

Basic Science

# The morphology and clinical significance of the dorsal meningovertebra ligaments in the cervical epidural space

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## Abstract

**BACKGROUND CONTEXT:** The dural sac is anchored within the vertebral canal by connective tissue called meningovertebra ligaments in the epidural space. During flavectomy and laminectomy, inadvertent disruption of the dorsal meningovertebra ligaments may lead to dura laceration and cerebrospinal fluid (CSF) leaks. All the described dorsal meningovertebra ligaments were located in the lumbar region. A rare study is available about dorsal meningovertebra ligaments of the cervical spinal dura to the adjacent vertebrae.

**PURPOSE:** To identify and describe the dorsal meningovertebra ligaments at each cervical level and discuss their clinical significance.

**STUDY DESIGN:** A dissection-based study of 22 embalmed cadavers.

**METHODS:** The anatomy was studied in 22 whole cervical cadavers (11 females, 11 males), prepared with formaldehyde, whose ages at the time of death ranged from 55 to 78 years. The vertebral canal was divided to expose the dural sac and the spinal nerve roots. At all levels of the cervical vertebra, the morphology, quantity, origin, insertion, and spatial orientation of the dorsal meningovertebra ligaments were determined and the length, width or diameter, and thickness of the ligaments were measured with vernier calipers.

**RESULTS:** The dorsal meningovertebra ligaments in the cervical region anchored the posterior dural sac to the ligamentum flavum or laminae. The number of attachment points on the ligamentum flavum was relatively larger than that on the lamina, and the occurrence rate of dorsal meningovertebra ligaments was 100% at C1–C2 and C4–C5. The thickest ligaments were observed at the C1 and C2 vertebrae. The length of the ligaments varied from 1.50 to 35.22 mm, and the orientation of the ligaments mostly was craniocaudal. The morphology of the dorsal meningovertebra ligaments was divided into four types: strip type, cord type, grid type, and thin slice type.

**CONCLUSIONS:** In the cervical spine, the dorsal meningovertebra ligaments exist between the posterior dural sac and the ligamentum flavum or lamina. The dorsal meningovertebra ligaments may be of clinical importance to surgeons. Dissecting the dorsal meningovertebra ligaments before the cervical flavectomy and laminectomy may be an important step in reducing postoperative dura laceration and CSF leaks, which may result in significant benefits for patients and health-care organizations. © 2014 Elsevier Inc. All rights reserved.

## Keywords:

Cervical region; The meningovertebra ligaments; Dura laceration; Dural sac; The ligamentum flavum; Lamina

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## Introduction

The fibrous tissues connecting the dura to the spinal cord have been alluded to in anatomic texts. The dorsal connective tissue structures were proposed by Luyendijk [1], who presented the results of peridurography studies and described a central defect based on the distribution of the contrast medium. He attributed the defect to a dorsomedial fold of the dural sac and assumed that the fold was caused by median attachments of the dural sac to the vertebral laminae. Hofmann [2] observed membranous structures between the posterior longitudinal ligament and the dural sac and called them “ligamenta anteriora durae maters;” these structures subsequently became known as “Hofmann ligaments.” However, this name for the dorsal connective tissue band in the spinal epidural space was incorrect. The 40th edition of Gray’s Anatomy reported that the meningovertebral ligaments connected the theca to the tissue lining the vertebral canal. The term “meningovertebral ligaments” is preferred to that of “ligaments of the dura” to avoid confusing them with the denticulate ligaments. Solaroglu et al. [3] described a new ligament, the ATA, between the dural sac and the ligamentum flavum at L5. However, we consider that the ATA may be a part of the dorsal meningovertebral ligaments in the lumbosacral epidural space and doesn’t exist only at L5. Blomberg [4] conducted an anatomical study of the lumbar epidural space and found that there was a dorsal connective tissue band in the midline of the epidural space between the dural sac and the ligamentum flavum; he argued that the existence of the dorsomedian connection might help explain some of the unexpected events that occur during clinical epidural anesthesia, such as accidental dural punctures and uneven onset and spread of anesthesia. In the past experiments, we have conducted a systematic anatomy study for the dorsal meningovertebral ligaments in the lumbar segment and found that these ligaments may create a potential risk for inadvertent dural lacerations during flavectomy and laminectomy [5].

