



Minimally invasive resection of a lumbar extradural schwannoma: how I do it

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Abstract

Background Complete surgical resection of a foraminal lumbar schwannoma may require an extended surgical exposure and facetectomy and thus secondary instrumentation. The minimally invasive technique through the use of tubular retractors may represent a valid surgical alternative.

Method We describe the resection of a foraminal lumbar schwannoma through the use of tubular retractors, along with its advantages and limitations. A limited medial facetectomy was performed and no stabilization was needed.

Conclusion Minimally invasive surgery is suitable for an efficient and safe resection of foraminal schwannomas and may help in avoiding stabilization when a limited facetectomy is performed.

Keywords MetrX · Minimally invasive spine surgery · Schwannoma · Tubular retractor

Relevant surgical anatomy

The spine anatomy should be studied in detail to define the relationship of the schwannoma with the dura and the exact location of the parent nerve.

The spinous process, the lamina and the articular process, the pars interarticularis, and the pedicle and the transverse process are the important bony landmarks.

The paraspinal muscles of interest are the grand dorsalis superficially with its thoraco-lumbar fascia inserting at the midline on the spinous processes and in the depth the longissimus laterally and the multifidus medially.

Description of the technique (video)

The patient was positioned in a prone position on a Wilson frame. The interested level is identified with intraoperative X-rays or CT. A paramedian skin incision of about 4 cm is performed and after the opening of the thoraco-lumbar fascia, a tubular retractor is positioned along the Wiltse plane, centered on the articular process, istmus and lateral part of the superior lamina (Fig. 1).

The microscope is brought in. The medial third of the articular process and the lateral portion of the lamina are drilled out to expose the ligamentum flavum (Fig. 2). A flavectomy is performed to expose the dura, along with the parent root (in this case L4, Fig. 3). The schwannoma is identified at the foramen, and monopolar stimulation (anionic stimulation of 200 msec, 1 Hz, 0.1–3 mA) is performed to identify the distribution of motor fibers. Once this is defined, the capsule of the tumoral lesion is incised, and a stitch is attached to the epineurium to perform some traction. A capsular dissection is then performed with the aid of Rhoton's dissectors.

Once some tissue is sent for pathological analysis, an intracapsular debulking is performed with the CUSA®, and then the capsule is removed. Once the resection is complete (Fig. 4), the nerve may be sutured with a 6.0 Prolene running suture, if it is possible.

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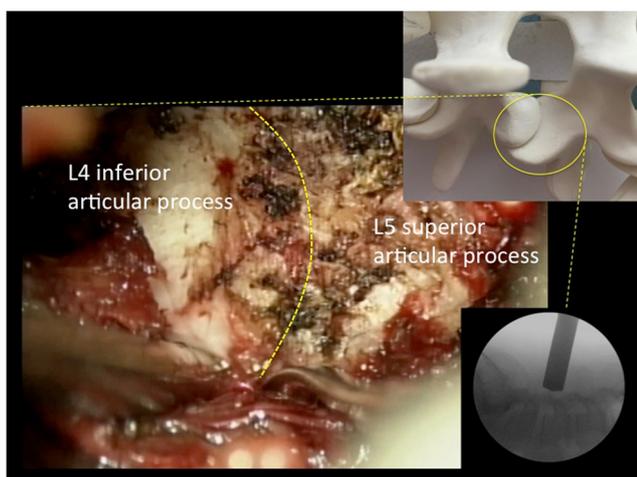


Fig. 1 Bony landmarks are visualized through the tubular retractor. The position of the retractor is checked and adjusted under X-ray control (small panel on the right, inferior edge), and in this case, the inferior articular process of L4 and the superior articular process of L5 should be exposed

Indications

Extradural nerve sheath tumors of the lumbar spine are rare and account for 2.4–3.2% of spinal schwannomas [1, 7]. Extraforaminal schwannoma may remain asymptomatic in most cases, and slow growth is generally observed. Only patients presenting refractory neuropathic pain or neurological deficits should undergo a surgical procedure for the resection of the lesion [5].

Selection of the surgical approach is fundamental to achieve a successful surgical outcome. Surgery should be tailored according to the size and location of the lesion and to the anatomy of surrounding structures [6].

