

## Case Report

# Therapeutic effect of microsurgery through hemilaminectomy approach on extramedullary spinal tumor

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Received September 20, 2015; Accepted December 4, 2015; Epub February 15, 2016; Published February 29, 2016

**Abstract:** Objective: To observe the therapeutic effect of microsurgery through hemilaminectomy approach on extramedullary spinal tumor. Methods: Hemilaminectomy was performed on 45 patients with extramedullary spinal tumor. Of the 45 patients, 35 had intradural extramedullary spinal tumors and 10 dumbbell-shaped spinal tumors. Spinal schwannoma occurred in 36 patients and spinal meningioma in 9 patients. Of the 45 patients, 32 had cervical spinal tumors, 6 thoracic spinal tumors and 7 lumbar spinal tumors. Results: In the 45 patients, tumors were completely removed. During 6 to 48-month follow-up, signs and symptoms were markedly improved; and no new nerve damage, complications, spine malformation and tumor recurrence occurred in all patients. Conclusion: Hemilaminectomy is a good method for treatment of lateral or latero-dorsal intradural extramedullary spinal tumors, and dumbbell-shaped spinal tumors because it has some advantages, such as slight operation wound, few complications and good spinal stabilization.

**Keywords:** Hemilaminectomy, intradural extramedullary spinal tumor, dumbbell-shaped spinal tumor, microsurgery

### Introduction

In the past, total laminectomy was usually used for surgery of intradural extramedullary spinal tumor, namely that tumor-related spinous processes and vertebral plates were all removed to expose tumors. Total laminectomy requires removal of all the posterior part of spinal canal, so operation wound is severe. This easily leads to postoperative spinal instability. From March 2006 to August 2014, we used hemilaminectomy to treat extramedullary spinal tumor in 45 patients and achieved good therapeutic effects.

### Materials and methods

All study methods were approved by Institutional Review Board and Ethics Committee of the Third Affiliated Hospital, Sun Yat-sen University. All the subjects enrolled into the study gave written formal consent to participate.

### Subjects

There were 45 patients with extramedullary spinal tumor in this study. Of the 45 patients, 35 had intradural extramedullary spinal tumors and 10 dumbbell-shaped spinal tumors. The transverse diameters of intraspinal tumors were 0.8-1.9 cm, and the transverse diameters of extraspinal tumors were 1.0-6.9 cm. Spinal schwannoma occurred in 36 patients including 10 patients with dumbbell-shaped spinal tumor, and spinal meningioma in 9 patients. Of the 45 patients, 32 had cervical spinal tumors, 6 thoracic spinal tumors and 7 lumbar spinal tumors. Of the 45 patients, 26 were men and 19 women, with a mean age of 41 years (range 18-65). Physical examination: 21 patients had dyskinesia in unilateral limb, 4 patients in both lower limbs, 3 patients in four limbs; 32 patients had lesion-segmental nerve root pain and 29 patients had sensation disorders in torso and limbs. From March 2006 to August 2014, we

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used hemilaminectomy to treat lateral or latero-dorsal extramedullary spinal tumors; but for ventral or medi-dorsal tumors, or tumors with malignant tendency suggested by radiographic features, we adopted total laminectomy.

### *Radiographic data*

All patients in this study were diagnosed with extramedullary spinal tumor by MRI. These tumors were located in the lateral or latero-dorsal side of spine. Ten patients had dumbbell-shaped spinal tumor.

### *Surgical procedures*

After endotracheal intubation and general anesthesia, patients were in prone position. The localization of pathological vertebral bodies was performed with X-ray. A longitudinal incision on the dorsal side of vertebral column was made. The paraspinal muscles were separated, and then pulled not over the lateral border of articular processes in order to avoid injury of vertebral artery. The number of removed vertebral plates was determined according to the size of tumor, but is generally not more than 3 vertebral plates. Spinous process, interspinous ligament and articular process were retained. In some patients, partial articular process was resected, but the removed part was not more than 50% of the articular process. Ligamentum flavum was cut out from the inner side to the basilar part of spinous process to expose spinal dura mater. In order to improve the exposure of dura sac, partial bone in the basilar part of spinous process was removed by abrading as necessary. The operating bed might be sloped to thoroughly expose the contralateral side of the spinal canal. Under a microscope, the spinal dura mater was opened, and then the arachnoid on the surfaces of tumor and spinal cord was treated to separate the tumor from the spinal cord. Electric coagulation was performed on tumorous capsule to decrease tumor size by reducing blood supply. After the tumorous capsule was cut open, the tumor was divided into several blocks, and then was removed one after another. After adherent spinal cord and nerve roots were carefully separated, electric coagulation was performed on tumorous feeding artery to thoroughly stop bleeding. For dumbbell-shaped spinal tumors, the part of intraspinal tumor was first removed by hemilaminectomy approach, and then the

parts of tumor in intervertebral foramen and outside spinal canal were excised. Whenever the tumor size outside spinal canal was larger, it was removed by hemilaminectomy approach combined with lateral approach. Thorough electrocautery was performed on the spinal dura mater attached by the tumor, or the inner layer of the spinal dura mater was excised to prevent tumor recurrence. The spinal dura mater was stitched closely to prevent cerebrospinal leak. The hole of hemilaminectomy was covered with gelatin sponge, and then muscles and skin were sewed. All patients were monitored by somatosensory evoked potential and EMG during operation. A typical case is shown in **Figure 1**.

