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HOW I DO IT - SPINE - OTHER

How I do it: en-bloc subaxial cervical laminectomy using a high-speed drill with a footplate attachment

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Abstract

Background Cervical laminectomy is a common strategy to decompress the spinal canal.

Methods The anatomy of the cervical spine and surrounding critical structures as viewed from the posterior approach is described. The use of a high-speed drill with a footplate attachment to make laminar troughs with an en-bloc subaxial cervical laminectomy is described with a discussion on surgical technique and complication avoidance.

Conclusion This technique allows for a safe, comfortable, and rapid decompression of the cervical spine with minimal risk. For routine cases, this may potentially be more safe and cost-effective than using a cutting bur or bone scalpel attachment.

Keywords Cervical spondylotic myelopathy · Cervical laminectomy · Adult craniotome with footplate attachment · Decompression · Durotomy · High-speed drill

Abbreviations

IAP Inferior articulating process

Relevant surgical anatomy

The cervical lamina and spinous process form the posterior bony elements of the cervical spinal canal [10]. Lamina slopes downward toward the facet and lateral masses. The lamina-facet junction is marked by a groove that identifies the lateral border of the spinal canal. The inferior articulating process (IAP) is often seen as the exposure is carried further laterally.

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The posterior approach is a familiar exposure to the cervical spine for surgeons and is commonly employed when the pathology spans multiple levels. Caution must be maintained at the interlaminar spaces to avoid neural injury or a durotomy (Fig. 1).

Description of the technique

Exposure

Finding and exploiting the midline avascular plane of the ligamentum nuchae on initial dissection facilitate exposure with optimal hemostasis. Going lateral to this risks entering the paraspinal musculature with resulting bleeding. Subperiosteal exposure is continued to identify the lateral border of the lateral mass. All soft tissue should be removed from the bony elements to facilitate drilling the laminar troughs.

Surgical instrument—tapered drill bit with footplate attachment

Some surgical instruments that have been previously described include rongeurs, high-speed drill with a cutting bur attachment and an ultrasonic bone scalpel [1, 2, 6–9]. The adult-sized craniotome is comprised of a footplate attachment with a tapered router drill bit. We prefer this in adults, as

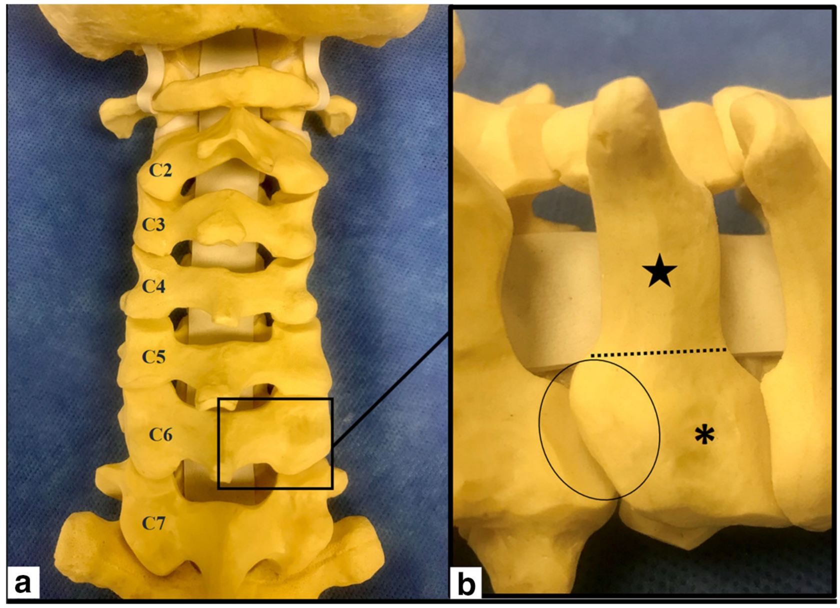

Fig. 1 Key anatomical landmarks. **a** Posterior view of the bony elements of the cervical spine. The lateral masses form a box. **b** Magnified view of the lamina (star) sloping downward toward the lamina-facet junction (dashed line). The inferior articulating process is usually seen as part of the facet joint (circle). The lateral mass (asterisk) form a box with the lamina-facet junction being the medial border

compared with the pediatric craniotome, due to the more robust bone anatomy [3]. This attachment is standard in a variety of sets and has several lengths. It can be re-sterilized for multiple uses. At 2.3 mm, its size is comparable to a 2-mm Kerrison rongeur. The footplate attachment protects the soft tissue and underlying neural elements when cutting through bone. Furthermore, the router does the cutting of the bone and minimizes local heating to the surrounding neural structures and limits irrigation to preserve a clear operative field (Fig. 2).

