Management of Thoracic and Lumbar Schwannomas Using a Unilateral Approach without Instability: An Analysis of 15 Cases

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Study Design: Retrospective case series.

Purpose: The objectives of this study were to determine and discuss the surgical planning of patients who underwent operations following diagnoses of thoracic and lumbar spinal schwannomas. We also aimed to discuss the application of unilateral hemilaminectomy for the microsurgery of schwannomas.

Overview of Literature: Schwannomas are located in different regions and sites. These differences require several surgical approaches. Unilateral laminectomy without stabilization of the spine provides a more minimally invasive removal of the tumor.

Methods: In this retrospective study, 15 patients with spinal schwannomas were evaluated with regards to age, sex, onset history, neurological findings, tumor locations, McCormick scale, surgical procedure, and operational results. The lateral approach provides exposure of intradural structures and posterior paraspinal regions. Extensions of tumors cause problem for the surgeon in terms of approach, resectability of the tumor, and stability of the spine. Gross total resection was achieved in all cases, and none of the patients necessary required a fusion procedure.

Results: Five patients were males and 10 were females. The age interval was 29-65 years. The tumor was located in the lumbar region in 9 patients, in the thoracic region in 2 patients, and in the thoracolumbar junction in 4 patients. The intradural lesions were removed by laminectomy and the extradural lesions were resected with hemilaminectomy. The paramedian route was used to explore the extraspinal part of the tumor. Costotransversectomy was for the thoracic region. Subtotal resection was performed in 1 patient. Patient symptoms recovered gradually in the postoperative period.

Conclusions: Resection of giant schwannomas is challenging and usually requires a different approach. We describe the complete resection of complex dumbbell or paraspinal schwannomas of the thoracic and lumbar spine by unilateral hemilaminectomy.

Key Words: Thoracolumbar Schwannoma, Unilateral approach, Instability, Management

Introduction

A total of 40% of spinal tumors are located in the intradural extramedullary region, 55% in the extradural, and 5% in the intradural intramedullary regions. Spinal schwannoma constitutes approximately 25% of the intradural tumours [1,2] and these arise from Schwann cells. Most of them are benign and show high histological cellularity, whereas multiple forms are generally seen in neurofibromatosis [3,4]. They most frequently arise and grow in the posterior and...
posterolateral sites of the spinal cord on the thoracic region, and are located in the intradural extramedullary region in 50% of all cases [5-7]. Spinal schwannoma present as dumbbell shaped in 10-15% of the cases. They are less frequently located in the intramedullary region. The tumors that were totally removed do not show recurrence and the prognosis is good. Also, radiotherapy is often not indicated [8-11]. Fifteen patients with thoracal and lumbar schwannomas were reported. Unilateral hemilaminectomy was used for tumor resection in patients with complex dumbbell or paraspinal schwannomas of the thoracic and lumbar spine.

**Materials and Methods**

We documented the data and surgical treatment of 15 patients who were diagnosed with spinal schwannoma, operated, and followed up in our clinic between 2000 and 2010. The age, sex, onset complaints, radiological diagnosis, neurological examination, McCormick Scale [12], surgical techniques, and test results of the patients were evaluated (Table 1). Modified Sridhar classification was used for the location of the tumors (Table 2) [13]. We performed different surgical interventions on our patients according to the tumor location. Intradural extramedullary tumors were

![Fig. 1. (A) Axial T1-weighted magnetic resonance imaging (MRI) scan of the patient shows dumbbell tumors which compress the spinal cord. (B) Sagittal T2-weighted MRI scan of the patient shows a dumbbell tumor at the T12-L1 level. Postoperative (C) lateral radiographs of the dorsolumbar spine showing widening of the intervertebral foramina. (D) The ipsilateral neural foraminal widening is observed in computed tomography (CT) (arrow). (E) Three-dimensional CT scan showing enlargement of a vertebral neural foramen (F) T2-weighted sagittal MRI showing widening of the neural foramina.](image-url)
dissected from the root under microsurgery and totally removed after the laminectomy and midline dural opening, while the dura was primarily closed. The surgical interventions differentiated for the dumbbell-shaped tumors. Tumors were dissected from the root under microsurgery and totally removed after the laminectomy and midline dural opening (T incision if required). The dura defect formed was closed by duraplasty following the removal of the extradural part of the mass. Compatible with this, the related rib was partially excised in the thoracic or thoracolumbar region, while the facet joint was preserved. In that phase, the paravertebral muscles were not lacerated, and may have been hanging to the medial side from the lateral. Having the extraspinal side of the tumor dissected from the soft tissue, the pleura and the bone, and the facet joint without being damaged, was totally excised together with its capsule from the medial to lateral side. It would also be possible to have it excised together with its capsule. As the facet joint is preserved, stabilization was not required (Fig. 1).