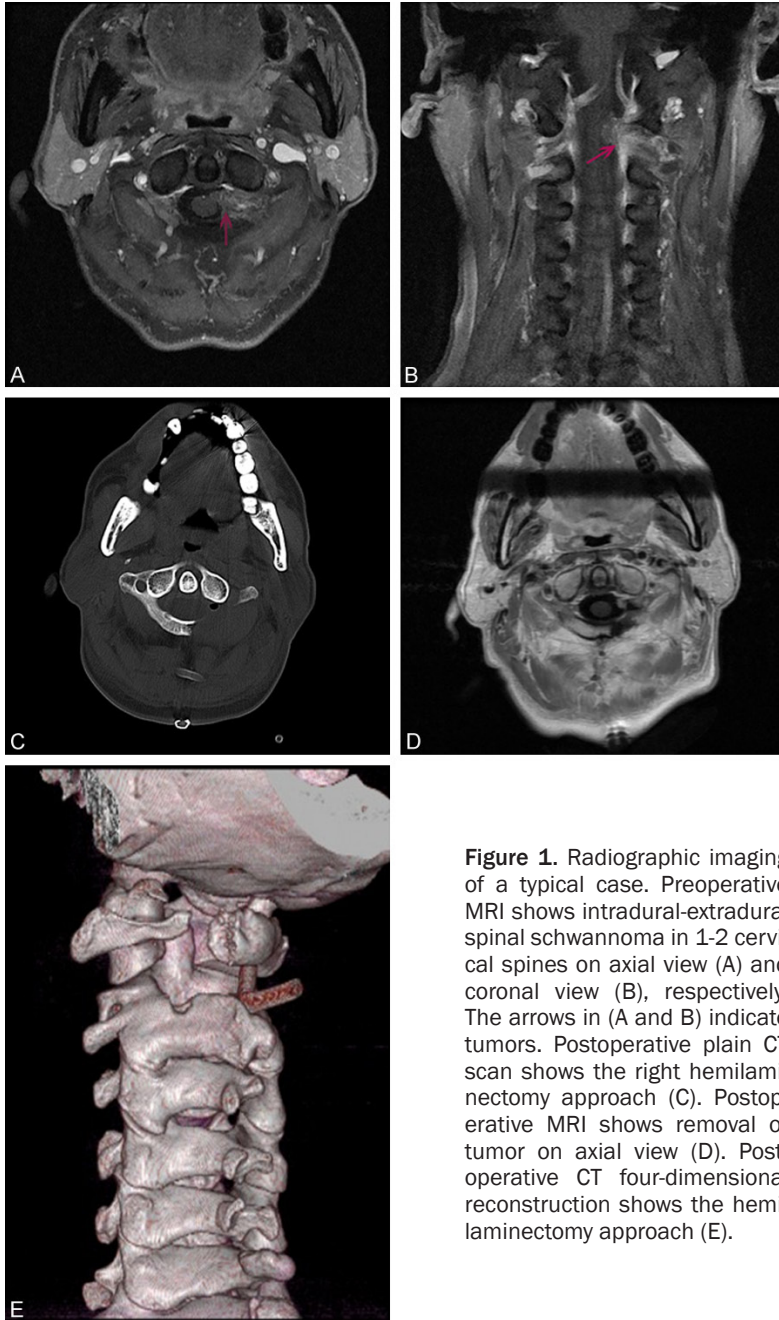
### **Results**

Postoperative pathology indicated that spinal schwannoma occurred in 36 patients including 10 patients with dumbbell-shaped spinal tumor, and spinal meningioma occurred in 9 patients. In the 45 patients of this study, tumors were completely removed, operation duration lasted 120-250 min, and the length of hospital stay was 7-14 days. Bed activities began 3 days after operation, and ambulation began 5 days after operation. No incision infection and cerebrospinal leak occurred and root pain disappeared. Movement and sensory disorders of limbs were gradually recovered in postoperative one or two months. No new neurological damage and other complications were found. During 6 to 48-month follow-up, radiographs indicated no tumor recurrence and spinal instability, such as straight cervical spine or kyphosis.