Initial Laminotomy

It is standard practice at our institution to stabilize with instrumentation following a multi-level posterior cervical laminectomy. As such, the pilot holes for the lateral mass screws are initially drilled with a 3-mm matchstick and the lateral mass screws are either placed at this point or following the decompression. The 3-mm matchstick is then used to create a laminotomy on each side of the caudal level. The laminotomy is drilled at the caudal end of the lamina because the ligamentum flavum, lying underneath, serves to minimize neural injury. The ligamentum flavum attaches to the middle of the lamina, and, as such, the resulting rostral aspect of the lamina has minimal soft tissue (mainly epidural fat) between the bony elements and the neural structures. Kerrison rongeurs can be further used to widen the laminotomy to facilitate placement of the footplate attachment. Curettes should be used to dissect the ligamentum flavum from the underlying bone. Preservation of the ligamentum flavum prior to drilling the laminar toughs is key to protect the underlying neural structures (Fig. 3).

Bilateral laminar troughs and en-bloc laminectomy

The footplate is placed between the lamina and ligamentum flavum. The attachment allows for better surgeon comfort than with traditional cutting tips or an ultrasonic bone scalpel. The footplate is held orthogonal to the slope of the lamina. The cut line must not extend beyond the beginning of the lateral mass so as to avoid injury to the exiting nerve roots (Fig. 4). The

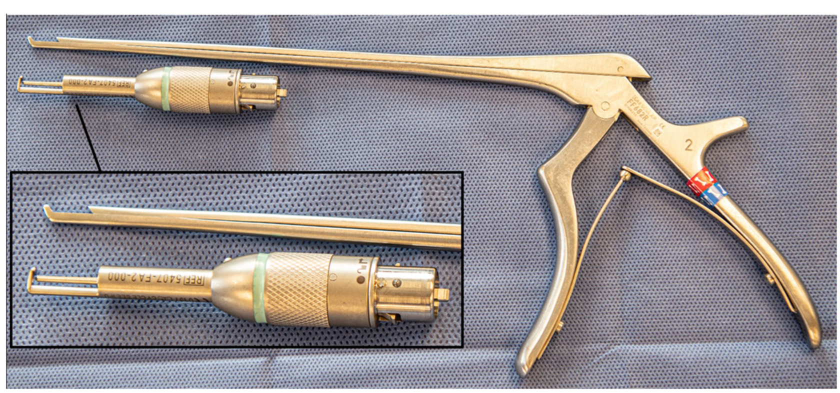

Fig. 2 Surgical instrument—tapered drill bit with footplate attachment. The footplate, at 2.3 mm, is slightly larger than a 2-mm Kerrison rongeur. The drill bit used is tapered

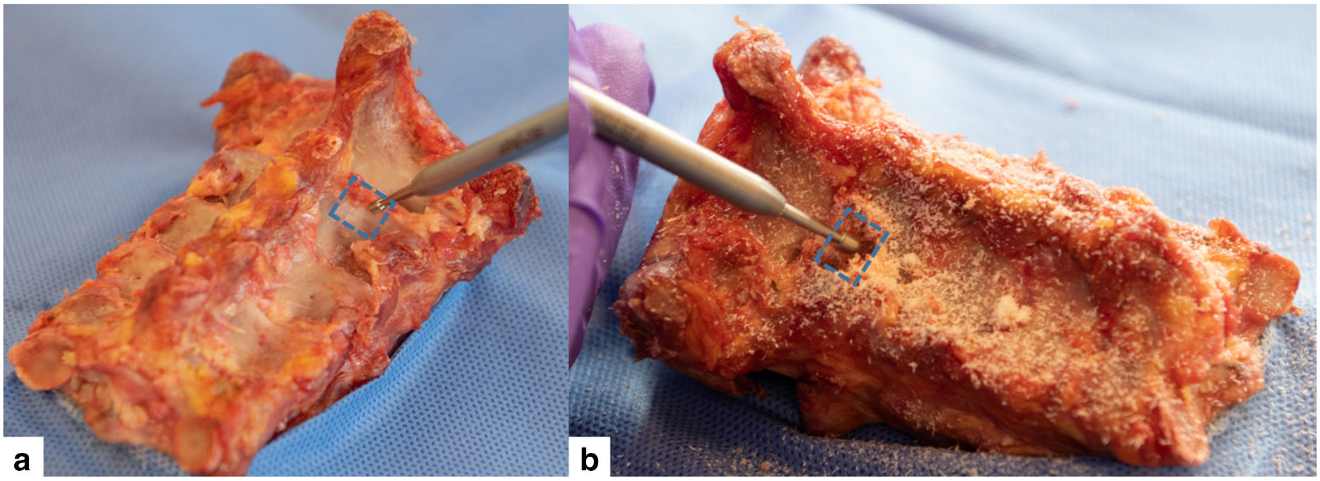

Fig. 3 Initial laminotomy. The initial laminotomy is performed bilaterally with a 3-mm matchstick. **a** Before and **b** after completion of a laminotomy. The ligamentum flavum is under the inferior half of the lamina and a small laminotomy is created. A 2-mm Kerrison rongeur can be used to widen the laminotomy to allow for the insertion of the footed attachment