The tubular retractor is commonly used for lumbar disk herniation and stenosis, as well as for interbody fusion, but its clinical application has been widened to resection of spinal and paraspinal tumors [8, 10]. Extradural nerve sheath tumors of the lumbar spine are rare and account for 2.4–3.2% of spinal schwannomas [1, 7].



Fig. 2 Once the inferior facet of L4 is drilled out, the ligamentum flavum is exposed

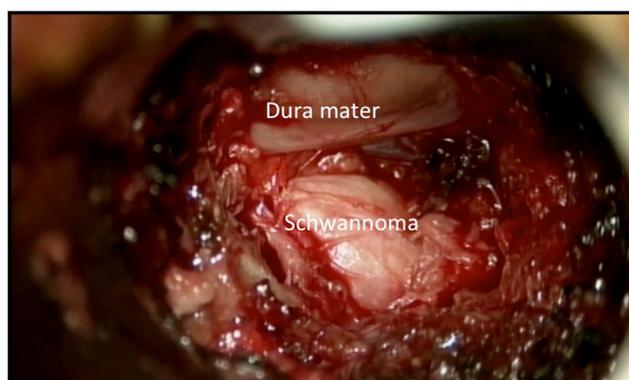


Fig. 3 The medial part of the superior facet of L5 is also removed, and after a flavectomy, the dura mater is exposed and the schwannoma is identified laterally, towards the foramen

Expandable retractors coupled to tubular dilators allow the identification of useful bony landmarks with a minimal soft-tissue injury, less blood loss, limited postoperative pain, and shorter recuperation.

Limitations

The dimensions of the lesion may represent a limiting factor, as giant lesions may require a more extended approach, and multiple maneuvers should be performed with the tubular retractor to change the orientation and allow tumor resection through this mini-invasive approach. In these cases, a larger incision could be necessary, and it should be correctly planned to be able to reach all the portions of the tumor.

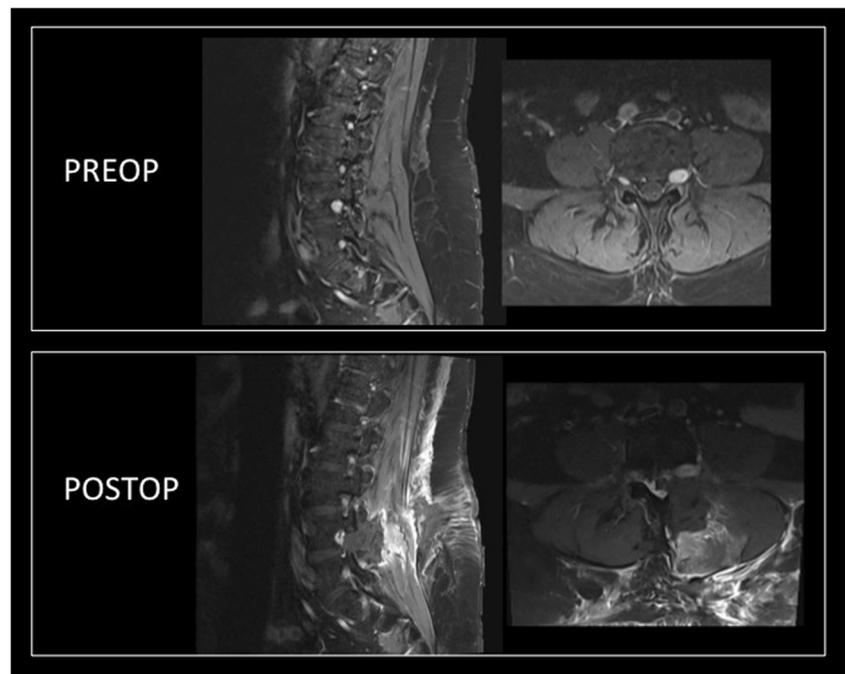
How to avoid complications

The surgery should be carefully planned and imaging analysis should help in the positioning and orientation of the tubular retractor. Intraoperative X-rays or navigation associated with intraoperative CT may help to get the best trajectory and position of the retractor.

