Laminotomy: a technical note

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Abstract. In order to restore spinal integrity following posterior exposures of the spinal canal in children, we describe modifications of Raimondi’s laminotomy technique. The use of a pneumatic dissecting tool with footplate to create a hinged osteoplastic laminotomy is described, as are techniques for securing the laminotomy flap in place at the end of the procedure.

Key words: Laminotomy – Laminectomy – Posterior decompression – Spinal canal

Spinal deformity is a well-recognized complication of laminectomies in children, certainly in the cervical and thoracic regions [5]. It has been suggested that replacement of the posterior elements may help to prevent spinal deformity from occurring [4]. Stimulated by Raimondi [3], the authors have undertaken laminotomies with replacement of the posterior elements in preference to laminectomies for posterior spinal canal access in children. With the institution of selective functional posterior rhizotomy for the treatment of spasticity in children with cerebral palsy, the number of cases requiring a posterior approach to the spinal canal, especially the lumbar canal, has increased in our institution, as it has in many other centers. In the absence of contraindications such as spinal stenosis, we have replaced posterior elements as a routine part of our operative procedure. This technical note describes the instrumentation and methods we use to effect a laminotomy, with emphasis on the reconstitution of spinal integrity and the protection of the intradural elements.

Operative procedure

Lumbar laminotomy

Following the midline exposure of the supraspinous ligament and the lumbodorsal fascia, paramedian incisions are made in the lumbodorsal fascia, preserving the attachment of the supraspinous ligament to the spinous processes. The multifidus and interspinalis muscles are reflected from the spinous processes and laminae to expose the medial half of the inferior articular processes. This provides a sufficient width of exposure so that the pneumatic drill with B5 dissecting tool and B5 attachment (Midas Rex Pneumatic Tools, Fort Worth, Texas) can be used easily. For older children and teenagers who have thicker laminae, a B1 dissecting tool and attachment may be required.

With self-retaining retraction in place, a Howarth, Cloward periosteal osteophyte or Adson elevator is used to strip the ligamentum flavum from the undersurface of the lowest lamina to be removed. The supraspinous ligament is left intact as it stabilizes the laminae while the laminotomies are cut. The footplate of the B5 attachment provides protection to the epidural fat and dura while the B5 dissecting tool cuts the laminotomy. The instrument is inserted into the spinal canal and drawn up against the undersurface of the lamina, away from the dural sac. The degree of overlap of lamina and infolding of the ligamentum flavum affects how the instrument is handled during the cutting process. As the instrument is moved from caudal to cranial over the extent of the exposure, tilting the handpiece cranially while applying dorsal pressure on the footplate allows the dissecting tool to cut through the lamina. Gentle caudal movement of the handpiece once the lamina is cut allows safe advancement of the footplate under the superior ligamentum flavum. This rocking movement is repeated at each level.

With completion of the laminotomies on both sides, the caudal attachment of the supraspinous ligament is incised with a scalpel. Residual ligamentum flavum is incised, and the laminotomy flap is elevated and reflected cranially and hinged on the intact supraspinous and interspinous ligaments and the ligamentum flavum at the cranial end of the exposure. The laminotomy flap is not removed but wrapped in a saline-soaked gauze and secured out of the field using a suture or Kocher or towel clip (Fig. 1).

In the lumbar area, drill holes are not required to return the flap to its anatomical position, so that at this stage all bone edges are waxed and the intrasural procedure is carried out. To reposition the laminar flap at the end of the procedure, 2-0 polyglyactin sutures (Vicryl, Ethicon, Peterborough, Ontario) are placed at each interlaminar level through the ligamentum flavum on the flap and through the residual ligamentum flavum or facet joint capsule laterally (Fig. 2). A final suture is placed through the supraspinous and interspinous ligament at the caudal end of the flap, joining it with the lowest intact spinous process. The stabilizing sutures on both sides are tied simultaneously, starting cranially and working caudally. The last suture tied is that between the lowest intact spinous process and its caudal neighbor.

The paraspinous musculature can be approximated using 2-0 sutures placed through the interspinous ligament at each level, or they
spinous processes facilitate the approximation of the paraspinal musculature. This elevates the laminar flap out of the spinal canal. The ligamentum nuchae is then closed.

**Thoracic laminotomy**

In the thoracic area, obstruction caused by the vertical orientation of the spinous processes precludes the reflection of the laminotomy flap. Excision of part or all of the spinous process of the intact vertebra at the cranial end of the exposure, while leaving the ligamentum flavum intact, removes this impediment and allows the flap to be hinged superiorly as described. A similar technique is used to deal with bulky spinous processes in the lumbar spine in older children.

Drill holes are required for fixation in the thoracic area as described for the cervical laminotomy. Paraspinal musculature and fascia are sutured to the spinous process or supraspinous ligament. Transverse drill holes through the spinous processes may be required.

**Discussion**

It has yet to be shown whether laminotomy prevents or reduces the risk of kyphoscoliosis in children undergoing intraspinal procedures. Theoretically, it allows the reconstruction of normal anatomy following posterior approaches to the spine at all levels. It also prevents the development of myodural cicatrix, which can compromise the spinal canal [2]. In our experience the osteotomies heal, as demonstrated on subsequent CT imaging (Fig. 3).

Our experience using this technique for posterior spinal access over two or more levels is summarized in Table 1. Exposure of the intraspinal contents has been ample for lumbar and cervical rhizotomy as well as for removal of intradural and extradural tumors, tumor abscesses, and syringostomy. Lateral undercutting of facets or facetectomy, required for patients with spinal stenosis or laterally situated dumbbell tumors, was easily performed. Adequate longitudinal exposure with a hinged laminotomy flap is obtained by extending the laminotomy one level above that which would be necessary if the laminotomy flaps were to be removed. The laminotomy flap has not been replaced in patients with a small spinal canal or if infection was present.

Complications to date have been few. One dural tear, without arachnoid tear, occurred early in the series. This was within the operative field and easily repaired. No thermal or abrasive injury to the dura has been noted. One patient undergoing a lumbar rhizotomy developed an anteriorly placed subdural hematoma during the opening which required evacuation. No cause for this was found on intradural exploration. Other injury to the spinal contents has not occurred. Spinal deformity has not developed to date and in no patient have the replaced posterior elements fused.

There are several technical points that recommend this approach. The Midas Rex footplate is smaller than than most rongeurs. This allows the laminotomy to be cut with minimal intrusion into the spinal canal. The lateral placement of the laminotomy and the protection afforded the