attachment is held comfortably and the tendency to pull up with the attachment must be avoided. Doing this minimizes the ability of the drill to cut and progress forward simultaneously. The footplate will automatically move to the subsequent levels. The cutting nature of the router also allows for the added benefit of hemostasis while the cuts are being made. Furthermore, because rapid and efficient laminar troughs can be made, the use of irrigation is able to be minimized and the clear operative field is preserved. Separating the interspinous ligaments at the rostral and caudal extent of decompression then allows for an en-bloc laminectomy (Fig. 5). When removing the lamina en-bloc, be careful not to toggle or allow the bone fragments to recoil back and cause neural injury. At our institution, this bone is further used as autograft to facilitate arthrodesis.

Indications

A cervical laminectomy is useful to decompress multiple segments of the cervical spine for degenerative conditions when an anterior approach is not indicated. Moreover, its use is also advantageous for intradural tumors, vascular malformations, and continuous ossification of the posterior longitudinal ligament. The technique is also valuable for laminoplasty in certain indications.

Limitations

This technique describes an efficient method of creating laminar troughs to facilitate a multi-level posterior

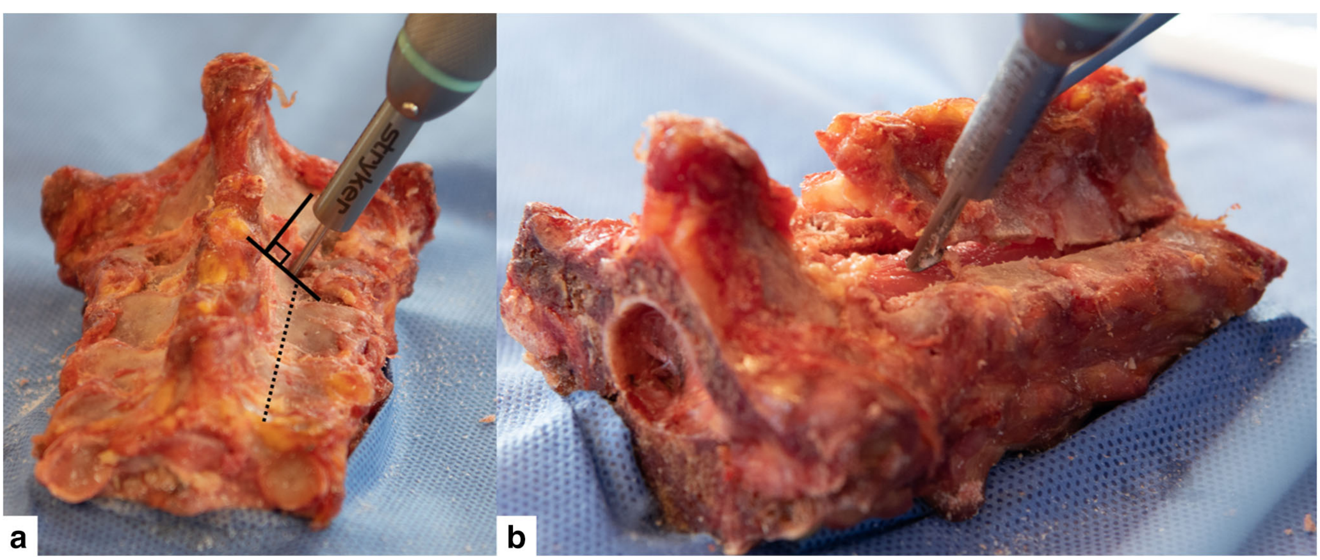

Fig. 4 Bilateral laminar troughs. **a** The footplate is placed orthogonal to the lamia. The cut line should not deviate beyond the start of the lateral mass. **b** The en-bloc laminectomy is lifted to demonstrate how the footplate fits underneath the lamina, with the footplate protecting the underlying soft tissue and thecal sac

