The Spine Journal 16 (2016) 1062–1069

Clinical Study

Laminar closure after expansive open-door laminoplasty: fixation methods and cervical alignments impact on the laminar closure and surgical outcomes

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Received 25 November 2015; revised 20 April 2016; accepted 27 April 2016

Abstract

BACKGROUND CONTEXT: Although several laminar fixation methods in expansive open-door laminoplasty (EODL) have been reported, the differences in outcomes between the methods have not been well understood.

PURPOSE: The aim of this study were to investigate the impact of laminar fixation methods and cervical spine alignment after EODL on clinical and radiological outcomes, and to investigate the impact of laminar closure on clinical outcomes.

STUDY DESIGN: This study is a retrospective review of clinical and radiological data.

PATIENT SAMPLE: The inclusion criteria were having undergone EODL with suture anchor (n=74, Anchor group) or hydroxyapatite spacers (n=65, Spacer group) for cervical spondylotic myelopathy (CSM). Different surgical procedures were used during two time periods: anchor technique from 2001 to 2006, and spacer technique from 2007 to 2012.

OUTCOME MEASURES: Japanese Orthopaedic Association (JOA) scores for cervical myelopathy were recorded. Cross-sectional areas (CSA) were measured preoperatively, and at 1 week, 6 months, and 2 years postoperatively at each level (C3–C6) using reconstructed axial computed tomography (CT) images. The CSA decrease of more than 20% was defined as laminar closure.

METHODS: The JOA scores and the CSA values were compared between the two groups (Anchor group vs. Spacer group) and subgroups (preoperative kyphosis vs. lordosis alignment, closure vs. non-closure groups).

RESULTS: In both groups, the mean CSA decreased at 6 months postoperatively compared with that at 1 week postoperatively. The CSA further decreased at 2 years postoperatively in the Anchor group but remained unchanged after 6 months in the Spacer group. The CSA remained unchanged in patients with preoperative lordosis in both groups. However, patients with kyphosis in the Anchor group showed a continuously decreasing CSA throughout the follow-up period, whereas CSA was stable in patients with kyphosis in the Spacer group ($p<.01$). Although the preoperative JOA scores did not differ between the closure and non-closure group ($p=.924$), the JOA score was significantly worse in the closure group at 1 and 2 years postoperatively ($p=.023$ and $p=.011$ respectively).

CONCLUSIONS: The patients with CSM with kyphosis in the Spacer group experienced significantly less laminar closure after EODL compared with patients in the Anchor group. Laminar closure greater than 20% was associated with poor outcome. Therefore, spacer fixation is preferable to anchor screw fixation during EODL in patients with kyphosis.

Keywords: Cervical alignment; Cervical myelopathy; Laminar closure; Laminar fixation; Laminoplasty; Outcome assessment

FDA device/drug status: Not applicable.

Author disclosures: ***KT:*** Nothing to disclose. ***AS:*** Nothing to disclose. ***HidT:*** Nothing to disclose. ***HirT:*** Nothing to disclose. ***MH:*** Nothing to disclose. ***HN:*** Nothing to disclose.

This study protocol was approved by the Institutional Review Board of Osaka City University.

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http://dx.doi.org/10.1016/j.spinee.2016.04.018
1529-9430/

Introduction

Expansive open-door laminoplasty (EODL), developed and described by Hirabayashi et al in 1981 [1], has been widely used as a posterior decompression method for treating cervical spondylotic myelopathy (CSM), disc herniation, ossification of the posterior longitudinal ligament, and adjacent segment degeneration after anterior cervical decompression and fusion [2]. In the original method, the laminae are held open by stay sutures placed between the laminae and the muscles surrounding the facet joints [1,2]. Although Hirabayashi et al's original method was simple and cost-effective, postoperative laminar closure is a major complication of this procedure [3,4]. Therefore, several modified methods using autologous spinous processes [5,6], anchoring screws [7,8], plates [9,10] [11] [12], or hydroxyapatite (HA) spacers [13] to hold the laminae open have been developed. These procedures can be divided into two groups according to the way the laminae are held together. In the first group, the anchor fixation group, the laminae are held together with strings, as in the original method, and suture anchor screws. In the second group, the spacer fixation group, the laminae are held together rigidly using spacers made by autologous spinous processes, metal plates, or HA blocks. Several studies have evaluated the differences between these two fixation methods [14]; however, their impact on the stability of the opened laminae is not well understood. Also, although cervical alignment is an important factor in EODL outcome [15–18], to the best of our knowledge, there are no reports on the association between cervical alignment and efficacy of these fixation methods. The present study therefore aimed to (i) identify any differences in clinical and radiological outcomes between anchor and spacer fixation in regard to two cervical alignments: kyphosis and lordosis, and (ii) investigate the impact of laminar closure on clinical outcomes after EODL.

Subjects and methods

The present study was a retrospective analysis of prospectively collected data of patients who underwent EODL for CSM. The study protocol was approved by the Institutional Review Board of Osaka City University.

Patient population

The present study included 218 patients with CSM who underwent EODL at C3–C6 levels at our institution between 2001 and 2012 and were followed up for more than 2 years postoperatively. The patients were excluded if they had cervical disc herniation (n=15) or ossification of the posterior longitudinal ligament (n=29) and surgery performed at other levels (n=25). Finally, a total of 139 patients were included in the analysis (84 men, 45 women; mean age at surgery 64.2 years, age range 35–86 years). They were divided into two groups according to the method used to hold open the laminae. The anchor fixation group (Anchor group) consisted of 74 patients (296 laminae) who had undergone EODL with strings and anchor screws (Fig. 1). The spacer fixation group (Spacer group) consisted of 65 patients (260 laminae) who had undergone EODL with the HA spacer technique (Fig. 2). The operation used depended on the time period of the surgery: between 2001 and 2006, all patients underwent EODL with

EVIDENCE & METHODS

Context

The authors present an interrupted time series comparing two types of fixation for open door laminoplasty in the treatment of patients with cervical kyphosis. At their center, suture anchors were used from 2001–2006 and hydroxyapatite spacers from 2007–2012.

Contribution

The authors include 74 patients in the anchor group and 65 in the spacer group. Across cohorts, laminar closure greater than 20% was associated with inferior outcomes. The authors maintain superior outcomes were associated with spacer fixation as opposed to the use of suture anchors.

Implications

As an interrupted time series, there is the potential that the results could be confounded by evolving technical skills and surgical techniques as opposed to the type of fixation in and of itself. Nonetheless, for clinicians performing expansive open door laminoplasty in patients with cervical kyphosis, this study presents useful information in terms of selection of surgical fixation. Given the sample size as well as the potential for residual confounding, this study presents Level IV data.

—The Editors

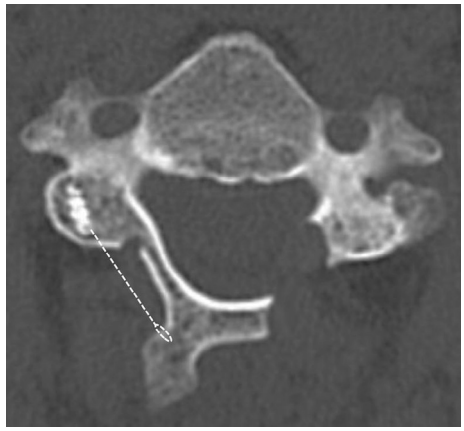

Fig. 1. Illustrative image of anchor screw technique. This image was taken 1 week after surgery. The broken white lines indicate strings that were passed through bone tunnels to connect the implant to the bone.