

## Review Article

# Anatomy of the posterolateral spinal epidural ligaments

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## ABSTRACT

**Background:** The epidural ligaments (ELs) (of Hofmann) were described as fibrous bands interconnecting the ventrolateral spinal dura and the posterior longitudinal ligament below L1. They are hardly ever discussed in the literature or considered in hypothesis-driven basic science experiments or spine biomechanical models.

**Methods:** Intraoperative photographs were obtained to illustrate a group of posterolateral spinal ELs. In addition, electronic database searches (PubMed, Ovid Embase, and SCOPUS) were utilized to summarize the anatomy, and relevant clinical and surgical factors impacting these ELs.

**Results:** ELs attach circumferentially at most spinal levels. They anchor the nerve root sleeves ventrally, and therefore, may play a role in the some idiopathic neurologic deficits (e.g., postoperative radiculopathies, C5 palsies) in patients without radiological compression. The posterolateral ELs originate on the dura dorsal to the nerve root sleeves and insert on the ipsilateral lamina, interlaminar ligament, and facet capsule. They appear to be continuous with the peridural membrane, a fibrovascular sheath that surrounds the thecal sac and serves as a scaffold for the internal vertebral venous plexus of Batson and epidural fat.

**Conclusion:** The spinal ELs should be divided sharply during surgery to prevent durotomies, especially in patients with advanced spondylosis and facet arthropathy. Disconnecting these ligaments releases the thecal sac laterally and ventrally, allowing for medial mobilization when performing discectomies or for working in the ventral epidural space.

**Keywords:** Anatomy, Durotomy, Epidural ligaments, Hofmann's ligaments, Meningovertebral ligaments, Peridural membrane

## INTRODUCTION

The epidural ligaments (ELs) (of Hofmann) have been historically described as fibrous bands interconnecting the ventrolateral spinal dura and the posterior longitudinal ligament (PLL) ventral to the nerve root sleeves below the L1 spinal level. These anatomically variable ligaments are present at most spinal levels, and anchor the thecal sac circumferentially, not only ventral to the nerve roots as initially described by Hoffmann [Table 1 and Figure 1].<sup>[2,3,5,12,13]</sup>

Here, we reviewed the spinal posterolateral ELs and their anatomic relationships with the peridural membrane (PDM) and insertions on the ipsilateral interlaminar ligament (ligamentum flavum), vertebral lamina, and medial zygapophyseal facet capsule.

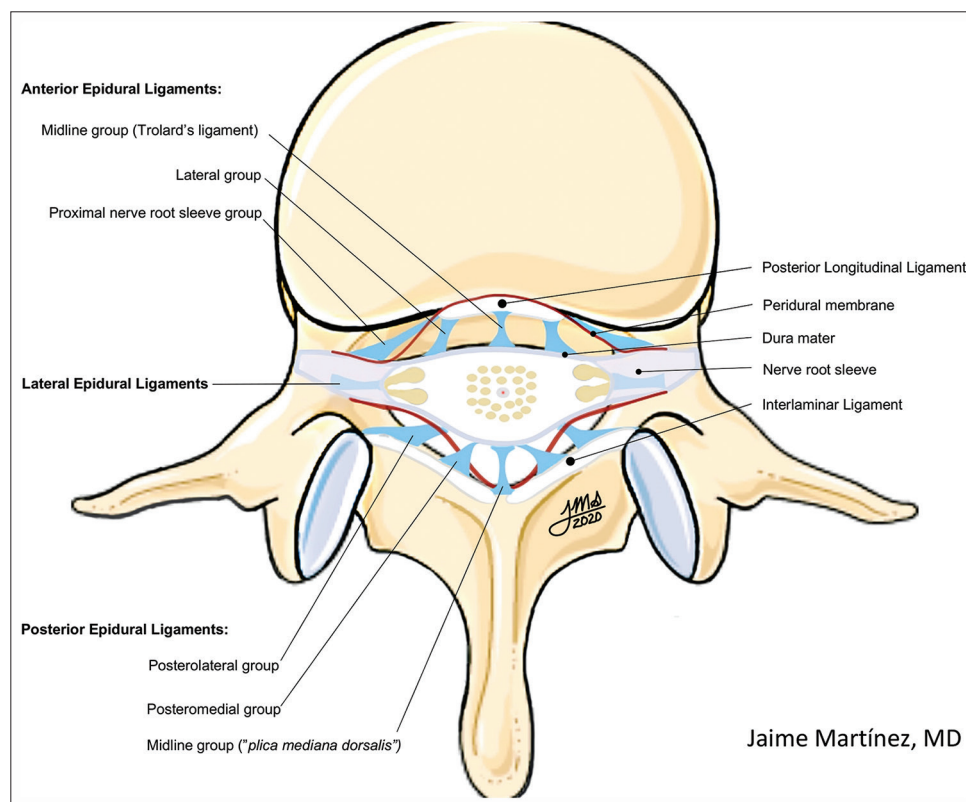
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**Table 1:** Epidural or meningovertebral ligaments.