The skin incision should be of the correct length to avoid skin ischemia during the opening of the self-retaining retractor. Careful hemostasis should be performed during the procedure.

Current treatment for spinal schwannomas is total resection of the tumor with preservation of neurovascular structures. Intraoperative electrophysiological monitoring is fundamental to monitor and preserve motor functions, especially over the parent root. Commonly, schwannomas arise from Schwann cells of sensory nerve roots, and the lesion is more commonly located dorsal while motor fibers are ventral. Monopolar stimulation may help to determine the position of motor fibers and thus the entry point for tumoral resection.

Fig. 4 The preoperative and postoperative T1-weighted MRI after gadolinium administration are here compared. The superior panel shows a round lesion in the L4 foramen (sagittal view on the left and axial view on the right) with well-defined margins and strong and homogeneous contrast enhancement. The aspect is typical of a foraminal schwannoma. The inferior panel shows complete resection of the lumbar schwannoma with no postoperative complications.



Specific perioperative considerations

All patients should have a preoperative injected lumbar magnetic resonance imaging (MRI) to define the size and the extension of the schwannoma, as well as its morphology and its relationships with surrounding structures such as the nerves and the dura. A computed tomography (CT) may also help in defining bony elements in contact with the tumor and the presence of bone remodeling.

The collaboration with an expert electrophysiology team may help in determining the distribution of nerve fibers in relationship with the tumor. A microscope is another fundamental tool to safely perform the procedure, as the microsurgical technique is essential to identify the plane between the tumor capsule and the parent root.

Specific information to give to the patient about surgery and potential risks

When performing schwannoma surgery, preservation of the involved root should be performed. However, the risk of a new neurological deficit in the postoperative period can get as high as 44% [1], and it may be secondary to tumor dissection or to the necessity of sacrificing the nerve root [4].

Recurrence is reported in 5% of cases of spinal schwannomas, and when an intracapsular resection is performed, a four-time increase in the recurrence rate is described when compared to en bloc resection [3].

The risk of CSF leak is generally low with extradural tumors but it should be carefully explained to the patient when a

dural opening is necessary to address an intradural component. If the tumor is completely extradural, the lesion may be dissected after the opening of the epineurium with no major risk of CSF leak. In the case of dural opening, a primary suture should be performed, covered by a layer of fibrin glue.

As the soft-tissue dissection is limited and the blood loss is minimized with this approach, the patient may walk the same day of the surgery and no particular restrictions are required. Muscular back pain is common but rapidly improves after some days of rest and the wound may be closed with resorbable stitches.

In addition to routine incisional pain, a variable portion of patients between 10 and 50% may also present postoperative neuropathic pain [2, 9], and it should be treated aggressively with medication, physical therapy, and sensory desensitization [5].

Less than 10% of patients may also present postoperative radicular paresthesias [2].

Compliance with ethical standards

Patient consent statement The patient/next of kin/guardian has consented the study “How I Do It” for submission to the journal.

Conflict of interest The authors declare that they have no conflict of interest.

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2. Spinal schwannomas generally originate from the dorsal roots of spinal nerves.
 3. The aim of the surgery is to perform a complete excision while preserving motor fibers.
 4. Detailed knowledge of the spine anatomy is necessary to plan and guide the surgery.
 5. The mini-invasive approach is a safe and efficient technique, as it allows a good exposure with limited tissue damage and blood loss, diminished postoperative pain, and shorter hospital stay.
 6. Because of the decreased tissue dissection, a concomitant stabilization may be often avoided. In the case of secondary instability, instrumented surgery should be performed through the same approach.
 7. Neuromonitoring is a key step in the procedure as it allows the identification and the sparing of motor fibers.
 8. The risk of recurrence after complete resection of extradural schwannoma is low but a four-time increase in the recurrence rate is described with intracapsular resection.
 9. Surgical risks include CSF leakage, neurological deficits, local and radicular pain, and paresthesia.
 10. A long-term follow-up remains a mainstay of the management to detect any recurrence, even after complete resections.

Key points 1. Injected MRI is the gold standard to perform the diagnosis of spinal schwannoma, which generally presents a strong and uniform contrast enhancement and well-defined margins.

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