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The Spine Journal 13 (2013) 384–390

THE SPINE JOURNAL

Clinical Study

Range of motion loss after cervical laminoplasty: a prospective study with minimum 5-year follow-up data

Seung-Jae Hyun, MD, PhD[a], K. Daniel Riew, MD[b], Seung-Chul Rhim, MD, PhD[c,*]

[a]*Department of Neurosurgery, Spine Center, Seoul National University Bundang Hospital, Seoul National University College of Medicine, 300 Gumi-dong, Bundang-gu, Seongnam, Korea*

[b]*Department of Orthopaedic Surgery, Barnes-Jewish Hospital at Washington University, School of Medicine, Suite 1100 WP, 1 Barnes-Jewish Plaza, Campus Box 8233, St. Louis, MO 63110, USA*

[c]*Department of Neurosurgery, Asan Medical Center, University of Ulsan College of Medicine, 388-1 Pungnap-2dong Songpa-Gu, Seoul 138-736, Korea*

Received 22 November 2011; revised 23 June 2012; accepted 26 October 2012

Abstract

BACKGROUND CONTEXT: Although numerous studies have reported on the loss of flexion-extension range of motion (ROM) associated with laminoplasty, few have reported on the time course of this loss of motion for a long-term follow-up period.

PURPOSE: We previously reported our early data on postlaminoplasty cervical ROM. In this article, we describe our minimum 5-year follow-up data to identify the time-dependent change in ROM after cervical laminoplasty.

STUDY DESIGN: A prospective cohort study.

PATIENT SAMPLE: The procedure was performed in 23 patients. Eighteen patients with a minimum 5-year follow-up were included in the study.

OUTCOME MEASURES: The time-dependent neck ROM changes observed in the neutral, flexion, and extension radiographs were used to measure the radiological outcome. The Japanese Orthopaedic Association classification and a numerical rating scale of axial neck pain and arm pain were used to evaluate clinical outcome.

METHODS: Twenty-three patients who received unilateral open-door laminoplasties, including miniplate fixation over three levels, were serially evaluated at regular set intervals postoperatively. Eighteen patients with a minimum 5-year follow-up were included in the study. The mean follow-up period was 68.1 months (range, 60–78 months). Nine patients had ossification of posterior longitudinal ligament (OPLL) and nine patients had cervical spondylotic myelopathy (CSM). Enrolled patients were divided into subgroups (OPLL vs. CSM; autofusion vs. nonautofusion) to compare the ROM between the groups. We evaluated the time-dependent neck ROM changes by taking neutral, flexion, and extension radiographs preoperatively and at 1, 3, 6, 9, 12, 18, and 24 months postoperatively. Follow-up radiographs were taken annually after a 2-year follow-up.

RESULTS: The preoperative and 1-, 3-, 6-, 12-, 24-, 36-, 48-, and 60-month postoperative ROM figures were 39.9±11.2°, 35.0±9.2°, 33.0±11.0°, 30.1±10.4°, 25.8±13.1°, 24.7±10.0°, 23.8±6.5°, 24.6±8.3°, and 23.6±9.4°, respectively, and at the most recent follow-up, ROM was 24.5±10.1°. Thus, the mean ROM decreased by 15.4±8.4° (38.5%) by the last follow-up ($p<.0001$). In the OPLL group, we observed a more limited cervical ROM than in the CSM group (47.2% vs. 72.7%). As expected, in the laminar autofusion group, the ROM decreased significantly (55.6% decrease), whereas in the nonautofusion group, the ROM decreased less significantly

FDA device/drug status: Not applicable.

Author disclosures: ***S-JH:*** Nothing to disclose. ***KDR:*** Biomet (F), Osprey (B), Medtronic Sofamor Danek (G); Stock Ownership: Osprey (10 Shares, 0%), Expanding Orthopedics (Unknown shares, unknown ownership), Spineology (Unknown shares, <0.1% ownership), Spinal Kinetics (Unknown shares, <0.1% ownership), Nexgen Spine (Unknown shares, <0.1% ownership), Amedica (Unknown shares, <0.1% ownership), Vertiflex (Unknown shares, <0.1% ownership), Benvenue (Unknown shares, <0.1% ownership), Paradigm Spine (Unknown shares, <0.1% ownership), PSD (Unknown shares, <0.1% ownership); Board of Directors: Korean Association of Spinal Surgeons (None), Cervical Spine Research Society (None). ***S-CR:*** Nothing to disclose.

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

* Corresponding author. Department of Neurosurgery, Asan Medical Center, University of Ulsan College of Medicine, 388-1 Pungnap-2dong Songpa-Gu, Seoul 138-736, Korea. Tel.: (82) 2-3010-3554; fax: (82) 2-476-6738.