Anterior (or Ventral) epidural ligaments (Hofmann's)	<ul style="list-style-type: none"> <li>• Midline group (Trolard's ligaments): originate on the ventral dura and insert on the PLL</li> <li>• Lateral group: Originate on the ventrolateral dura and insert on the lateral border of the PLL</li> <li>• Proximal nerve root sleeve group (not initially described by Hofmann) originate on the lateral dura, ventral to the nerve root sleeve, and insert anteriorly on the PLL and inferior pedicle</li> </ul>
Lateral epidural ligaments	<ul style="list-style-type: none"> <li>• Originate on the lateral dura, at the level of the nerve root sleeve and insert on the pedicle</li> </ul>
Posterior (or Dorsal) epidural ligaments	<ul style="list-style-type: none"> <li>• Midline group ("Plica mediana dorsalis"): originate on the dorsal dura and insert on the lamina and interlaminar ligaments, bridging the midline gap between the interlaminar ligaments</li> <li>• Posteromedial or dorsomedial group: Originate on the dorsal dura and insert on the ipsilateral interlaminar ligament and lamina</li> <li>• Posterolateral group: originate on the posterolateral dura (dorsal to the nerve root sleeve) and insert on the ipsilateral vertebral lamina, interlaminar ligament and zygapophyseal joint capsule</li> </ul>

PLL: Posterior longitudinal ligament

**Figure 1:** Illustration of an axial section at lumbar spine level showing the epidural ligaments (in blue) and peridural membrane (in red). The epidural fat and internal vertebral venous plexus of Batson are not shown.

### ELs (OF HOFFMAN)

The epidural or meningovertebral ligaments (of Hofmann) are anatomically variable fibrous bands (0.5–28.8 mm in length) that interconnect the ventrolateral spinal dura mater and the

PLL.<sup>[9,11–13]</sup> Spencer *et al.*<sup>[10]</sup> additionally described the “lateral Hofmann’s ligaments” that anchor the spinal nerve sleeve (i.e., originate laterally on the nerve root sleeve and insert ventrally on the PLL) preventing the nerve from moving or stretching posteriorly in cases of ventral compressions

(e.g., disc herniations) [Figure 1].<sup>[13]</sup> This anatomic relationship may explain why patients develop postoperative radiculopathies, C5 palsies, or radicular compression signs in without obvious radiologic neuroforaminal compression.

## CLASSIFICATION OF ELS

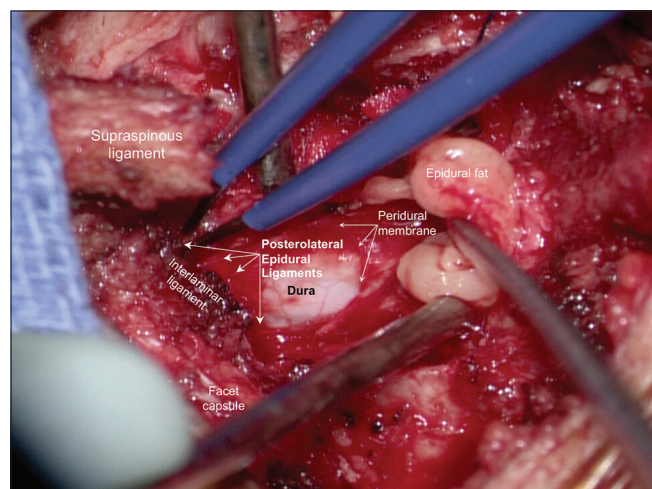
The ELS have been classified into the following three groups [Table 1 and Figure 1]: (1) midline-originating on the ventral dura and inserting on the PLL, (2) lateral- originating on the ventrolateral dura and inserting on the lateral border of the PLL, and (3) and proximal nerve root sleeve - originating on the lateral dura and inserting anteriorly on the PLL and periosteum of the inferior pedicle.<sup>[11,12]</sup>

## POSTERIOR ELS

A posterior group of ELS referred to as “dorsomedial” or “posteromedial” ligaments<sup>[2,4]</sup> were seen in 9 (52.9%) of 17 soft-fixed cadaveric lumbar spines<sup>[2]</sup> and in 5 (35.71%) of 14 cadaveric thoracic spines<sup>[6]</sup> interconnecting the dorsal dura and the interlaminar ligaments [Figure 1 and Table 1].