Dural laceration is one of the most common complications of spinal surgery and has been reported with an incidence as high as 1% to 17% [6]; when handled incorrectly, this complication is associated with the risks of poor wound healing, meningitis, and pseudomeningocele [7]. Knowledge of the surgical anatomy of the dorsal meningovertebral ligaments and their variations could provide important clues in improving surgical outcomes. However, regrettably, detailed anatomical studies on the dorsal meningovertebral ligaments of the cervical spinal column to the adjacent vertebrae have not been performed. This study is designed to investigate the anatomy and the surgical significance of these ligaments at each cervical level.

## Materials and methods

A total of 20 healthy adult cadavers that were fixed in 10% formalin were used (10 men and 10 women; age range, 55–78 years; mean age, 67 years). The cervical spinal columns were

separated from the skull and the thoracic segments en bloc using an electric band saw. The posterior aspect of the vertebral column was exposed from C1 to T1 by dissecting the postvertebral muscles. Craniocaudal endoscopy was performed on the specimens. All findings were documented with photography. The dorsal aspect of the cervical vertebrae was divided into 12 segments: C1 laminae, C1–C2 ligamentum flavum, C2 laminae, C2–C3 ligamentum flavum, C3 laminae, C3–C4 ligamentum flavum, C4 laminae, C4–C5 ligamentum flavum, C5 laminae, and C5–C6 ligamentum flavum, C6 laminae, C6–C7 ligamentum flavum, C7 laminae, C7–T1 ligamentum flavum. After epiduroscopy, the cervical vertebral bodies from C1 to T1 were carefully removed. The posterior dural sac was exfoliated from the ligamentum flavum or laminae to observe the anatomical structures between them. Then, the extradural fat was removed. The dural sac was elevated free to identify the meningovertebral ligaments. In addition, another two whole cervical vertebral segments were cut into a medial view of a midsagittal section for qualitative description. The distribution, morphology, number, orientation and sites of origin, and insertion of the meningovertebral ligaments were observed and recorded. The length, width or diameter, and thickness of the ligaments were measured using vernier calipers (accurate to 0.01 mm) under the surgical microscope. Statistical analysis on the measurements was performed using IBM SPSS Statistics 20.0 (SPSS Inc., Chicago, IL, USA). The

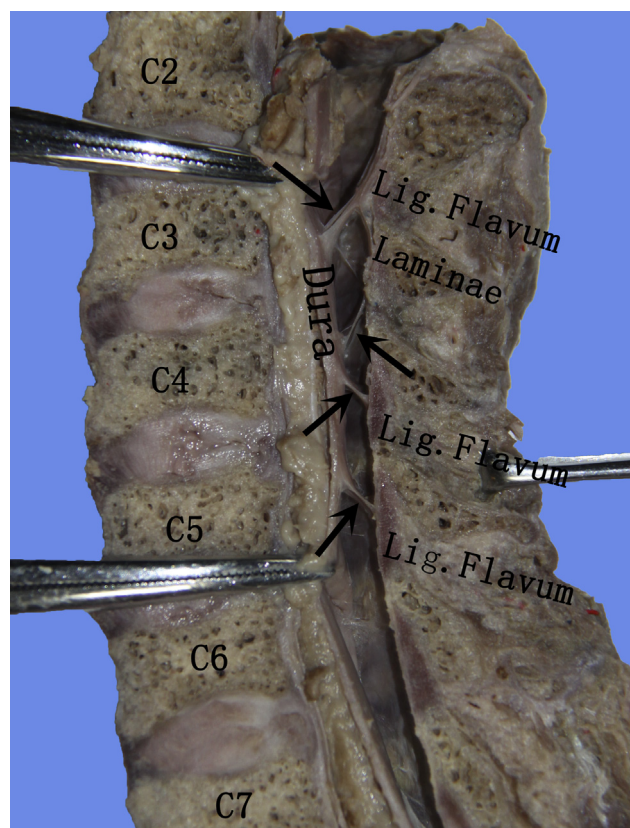


Fig. 1. The dorsal meningovertebral ligaments (black arrow) exist at the levels C2–C6. Lig., ligamentum.

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