E-mail address: scrhim@amc.seoul.kr (S.-C. Rhim)

1529-9430/$ - see front matter
http://dx.doi.org/10.1016/j.spinee.2012.10.037

(13.4% decrease) at the last follow-up. Postoperative axial pain did not correlate with the cervical ROM.

CONCLUSIONS: These results suggest that the loss of cervical ROM after laminoplasty is time-dependent, and patients with OPLL and laminar autofusion had less ROM. Postlaminoplasty ROM reduction can recover after several years, unless laminar autofusion occurs.

Keywords: Spondylosis; Ossification of the posterior longitudinal ligament; Cervical spine; Laminoplasty; Range of motion

Introduction

Cervical laminoplasty is considered to be a motion preserving operation compared with procedures requiring fusion [1–5]. In recent studies, long-term clinical outcomes after laminoplasty were satisfactory [6–11]. However, several studies have reported that flexion-extension ROM (range of motion) was significantly decreased after laminoplasty [6–9,12].

We previously reported our early data on postlaminoplasty cervical ROM [13,14]. In that study, we found that cervical ROM was reduced after cervical laminoplasty and that the loss of ROM is time-dependent and plateaus by18 months after surgery, with no further decreases thereafter. In the present study, we continued to prospectively follow these patients to determine the long-term results of cervical laminoplasty on ROM and clinical results.

Materials and methods

Between July 2003 and March 2006, 23 patients scheduled for cervical laminoplasty were studied prospectively. Patients in whom kyphotic cervical curvatures were documented were excluded in the previous study [13]. Of these, 18 patients who were followed for 5 years or more after surgery were included in the present study. Of the remaining five patients, two patients died of unrelated causes, two patients underwent follow-up evaluations for less than 5 years, and one patient replied negatively because of his comorbidity (dementia). The mean follow-up period was 68.1 months (range, 60–78 months). There were 12 men and six women. The mean age at surgery was 56.4 years (range, 42–77 years). Nine patients had ossification of posterior longitudinal ligament (OPLL) and nine patients had cervical spondylotic myelopathy (CSM). Enrolled patients were divided into subgroups (OPLL vs. CSM; laminar autofusion vs. laminar nonautofusion) to compare ROM between the subgroups. The subgroup of laminar autofusion was defined as those patients who demonstrated interlaminar bony fusion after cervical laminoplasty. All patients underwent a unilateral expansive open-door laminoplasty augmented with miniplates. All operations were performed by the senior author (SCR), an academic spine surgeon. The decompression extended to one level cranial and caudal to the compressive level(s). If C2 was the most cranial level, a dome laminoplasty, undercutting the undersurface of the lamina, was used. The open side of the lamina was chosen to be the dominant symptomatic side. If there was no dominant side, the left lamina was usually opened. The opened lamina was fixed by placing miniplates and screws. In some patients who presented with radiculopathy, a simultaneous bilateral foraminotomy was conducted using a high-speed drill. All bone work was performed under a microscope. The postoperative cervical collar period was 2 to 4 weeks in all patients.

A series of lateral radiographs, including neutral, maximal flexion, and extension views of the cervical spine, were taken preoperatively and at 1, 3, 6, 9, 12, 18, and 24 months postoperatively to evaluate serial cervical ROM changes. Follow-up radiographs were taken annually after the 2-year follow-up. The range of motion of the cervical spine was calculated as the difference between the lordotic and kyphotic angles measured during extension and flexion, respectively [13]. Angles created by a line parallel to the inferior aspect of the C2 body and a line parallel to that of the C7 body were measured on the flexion and extension lateral radiographs and a total ROM value was obtained by the summation of these angles. These measurements were performed over three times by one of the authors and an independent experienced musculoskeletal radiologist to reduce the intra- and interobserver bias. These two observers also identified interlaminar bony fusion, which was evaluated using lateral radiographs taken at maximal flexion and neutral positions. All measurements were made using a picture-archiving and communications system, DICOM (version 3.0; CompuMed, Inc., Tucson, AZ, USA). Besides imaging, postoperative neck pain was evaluated using a numeric rating scale (NRS; score range 0–10, with 10 indicating the worst pain) [15]. The NRS scores were compared with cervical ROM to determine if there was any correlation. The Japanese Orthopaedic Association (JOA) classification was used to ascertain the severity of cervical myelopathy. Furthermore, the neurologic recovery rate at the last follow-up was calculated from pre- and postoperative JOA scores.

For statistical analysis, SPSS software (version 12.0, 2003; SPSS, Inc., Chicago, IL, USA) was used. ROM changes over time were assessed using Student t test or the Mann-Whitney U test to seek a trend. Possible univariate association between ROM changes and NRS scores was tested using Spearman rank correlation coefficients. Intra- and interobserver reliability of the measurements was estimated using kappa statistics. A p-value of less than