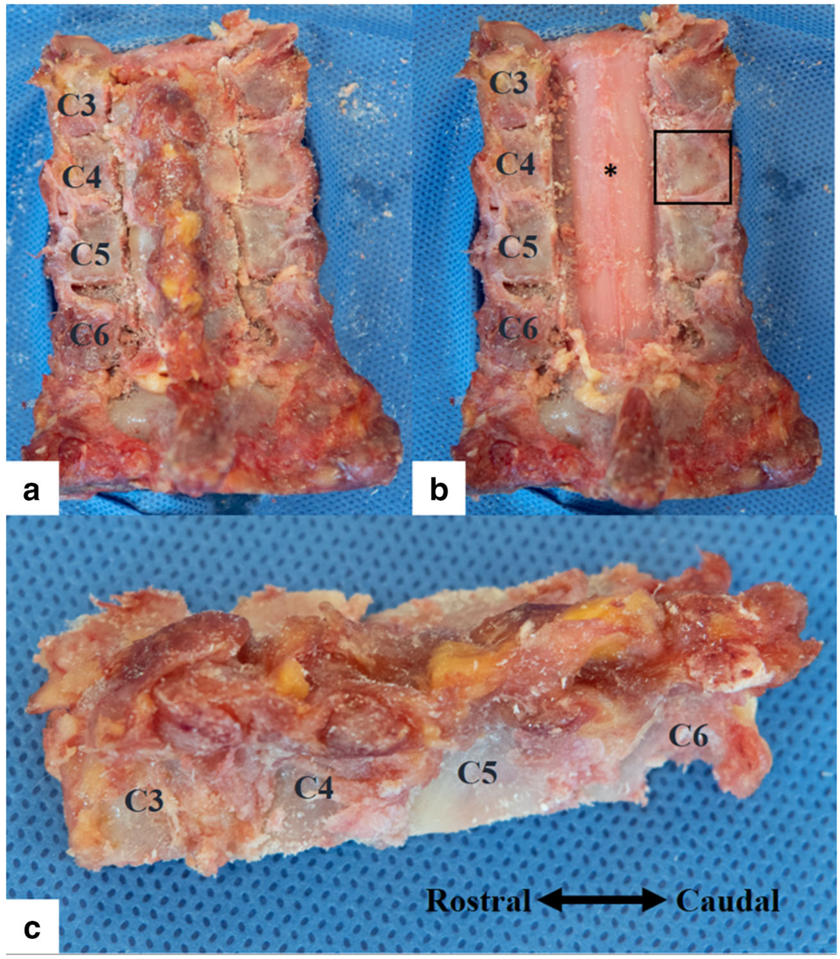

Fig. 5 En-bloc laminectomy. **a** Bilateral troughs have been created and the interspinous ligaments cut, all the lamina can be removed en-bloc. **b** The en-bloc laminectomy has been performed. The thecal sac (asterisk) is well decompressed, and the lateral mass is preserved (box). **c** The completed lamina is removed en-bloc and can be used for autograft or used later for a laminoplasty

cervical laminectomy for degenerative cases. The use of more advanced osteotomy cuts for cervical deformity requires other instruments. Cervical laminectomy via a posterior approach results in limited access to anterior pathology. An increase in neck pain secondary to denervation of posterior musculature can be seen as a result of the procedure.

How to avoid complications

The initial laminotomy should be sufficient to allow for the insertion of the footplate to slide under the remaining bony lamina. Maintaining this position and allowing the footplate to "do the work" as opposed to trying to force it will allow rapid cutting of laminar troughs. Avoid the tendency to pull up as this can limit forward advancement.

Specific perioperative considerations

If there is any loss of intraoperative neuromonitoring signals along with postoperative neurological deficits, the patients' blood pressure should be augmented to maintain perfusion postoperatively with careful monitoring of the patient's neurological status. Any incidental durotomy should be addressed prior to closure [4, 5]. A cervical collar is often applied following the procedure. For patients at high-risk for wound healing, prophylactic negative pressure therapy can be used to reduce the risk for developing a surgical site infection.

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

The need for decompressing the spinal cord must be explained to the patient. If there is preoperative neurological deficit, it should be communicated clearly that the primary purpose of surgery is to prevent further loss of function and damage to the spinal cord.

Summary of Key Points

1. Dissection along the avascular ligamentum nuchae facilitates exposure of the posterior cervical spine while minimizing blood loss.
2. The cervical lamina slopes downward toward the facet/lateral mass complex. Identifying the lamina-facet junction is a key marker for the lateral boundaries of the spinal canal.
3. Complete exposure requires meticulous dissection of the entire posterior bony elements.
4. Lateral mass screws are placed either before or after decompression (surgeon preference).
5. Initial laminotomy should be sufficient to facilitate footplate placement between the bone and ligamentum flavum.
6. The ligamentum flavum should be dissected from the underlying bone, but not removed so as to protect the underlying neural structures.
7. The footplate should be aligned orthogonal to the bony lamina at all times.
8. The footplate cut lines should not extend beyond the beginning of the lateral mass so as to avoid injury to the exiting nerve roots.
9. The footplate attachment protects the soft tissue and underlying neural elements when cutting through bone.
10. Use of the footplate attachment with a tapered router improves surgeon comfort and may be useful in resident training.

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Compliance with ethical standards

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

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