In the cases of tumor with extraspinal location, the tumor was located at the foramen and just lateral to the foramen. No compression was available on the dura in the spinal canal and the origin root was explored by hemilaminectomy. This root was incised from its proximal (durable point) by being connected and the tumor capsule was dissected. In that case, the root in the nerve sheath tumor (schwannoma) would always have to be incised (Fig. 2). We initially followed the nerve sheath, explored the tumor together with its capsule, and totally excised the tumor from its rootlets. Later on, we primarily sutured the nerve sheath, but if the tumor is diffusely infiltrated in to the nerve rootlets, this root must totally be excised. Although the root was dissected, no loss of function occurred after surgery. In addition, neurophysiologic monitoring may be used for these levels. The patients were followed up with serial magnetic resonance imaging (MRI) scans.

Results

Out of all the patients 66% were females and 34% were males. The age interval was 29-65 years. The tumor was located in the lumbar region in 9 patients, the thoracic region in 2 patients, and the thoracolumbar junction in 4 patients. The most frequent complaints included back pain, radiculopathy, myelopathy, motor weakness, and voiding difficulty. The final diagnosis was established by clinical, radiological, and histopathological examination. Direct radiography, computerized tomography (CT), and MRI were used as imaging methods. The onset of the symptoms changed from 1 month to 48 months. The motor functions were evaluated according to the modified McCormick scale: 46% were grade II, 6% were grade I, and 46% were grade III. In neurological examination, motor deficit was detected in 60% of the patients. Follow-ups from 2 to 48 months showed that the symptoms and signs had significantly improved, and no complication of surgery or spinal abnormality occurred in any of the patients.

Discussion

Schwannomas are benign tumors that grow slowly and have low invasion and metastasis potential. Spinal schwannoma constitutes approximately 25% of the intradural spinal tumors [1-12]. Most of them are benign and

![Fig. 2. (A) Axial T2-weighted magnetic resonance imaging (MRI) scan of the patient shows lumbar extraforaminal mass lesion. (B) Sagittal T2-weighted MRI scan of the patient shows the mass lesion, which enlarges the spinal foramina. The arrow shows the tumor. (C) Intraoperative view of the same tumor.](image-url)
present high histological cellularity, and are shaped like solid masses forming up of Antoni A and Antoni B type cells [2-8]. Multiple forms are generally seen in the case of neurofibromatosis [3,4]. These tumors grow slowly, but malignant transformation can occur, and have been seen in the 4th and 5th decades [5]. Although Conti et al. [7] reported
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that it was more frequently seen in males, McCormick et al. [12] reported that this rate was equal in both sexes. The age of our patients changed between the 3rd and 6th decades, and female prevalence was obvious. The tumor was most frequently located at the thoracic, cervical, and lumbar regions, respectively [5]. McCormick et al. [12] reported that this location order covered all tumors of the intradural extradural regions. Our patients were presented with lumbar and thoracic involvement. The most frequent location in our series was the lumbar region. The first symptoms included low back pain and radicular pain. It was reported that the pain increases at night and in the late period of the tumor, spinal cord findings occur as well [1-5]. Other signs of spinal schwannoma included motor weakness, sphincter problems, and sensorial disorders. The final diagnosis should be established by clinical findings and imaging methods and MRI is the best method for diagnosis and differential diagnosis [1-7]. The size and specific margins of the mass demonstrate the localization and invasion to the contiguous structures. The changes such as foramen enlargement and erosion in the pedicles detected in the direct graphs may be seen as masses with sharp margins and involve the peripheral contrast in the CT scans [14,15]. Schwannomas are frequently located in the extradural region, and may present as dumbbell shaped in 10-15% of cases. They may also be located at the intradural region. Ten percent of the tumors were in the extradural location, and 1% in the intradural intramedullary regional location [5-12,14-17]. Our patients most frequently presented with intradural extramedullary location. The mean complaint period may be 4-6 weeks to 2 years and more [7-12,14,18], and changed from 1 month to 2 years in our patients. We can speculate that early diagnosis was established in many patients. When the long-term results were investigated in the literature, the healing and mortalities of the schwannomas that were located in the lumbosacral region were better [6-10].