## SURGICAL FINDINGS WITH POSTERIOR ELS

At surgery, we have observed a separate group of posterolateral ELS that are continuous and blend in with the PDM and insert on the posterolateral dura (dorsal to the nerve root sleeve), ipsilateral vertebral lamina, interlaminar ligament, and zygapophyseal joint capsule [Figures 1-4]. The PDM divides the epidural space into two virtual spaces: (1)

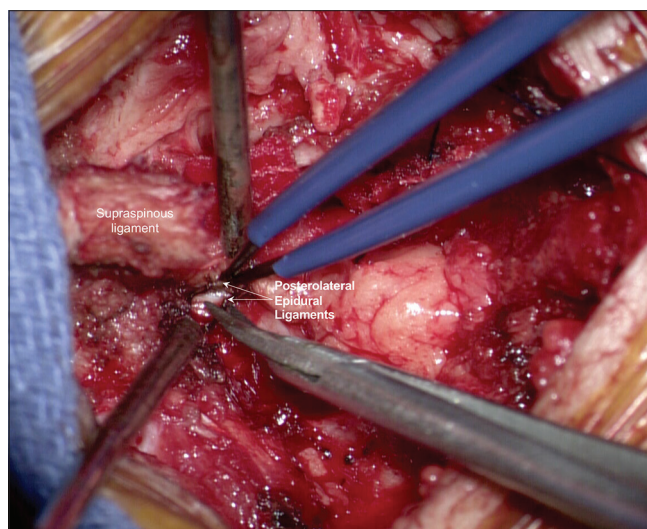


**Figure 2:** 12-year-old male who underwent a lumbar laminectomy for spinal cord detethering. Intraoperative photograph after performing an L4 laminectomy and removing the interlaminar ligament. The dura is exposed, and the epidural fat is mobilized caudally on the left side to identify the peridural membrane ventral to it and the posterolateral epidural ligaments attaching laterally on the facet capsule and interlaminar ligament.

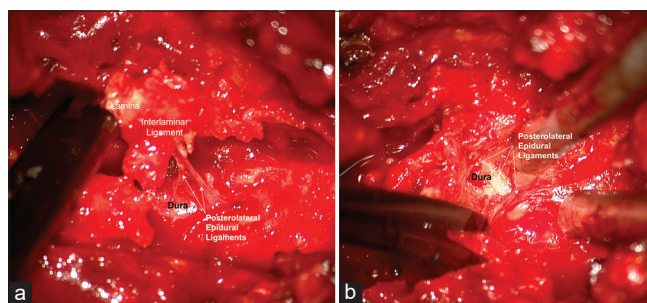
the outer or external epidural space (between the PDM and the walls of the spinal canal) and (2) the inner epidural space (virtual space between the PDM and dura).<sup>[1]</sup> Tributaries to the internal epidural venous plexus of Batson and epidural fat attach dorsally and are embedded within the PDM<sup>[1,13]</sup> and may track along the ELS. Epidural hemostasis can be achieved by identifying this thin layer of ELS, and gently holding it away from the dura between the blades of the bipolar electrocautery.<sup>[7,8]</sup>

## SPONDYLOSIS AND FACET ARTHROPATHY MAY CEMENT POSTEROLATERAL ELS TO THE DURA

Patients with advanced spondylosis, stenosis, and facet arthropathy may develop prominent posterolateral ELS that



**Figure 3:** Intraoperative photograph (of case shown in Figure 2) showing the bipolar electrocoagulation and sharp dissection of posterolateral epidural ligaments.



**Figure 4:** A 60-year-old male patients who underwent a lumbar laminectomy for neurogenic claudication. (a and b), intraoperative photographs after rongeur bites to the left L3 lamina and interlaminar ligament (a) and left-sided medial facet (b) showing how the posterolateral ligament is cemented to the posterolateral dura and inserts on the lamina, interlaminar ligament and medial facet capsule. Note that forceful traction on these fragments could inadvertently cause a durotomy.

become firmly adherent to the dura, attributed to a local inflammatory response. At surgery, a Kerrison rongeur or the foot plate attachment of a high speed drill may inadvertently grasp these ELs, causing their avulsion at site of dural insertion.<sup>[2,4]</sup> Therefore, at surgery, ELs should be sharply divided or cut (avoiding undue traction) [Figures 3 and 4] to allow for mobilization the thecal sac and nerve roots as in performing a discectomy.

## CONCLUSION

The posterolateral spinal ELs that insert on the lamina, interlaminar ligament, and medial facet should be sharply divided during surgery to prevent durotomies when working in the epidural space while performing discectomies or laminectomies.

## Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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