# History and Evolution of Laminoplasty

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**KEYWORDS**

• Degenerative cervical myelopathy • Ossified posterior longitudinal ligament • Multisegmental lesion • Posterior decompression • Expansive laminoplasty • Evolution of surgical procedure • Recent advance in implants

**KEY POINTS**

- Expansive laminoplasty for degenerative cervical myelopathy and ossified longitudinal ligament is reviewed, focusing on the history of the surgical procedure.
- Laminoplasty was developed by Japanese orthopedic surgeons from the 1970s to 1980s to overcome adverse conditions related to laminectomy.
- Recent laminoplasty techniques offer less invasive maneuvers to obtain better functional outcome, but every operation is carried out based on the unchanged initial concept.
- Complications related to laminoplasty and some potential solutions are introduced, with some literature review.
- Modifications of the surgical techniques and development of new implants are also discussed.

## INTRODUCTION

Surgical treatment of degenerative cervical myelopathy and ossified posterior longitudinal ligament (OPLL) is intended to release the spinal cord from cord-compressing pathology, by either direct removal of the cord-compressing lesion through the anterior approach or indirect decompression of the spinal cord through the posterior approach. Laminectomy has been the main method of the posterior approach, and has become safer with the development of high-speed drills. However, surgical outcomes have been significantly affected by the complications of postlaminectomy kyphosis (25%) and anterior subluxation (40%) even in patients with cervical radiculopathy.[1] Late neurologic deterioration caused by local epidural scar formation, the so-called laminectomy membrane, may also occur. Laminoplasty was developed by Japanese orthopedic surgeons from the 1970s to the 1980s to overcome these problems with conventional laminectomy. Since then, laminoplasty has been accepted as one of the standard techniques for posterior decompression among Japanese spine surgeons. Recently, laminoplasty has been associated with less invasive maneuvers to the posterior cervical muscle structures that reduce axial neck pain and obtain better functional outcome, but every operation is carried out based on the unchanged initial concept.

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Here the development and 45-year history of cervical laminoplasty is described, and its evolution is discussed with some literature review. Some recent attempts to improve the surgical results are also discussed, focusing on less-invasive maneuvers to the posterior muscle structures and the development of implants.

## Z-SHAPED LAMINOPLASTY

The original concept of cervical laminoplasty was based on extensive simultaneous multisegmental laminectomy for cervical OPLL, as initially described by Miyazaki and Kirita in 1968, and reported in 1986.[2] This technique starts with attenuation of the laminae, and laminotomy in the midline with the drill. Then the lateral gutters are formed until the laminae are bent and elevated. The remaining laminar edges are finally removed with scissors. Expeditious and simultaneous elevation of the multiple laminae is considered to be important to prevent localized posterior shift of the spinal cord after decompression, which may cause postoperative neurologic deterioration. Based on this concept of extensive simultaneous multisegmental decompression, several surgical procedures without resection of the elevated laminae were introduced in the following 15 years.

The first expansive laminoplasty was described by Oyama and colleagues[3] in 1973 as "expansive Z-shaped laminoplasty." The attenuated laminae are cut into Z-shape and elevated for suturing on the midline (**Fig. 1**). The posterior spinal canal is reconstructed to prevent scar formation over the dural surface, which is also expected to minimize reduction of spinal stability. The introduction of the high-speed automated surgical burr was important in establishing this procedure.[4]

## EN BLOC LAMINOPLASTY

En bloc laminectomy in which laminotomies are carried out bilaterally along the lateral margin of the spinal canal to separate laminae from the articular processes was introduced by Tsuji.[5] This procedure has been the principal technique for extensive multisegmental posterior decompression since 1978. This technique was modified to en bloc laminoplasty by reflecting the laminae as a flap to permit floating over the dural surface, without fixing sutures or bone grafting.[6] This technique was further modified to stabilize the laminar flap using bone blocks and wire ligatures to achieve stable and thorough decompression of the spinal canal.[7] Open-door laminoplasty (described later) was developed based on this modified technique of en bloc laminoplasty.[8]

Another modification of en bloc laminoplasty by a Japanese neurosurgeon involved insertion of hydroxyapatite (HA) beads between the cut surfaces of the laminae.[9] Because of the complexity and pitfalls in the surgical maneuvers, this procedure is no longer included as a standard treatment option.

## OPEN-DOOR LAMINOPLASTY

Unilateral open-door laminoplasty was introduced by Hirabayashi and coworkers in 1977,[10–12] and continues to be one of the standard techniques for posterior decompression of the cervical spine (**Fig. 2**). Gutters are created with the high-speed drill at the junction between the articular processes and the laminae. The gutters on the dominant side of the symptoms are cut completely to achieve laminotomy, and the spinous processes and the laminae are displaced laterally to the hinges of the gutters on the opposite side. The spinal canal is enlarged by opening the posterior bony elements, and the laminae are kept open with three or four sutures on the facet capsule on the hinge side.[12] The benefits of these procedures are to allow simultaneous decompression of multiple segments, and to preserve the posterior muscle structures that prevent postoperative

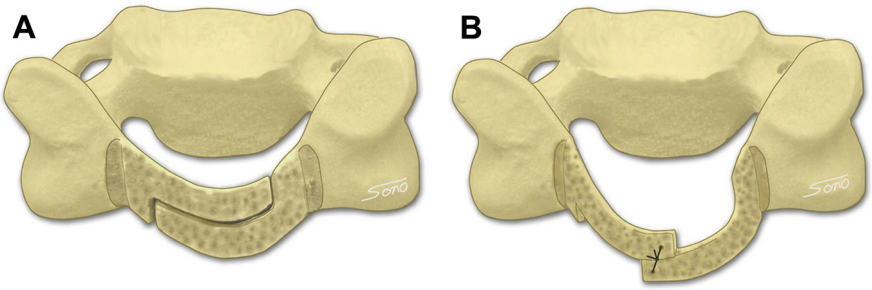


**Fig. 1.** Surgical diagrams of Z-shaped laminoplasty. (*A*) Laminae are attenuated with the drill, and Z-shaped laminotomies are formed in each lamina. (*B*) Split laminae are elevated and sutured to reconstruct the expanded spinal canal.