### **Discussion**

For extramedullary spinal tumor, spinal schwannoma and spinal meningioma are common. The spinal schwannoma usually stretches outside the spinal dura mater, forming dumbbell-shaped tumors. Surgical ablation is a unique effective method for treatment of these tumors. Total laminectomy is a traditional method for treatment of intradural extramedullary spinal tumors. Total laminectomy requires removal of spinous process, supraspinous ligament, interspinous ligament and bilateral vertebral plates, and separation of bilateral paravertebral muscles. These may lead to a series of postoperative complications. Sepalla et al. [1] reported

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**Figure 1.** Radiographic imaging of a typical case. Preoperative MRI shows intradural-extradural spinal schwannoma in 1-2 cervical spines on axial view (A) and coronal view (B), respectively. The arrows in (A and B) indicate tumors. Postoperative plain CT scan shows the right hemilaminectomy approach (C). Postoperative MRI shows removal of tumor on axial view (D). Postoperative CT four-dimensional reconstruction shows the hemilaminectomy approach (E).

that in 187 patients with intradural extramedullary spinal schwannoma who underwent total laminectomy, total resection rate was 90%, 10% of patients had postoperative complications, including pain, spinal instability or cerebrospinal leak, and 1.5% of patients died. After total laminectomy, spinal deformity rates were 10-40% in adults and 24-100% in children [2].

In order to avoid these complications, Raimondi et al. [3] used laminoplasty to treat extramedul-

lary spinal tumors. Laminiplasty achieved good therapeutic effects [4]. However, in recent years, McGirt et al. [5] have reported that laminoplasty can not reduce short-term progression risk of spinal deformity in the treatment of intradural extramedullary spinal tumors.

Chiou et al. [6] described that postoperative complications were less and the length of hospital stay was short after hemilaminectomy for spinal tumors. Hemilaminectomy can retain the interspinous ligament, supraspinous ligament, intervertebral joint and contralateral paravertebral muscles, keeping the integrity of the posterior part of vertebral bodies to the most degree, which is conducive to postoperative spinal stabilization. The theoretical basis of the hemilaminectomy is based on the retention of contralateral vertebral plates which maintains so-called "tension band" [7]. Asazuma et al. [8] have reported that the incidence of spinal instability is less in hemilaminectomy than in laminoplasty or total laminectomy.

In this study, no patients had postoperative complications, such as incision infection, spinal instability or cerebrospinal leak. All patients conducted bed activities 3 days after operation and ambulation 5 days after operation.

Hemilaminectomy requires high micro-operative technique in treatment of extramedullary spinal tumors because the incisional width is only 1-1.5 cm and spinous processes are also retained, so the surgical exposure is not sufficient, which easily leads to incomplete tumor

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excision, even spinal cord injury. To achieve larger surgical exposure, partial bone in the basilar part of spinous process is removed by abrading from the inside of bone window; partial articular process is resected as necessary, but the removed part was not more than 50% of the articular process; and the operating bed may be sloped to thoroughly expose the contralateral side of the spinal canal. It should be emphasized that tumor-intracapsular excision decompression is first performed to avoid dragging spinal cord. To prevent cerebrospinal leak, spinal dura mater requires close saturation, and spinal dura mater defect needs repair with artificial dura mater. Some surgeons have believed that there is no difference in exposure for the dorsal side of spinal cord between hemilaminectomy and total laminectomy [9]. And some surgeons have reported that hemilaminectomy is suitable for single intradural extramedullary spinal tumors, even ventral or medi-dorsal spinal tumors [10]. In this study, all tumors were located in lateral or latero-dorsal sides of spinal cord without ventral or medi-dorsal tumors, and surgical exposure is satisfied in all patients. Whenever hemilaminectomy is unable to completely removed spinal tumor without causing spinal cord injury, it may be changed to total laminectomy. In this study, hemilaminectomy is replaced by total laminectomy in no patients. For dumbbell-shaped spinal tumors, if the tumor size outside spinal canal was larger, it may be removed by hemilaminectomy approach combined with lateral approach.

Successful hemilaminectomy depends on accurate preoperative analysis and skilled micro-operative technique. Preoperative enhanced MRI can accurately show the shape and size of tumors, and tumor's position relation with spinal cord, which provides an important basis for successful hemilaminectomy.

Although hemilaminectomy is a promising operative approach, it can not completely replace total laminectomy. Hemilaminectomy is not suitable for the tumors involving contralateral concealment, bilateral extradural tumors, huge tumors with fan-shaped distribution along vertebral plates, bilateral easily-hemorrhagic tumors, boundary-unclear tumors and intramedullary tumors [11, 12]. We believe that for large tumors close to the median line, total laminectomy

is adopted for the purpose of safety to avoid residual tumor.

In summary, for lateral or latero-dorsal intradural extramedullary spinal tumors, and dumbbell-shaped spinal tumors, hemilaminectomy has some advantages such as slight operation wound, few complications and good spinal stabilization; but hemilaminectomy also has some disadvantages such as limited exposure and high micro-operative technique. For hemilaminectomy, we must select appropriate patients to avoid residual tumor. Hemilaminectomy is a good method for treatment of lateral or latero-dorsal intradural extramedullary spinal tumors, and dumbbell-shaped spinal tumors.

### Acknowledgements

This study was supported by National Natural Science Foundation of China (30901542), Natural Science Foundation of Guangdong Province of China (7301217), Science Research Foundation of Guangdong Province (20120314), Science Research Foundation of Guangzhou City (2013J4100057), and Fundamental Research Funds of Sun Yat-sen University for the Youth Scholars Education (12ykpy44).

### Disclosure of conflict of interest

None.

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