Different Surgical Approaches for Spinal Schwannoma: A Single Surgeon's Experience with 49 Consecutive Cases

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■ OBJECTIVE: **Comparing different surgical approaches for spinal schwannoma, the safety and efficacy of the minimally invasive surgery (MIS) approach were demonstrated, and a suitable indication for each surgical approach was analyzed.**

■ METHODS: **This study comprised 49 consecutive patients with intradural extramedullary schwannoma who underwent surgical resection: 31 patients via MIS approach (MIS group; 6 patients via a muscle-splitting approach using a tubular retractor and 25 patients via unilateral hemilaminectomy preserving the contralateral paraspinal muscle) and 18 patients via total laminectomy (TL group). Medical records including perioperative data and radiologic data were reviewed.**

■ RESULTS: **On initial magnetic resonance imaging, the mean maximal sagittal diameter of the tumor was 23.9 mm in the MIS group and 26.9 mm in the TL group, and the mean maximal axial diameter was 16.1 mm in the MIS group and 22.8 mm in the TL group ($P = 0.452$ and $P = 0.011$, respectively). The foraminal extension of tumor was identified in 8 patients in the MIS group and 9 patients in the TL group ($P = 0.081$). The tumor location was the lumbar spine in 20 patients in the MIS group and the cervicothoracic spine in 17 patients in the TL group ($P = 0.001$). Intraoperatively, all tumors in the MIS group could be totally resected with reduced operative time and blood loss. During the follow-up period of 38.2 months in the MIS group and 51.2 months in the TL group, the clinical improvement was not different between the surgical approaches ($P = 0.332$).**

■ CONCLUSIONS: **Safe and complete resection of intradural extramedullary schwannoma was obtained through the MIS approach. Regardless of sagittal extension of the tumor, a schwannoma with an axial diameter of 16 mm located in the lumbar spine can be effectively treated with the MIS approach, including foraminal extension.**

INTRODUCTION

Spinal schwannomas are slow-growing tumors that originate from a myelinated nerve sheath and are mostly classified as intradural extramedullary (IDEM) tumors.[1] Because most schwannomas are benign with a low recurrence rate, gross total resection (GTR) is the treatment of choice.[2] The traditional surgical approach for spinal schwannoma includes a laminectomy extending to levels above and below the tumor under a midline skin incision and bilateral subperiosteal muscle dissection from the posterior spinal elements.[3–7] Spinal schwannoma usually manifests with pain or paresthesia as the initial symptom, but new symptoms related to postlaminectomy instability and deformity are a major concern after the resection of these tumors, especially after a multilevel laminectomy.[8–10]

The use of minimally invasive surgery (MIS) approaches has been well described for the treatment of degenerative spinal

Key words
- Hemilaminectomy
- Minimally invasive surgery
- Spinal schwannoma
- Tubular retractor

Abbreviations and Acronyms
GTR: Gross total resection
IDEM: Intradural extramedullary
MAD: Maximal axial diameter
MIS: Minimally invasive surgery
MIS-H: Minimally invasive surgery using hemilaminectomy with unilateral muscle retraction with contralateral paraspinal muscle preservation
MIS-T: Minimally invasive surgery using a tubular retractor system
MRI: Magnetic resonance imaging
MSD: Maximal sagittal diameter
TL: Total laminectomy

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disease. In addition, MIS with mini—open hemilaminectomy has been used to treat various spinal pathologies including spinal tumors.[11–15] The MIS approach for resection of spinal tumors resulted in reduced intraoperative blood loss and postoperative pain and preservation of spinal stability with favorable clinical outcomes. The MIS approach is relatively contraindicated in tumors involving ≥2 levels and extraforaminal tumor extension; however, sufficient surgical indications have not yet been thoroughly evaluated.[12,13,15,16] Our surgical series of IDEM schwannomas compared the MIS approach with traditional laminectomy and demonstrated the safety and efficacy of the MIS approach as well as analyzing suitable indications for each surgical approach.