Clinical patterns of the patients were generally stable and the transformation rates were relatively low. Considering the locations of the schwannomas in our patients, we observed that the early period and late period surgical results were better when compared with the results of the preoperative examinations. The early diagnosis and appropriate surgical intervention resulted in good clinical outcome [2-10]. None of our patients presented with clinical deterioration and none of them died. Generally, approach to intradural spinal pathology was via total laminectomy. Total laminectomy may cause spinal instability and kyphosis due to damage to the musculoligamentous structures and posterior bony elements. Fusion may be required to correct postlaminectomy deformity and stabilize the spine. Although laminoplasty decreased spinal instability and deformity, it did not stop it. After the use of an operation microscope, intradural neoplasms can be safely and effectively treated with hemi-laminectomy techniques. The classical posterior approach may be adopted in the surgery and the modified posterior approaches may, in particular, be used in the large invasive or dumbbell-shaped tumors [11,12,14-19]. In the classical posterior approach, the tumor is reached by dural incision

| Original types          | Description                                                                 |
|------------------------|-----------------------------------------------------------------------------|
| Type I                 | Intraspinal tumor < 2 vertebral segments in length; a: intradural; b: extradural |
| Type II                | Intraspinal tumor > 2 vertebral segments in length (giant tumor)             |
| Type III               | Intraspinal tumor with extension into nerve root foramen                       |
| Type IV                | Intraspinal tumor with extradural extension (dumbbell tumors); a: extradural component < 2.5 cm; b: extradural component > 2.5 cm (giant tumor) |
| Type V                 | Tumor with erosion into vertebral bodies (giant invasive tumor), lat and posterior extensions into myofascial planes |

| Additional types for spinal intraosseous schwannoma |
|-----------------------------------------------------|
| Type VI                                             | Tumor in entirely intravertebral location without intraspinal portion |
| Type VII                                            | Intraspinal tumor with erosion into vertebral bodies (invasive tumor) and extension into nerve root foramen |

Table 2. Modified Sridhar classification of benign nerve sheath tumors (From Park SC et al. J Korean Neurosurg Soc 2009;46:403-8, with permission from the Korean Neurosurgical Society) [22]
through the median incision by multilevel laminectomy [7-12,14-20]. This may sometimes lead to instability due to muscle ligament dissection.

Regarding the location and size of the tumor, the major objectives of surgery are to perform decompression without instability and remove the tumor by not damaging the neural tissue [21,22]. Some surgeons excise the tumor by lateral hemilaminectomy for this reason. It is only possible to perform total resection with additional costotransversectomy in case of the dumbbell-shaped schwannomas demonstrating paraspinal extension [11,12,14-18,20]. The surgical approach and the numbers of bone window to be opened are associated with the tumor location and the size of the extradural component [7-11,13]. Despite being benign tumors, spinal schwannomas may show recurrence after subtotal removal. Park et al. [13] supported a new classification system for spinal schwannomas to solve this problem and suggested 2 types of giant spinal schwannomas, dumbbell-type intraspinal tumors with extraspinal extension > 2.5 cm, and invasive tumors with erosion of the vertebral bodies and lateral and posterior extensions into myofascial planes. Park et al. [13] examined the spinal schwannomas under 5 types (Table 2). Most of our patients were in the type 3 and type 4.

Schwannomas are located in different regions and sites. These differences require several surgical approaches. Spinal instrumentation is rarely needed for these tumors because the disc capsule and ligaments remain intact even if the pedicle and posterior elements are compromised.

**Conclusions**

We presented a group of 15 patients with spinal schwannoma. These are the most frequent tumors in the spinal cord. Early prognosis is established before the onset of severe neurological symptoms, and total resection positively affects the results. The tumor location is one of the most substantial parameters that affect the clinical outcome. It is possible to perform total resection considering the tumor location by not causing instability. Unilateral laminectomy without stabilization of the spine provides a more minimally invasive removal of the tumor, reducing blood loss and shortening the duration of hospital stay, and is a good alternative surgical approach.

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