

Clinical Study

Delayed hinge fracture after plate-augmented, cervical open-door laminoplasty and its clinical significance

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Abstract

BACKGROUND CONTEXT: Among the various forms of laminoplasty fixation, plate augmentation provides a semirigid arch reconstruction and is gaining popularity as the result of its safety and effectiveness. However, the effects of this procedure on hinge status and subsequent bony healing remain unclear.

PURPOSE: We sought to evaluate the status and time course of bony healing of the hinge gutter and to determine the effect on postoperative clinical course of plate-only, open-door cervical laminoplasty.

STUDY DESIGN: This was a retrospective clinical series.

PATIENT SAMPLE: A total of 79 adult men and women undergoing cervical laminoplasty in a university hospital setting were studied.

OUTCOME MEASURES: Time-dependent changes in hinges observed on computed tomography (CT) were used to measure the radiological outcome. A numerical rating scale of axial neck pain and arm pain was used to evaluate the clinical outcome.

METHODS: Patients who underwent plate-only, open-door laminoplasty for cervical myelopathy and had available postoperative CT scans were enrolled in this study. Neck pain intensity before and 1 year after surgery was assessed with questionnaires. CT scans (n=125) obtained after surgery were assessed in terms of bony healing of the hinge.

RESULTS: Most of the hinges were initially well-bent. Only 9% were found to be “fractured” or “in danger of fracture” at 1 week. Primary healing without callus formation, which is the next step of bony healing of well-bent hinges, was observed in 62% of cases at month 4. The remaining 38% were classified as “fractured” or in the process of “secondary healing.” A similar number of hinges was classified as “secondarily healed” after 1 or 2 years of follow-up. All except one hinge were well united and incorporated at the final follow-up, and the number of hinges classified as “fractured or secondarily healed” related to postoperative axial neck pain with respect to the 1-year visual analog scale for the neck and the Neck Disability Index.

CONCLUSIONS: Although plate-only, open-door laminoplasty is a safe and reliable surgery for decompression of multilevel cervical disease, the fixation that it provides on the open side may not be sufficiently stable to allow successful primary healing. Additional attention should be paid to the hinged side to prevent delayed fracture in the early postoperative period and to reduce postoperative axial pain. © 2014 Elsevier Inc. All rights reserved.

Keywords:

Postoperative axial pain; Hinge fracture; Cervical laminoplasty; Plate-augmented open-door laminoplasty

FDA device/drug status: Approved (Miniplates laminoplasty fixation system).

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EVIDENCE & METHODS

Context

The use of plates to support open door laminoplasty is now common. The authors evaluated bone healing within the hinge gutter side after surgery.

Contribution

The group found that approximately two thirds of cases healed via primary healing (ie, without callus) while the remaining cases demonstrated secondary healing (ie, with callus formation). The authors interpreted this to suggest that fracture, as opposed to the desired hinge bending, occurred in these latter cases. Interestingly, secondary healing was associated with more neck and/or shoulder pain.

Implications

There are limitations to the study, as timing of the CT scans was not controlled in addition to a number of confounders for pain. Thus, strong conclusions cannot be drawn at this time. Nonetheless, the information suggests that efforts to avoid hinge fracture, or to support healing via local graft or some other graft material, may be worthwhile.

—The Editors

Introduction

Laminoplasty provides decompression of the spinal canal over multiple segments without causing serious neurologic complications and aims to reconstruct the stable laminar arch with sufficient room for the decompressed spinal cord. To achieve this, many authors have introduced various modifications of this technique [1–5]. Although the modes of elevation and methods of fixation differ slightly, the basic principle of this technique is elastic deformation of thinned lamina, which allows complete healing. To avoid mechanical breakdown of deformed lamina, the open side must be detached before drilling the hinge side, and hinge stability must be frequently checked during elevation by pushing the spinous process [4]. Even with these surgical precautions, prevention of breakdown is sometimes difficult. Hinge fractures (HFs) that form during elevation of the lamina can cause pain or palsy that may be chronic [4,6]. Moreover, although greenstick deformation was created ideally, a delayed fracture can occur as the result of inherent mechanical weakness of the deformed lamina, especially if a less rigid form of fixation is used. Fortunately, the hinge heals in most cases without any serious complications [7–10]. However, systematic data showing the overall status of the hinge and its clinical implications have yet to be published. Therefore, the purpose of this study was to radiographically evaluate the status of

the hinge and correlate unfavorable radiographic findings with primary clinical measures.

Patients and methods

From February 2005 to January 2011, 113 patients with cervical myelopathy underwent open-door laminoplasty in our hospitals. Among them, 79 patients who had postoperative computed tomography (CT) scans within 2 years were enrolled in this study. All of the 79 patients exhibited myelopathic symptoms, such as motor weakness, sensory disturbance, or voiding difficulties. Table 1 shows the demographics of the study patients. There were 45 patients with spondylotic myelopathy, 31 with symptomatic ossification of the posterior longitudinal ligament, and three with developmental stenosis. The mean age of the patients was 58 years (range, 32–78 years). The male/female ratio was 52:27, or roughly 2:1.

All surgeries were performed by a senior surgeon who used a modification of the classic Hirabayashi open-door technique, which consists of securing the opened lamina with a titanium miniplate [11]. The number of levels operated on depended on the pattern of cord compression. The patient position, incision, and dissection were the same as for other routine cervical laminoplasties. Gutters were created at the junction of the lateral mass and lamina. A 2-mm cutting burr was used on the open side and a 3-mm burr on the hinge side. The inner cortex of the open-side gutter was removed using a 1-mm Kerrison rongeur, with the surgeon thinning the ventral cortex until a greenstick deformation of the hinge could be produced. Laminal elevation and miniplate fixation were performed singly in a rostrocaudal direction. We usually left the sublaminar membrane just below the gutter on the open side and allowed free

Table 1
Patient characteristics

| Parameters | N | Mean±SD (range) |
|-----------------------------------|-------|-----------------|
| Patients enrolled | 79 | |
| Age, y | | 58±10 (32–78) |
| Sex (male/female) | 52/27 | |
| Lamina operated | | 4.3±0.9 (3–7) |
| Number of hinge made | | 3.4±0.8 (2–5) |
| Involvement of C2 or C7 | | |
| Neither | 41 | |
| Either | 36 | |
| Both | 5 | |
| Preoperative C2–C7 lordotic angle | | |
| Lordotic (>10°) | 68 | |
| Straight (0–9°) | 11 | |
| Kyphotic (<0°) | 0 | |
| CT scans obtained postoperatively | 125 | |
| 1 wk | 32 | |
| 4 mo | 52 | |
| 1 y | 20 | |
| 2 y | 21 | |

CT, computed tomography.

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