MATERIALS AND METHODS

Between 2003 and 2011, 71 consecutive patients underwent surgical resection of spinal schwannoma confirmed by histopathologic examination. IDEM schwannoma with or without extraforaminal tumor extension was diagnosed in 49 patients. Patients excluded from this study included 11 patients with extradural sacral schwannoma with or without retroperitoneal extension, 6 patients with extradural paravertebral schwannoma, and 5 patients with neurofibromatosis-related spinal schwannoma. IDEM schwannomas were resected using 2 different surgical approaches. The MIS approach included a mini—open hemilaminectomy (MIS group), and the traditional approach included a total laminectomy (TL; TL group). In the MIS group, the hemilaminectomy was performed using 2 different methods: muscle splitting using a tubular retractor system (MIS-T) and unilateral muscle retraction with contralateral paraspinal muscle preservation (MIS-H).

Clinical symptoms were reviewed retrospectively using patients' medical charts. The initial clinical symptoms were classified into 3 categories: pain on the neck, back, or buttock; radiculopathy including radicular pain, sensory changes, or weakness along the corresponding root; and myelopathy including hyperreflexia, gait disturbance, and bowel and urinary difficulty. At the last clinical follow-up, the presenting symptoms were assessed using the following criteria: not present, residual, or no change. Perioperative data evaluated included the extent of tumor resection, operative time, estimated blood loss, perioperative complications, and length of hospital stay. Radiologic diagnosis conducted by a neuroradiologist was identified. Additionally, maximal sagittal diameter (MSD) and maximal axial diameter (MAD) of tumor were measured on contrast-enhanced T1-weighted magnetic resonance imaging (MRI). When the tumor extended to the foramen on axial MRI, it was defined as a foraminal extension of the tumor. When postoperative MRI was available, the existence of a remnant tumor or recurrence was checked. Spinal lordosis associated with the tumor was measured by Cobb's method on lateral radiographs preoperatively and last follow-up; the cervical spine was measured from C2 to C7, and the lumbar spine was measured from T12 and to S1.

Operative Details

All surgeries were performed by a single surgeon using standard microsurgical techniques. Intraoperative neurophysiologic monitoring was used when available. Patients with a tumor in the thoracic to lumbosacral spine were placed in the prone position on the operating table, and patients with a tumor in the cervical spine were kept in a prone position with the head secured by 3-point fixation. Intraoperative fluoroscopic images were used to locate the correct level.

MIS-T Approach

The level of the tumor was confirmed with fluoroscopic guidance, and a series of dilators was introduced to split the paraspinal muscles using an approximately 2.5-cm paramedian incision (Figure 1C—F). A nonexpandable tubular retractor, usually with a diameter of 18 mm, was placed, and a hemilaminectomy was completed using a high-speed drill and Kerrison rongeurs. The hemilaminectomy was usually performed with the corresponding lamina, and it was sometimes limited to half of the lamina (partial hemilaminectomy) (Figure 1G). The tubular retractor was occasionally modified for better visualization of the operative field; the 18-mm diameter of the system was a great advantage. The dura mater was incised and opened using a blunt hook. The tumor was dissected from the surrounding neurovascular structures and taken out of the dura mater. After the tumor origin was identified by determining whether motor response was present using intraoperative stimulation, the tumor was totally resected without piecemeal removal if possible. The dural closure was completed with a modified running interlocking suture with 6-0 polypropylene (Prolene) without using any specific equipment. The retractors were removed, and the fascia and skin were approximated in standard fashion.

MIS-H Approach

After identifying the operative level, a midline skin incision was made. After unilateral subperiosteal muscle dissection from the spinous process to lamina, a self-retractor system (Taylor retractor) was laterally placed to the pars interarticularis or to the facet joint, especially for tumors in the thoracolumbar spine (Figure 2). The retractor was connected to a cord, and the cord was hanging down under the operating table with a weight attached to it. For tumors located in the cervical spine, the usual hemilaminectomy retractor was enough to ensure an adequate surgical field (Figure 3). The hemilaminectomy was performed to fit the tumor size, and the dura mater was opened from paramedian to the spinal canal. If the surrounding tissue was compromised by the tumor and en bloc tumor removal could not be achieved, internal debulking of the tumor was first performed using a Cavitron ultrasonic surgical aspirator (Integra, New Jersey, USA).

TL Approach

Through a midline incision and dissection of the bilateral subperiosteal muscle, a laminectomy was performed to levels above and below the tumor. A radical facetectomy was occasionally performed when an extraforaminal tumor was not removed through the laminectomy site. After tumor removal using microsurgical techniques, the paraspinal muscle and skin were closed. A laminoplasty was performed using a plate or laminar screw, and posterior rigid instrumentation was used for cases of radical facetectomy or spinal instability.