a frequently used method to avoid iatrogenic injuries during surgery. For this purpose, electromyographic methods such as somatosensory evoked potentials, transcranial motor evoked potentials and dorsal column mapping are preferred(7). With the use of IONM in spinal cord tumors, spinal cord injuries can be prevented in most of the cases. For this reason, IONM was preferred in approximately 40% of the patients in our study. It was especially preferred in intramedullary tumors. But the presence of metallic implants and clips in the patient's body and previous cerebral lesions or skull defects are relative contraindications for IONM. In addition, it is sometimes difficult to set-up IONM, especially in emergent cases. While total excision (35.6%) and gross total excision (35.6%) were performed in most of our patients, subtotal excision (20.6%) or partial resection (11%) was performed in a small number of patients. Total excision rates were decreasing, especially in metastatic spinal tumors. Among the primary tumors, ependymoma (13.8%), schwannoma (10.7%) and meningioma (8.2%) were the most frequently observed tumors. Although these three tumor types were reported to be common in most studies, their frequencies varied between studies. Temiz et al.[11] reported that the most common tumors among primary spinal tumors were ependymoma (21.9%), schwannoma (16.4%) and meningioma (13.6%), similar to our findings. Schellinger et al.[15] reported that meningioma (29%), nerve sheath tumors (24%) and ependymomas (23%) were frequently observed among primary tumors. In the retrospective case series reported by Gelabert-González[18], it was stated that the most common primary intramedullary tumors were ependymoma (15.4%), while the most common extradural tumors were meningioma (33.9%) and schwannoma (31.5%). In the study of Asiltürk et al.[12], the most common primary spinal tumors were reported to be meningioma (16.2%), schwannoma (15.7%), and ependymoma (9.4%). Primary origins of metastatic tumors are frequently lung, breast, kidney, prostate and bowel. However, different rates have been reported in the literature. In the study of Zairi et al.[19], it was stated that the most common primary sites in 317 patients with metastatic spinal tumor were breast (25.2%), multiple myeloma (18.9%), and lung (16.4%), respectively. In a population-based study conducted by Sohn et al.[20] in Korea, metastatic spinal tumors between 2009 and 2012 were evaluated, and the most common tumor origins were lung (28.1%), liver/biliary (12.9%), breast (10.2%), colon (9.1%), stomach (8.9%) and prostate (5.8%). In the study of Hikata et al.[21], the most common locations were lung, breast and thyroid. In the study of Temiz et al.[11], it was stated that the most common metastases originate from the lung and prostate. In the study of Wang et al.[22], the most common origin site was the lung (36.4%). The type of resection was closely related to the spinal tumor type in our study. While the total or gross total resection rate in primary spinal tumors approached 80%, this rate remained around 50% in metastatic lesions. Although not evaluated in our study, failure of total resection may be associated with poor prognosis[23]. It was observed that metastatic tumors often did not improve after surgery compared to primary tumors. Total surgical resection of spinal tumors in children can be achieved by laminotomy with low incidence of future spinal deformity[24]. Laminectomy is mostly preferred technique in adult patients. On the other hand, in patients with metastatic tumors, the rate of patients whose neurological loss improved after surgery was also high. The possible reason for this may be that primary tumors do not often cause neurological loss[25]. In our study, it was observed that patients who had no neurological loss before surgery in primary tumors were discharged in the same way after surgery.

### Study Limitations

Our study had some limitations. As it was retrospective, it included all the limitations of this design. Our study included cases between 1999-2022. Therefore, the number of spinal cord cases was high (n=281). However, it can be said that diagnosis and imaging methods were less developed in the early period compared to today. This may have affected the primary and metastatic tumor distributions. However, similar distributions have been expressed for tumor types in more recent case series. Finally, our study did not evaluate the survival data, length of hospital stay, intraoperative characteristics, or health expenditures of primary and metastatic tumors. Spinal tumor epidemiology can be further elucidated with prospective studies evaluating these variables.

## CONCLUSION

Spinal tumors are frequently observed in 4th and 5th decades and in male patients. It frequently causes pain and neurological symptoms. Most of the operated spinal tumors consisted of primary tumors. While the most common primary tumors were ependymoma, schwannoma and meningioma, the most common primary sites in metastatic tumors were lung, prostate and breast cancer. Metastatic tumors are frequently seen in older patients and cause more severe symptoms. They are observed more frequently in the thoracic region compared to primary tumors. While primary tumors were mostly seen in intradural intramedullary and intradural extramedullary locations, the majority of metastatic tumors were located extradurally. Compared to primary tumors, metastatic tumors showed multi-level involvement, required emergency surgery, and had low total excision rates.

### Ethics

**Ethics Committee Approval:** The study protocol was approved by the University of Health Sciences Turkey, Gülhane Scientific

Researches Ethical Board in conformity with the Declaration of Helsinki (approval number: 2022/123, approval date: 14.09.2022).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: A.K., M.C.E., N.Ç.T., Concept: A.K., N.Ç.T., Design: A.K., M.C.E., N.Ç.T., Data Collection or Processing: A.K., M.C.E., Analysis or Interpretation: A.K., M.C.E., N.Ç.T., Literature Search: A.K., N.Ç.T., Writing: A.K., M.C.E., N.Ç.T.

**Conflict of Interest:** The authors have no conflicts of interest to declare.

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