

Clinical Study

Is more lordosis associated with improved outcomes in cervical laminectomy and fusion when baseline alignment is lordotic?

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Abstract

BACKGROUND CONTEXT: In cervical spondylotic myelopathy (CSM), cervical sagittal alignment (CSA) is associated with disease severity. Increased kyphosis and C2–C7 sagittal vertical axis (SVA) correlate with worse myelopathy and poor outcomes. However, when alignment is lordotic, it is unknown whether these associations persist.

PURPOSE: The study aimed to investigate the associations between CSA parameters and patient-reported outcomes (PROs) following posterior decompression and fusion for CSM when baseline lordosis is maintained.

STUDY DESIGN/SETTING: This is an analysis of a prospective surgical cohort at a single academic institution.

PATIENT SAMPLE: The sample includes adult patients undergoing primary cervical laminectomy and fusion for CSM over a 3-year period.

OUTCOME MEASURES: The PROs included EuroQol-5D, Short-Form-12 (SF-12) physical composite (PCS) and mental composite scales (MCS), Neck Disability Index, and the modified Japanese Orthopaedic Association scores. Radiographic CSA parameters measured included C1–C2 Cobb, C2–C7 Cobb, C1–C7 Cobb, C2–C7 SVA, C1–C7 SVA, and T1 slope.

METHODS: The PROs were recorded at baseline and at 3 and 12 months postoperatively. The CSA parameters were measured on standing radiographs in the neutral position at baseline and 3 months. Wilcoxon rank test was used to test for changes in PROs and CSA parameters, and Pearson correlation coefficients were calculated for CSA parameters and PROs preoperatively and at 12 months. No external sources of funding were used for this work.

RESULTS: There were 45 patients included with an average age of 63 years who underwent posterior decompression and fusion of 3.7±1.3 levels. Significant improvements were found in all PROs except SF-12 MCS ($p=.06$). Small but statistically significant changes were found in C2–C7 Cobb (mean change: +3.6°; $p=.03$) and C2–C7 SVA (mean change: +3 mm; $p=.01$). At baseline, only C2–C7 SVA associated with worse SF-12 PCS scores ($r=-0.34$, $p=.02$). Postoperatively, there were no associations found between PROs and any CSA parameters. Similarly, no CSA parameters were associated with changes in PROs.

CONCLUSIONS: Although creating more lordosis and decreasing SVA are associated with improved myelopathy and outcomes in patients with kyphosis, our study did not find such associations

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in patients with lordosis undergoing posterior laminectomy and fusion for CSM. This suggests that any amount of lordosis may be sufficient. © 2016 Elsevier Inc. All rights reserved.

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Introduction

Cervical spondylotic myelopathy (CSM) caused by repetitive, dynamic compression of the spinal cord from degenerative changes is one of the most common causes of spinal cord dysfunction in the world [1,2]. Cervical spondylotic myelopathy leads to progressive neurologic deficits; hence, there is little role for non-surgical management [3]. Clinical improvements following surgery have been demonstrated using both anterior and posterior approaches [4], with cervical sagittal alignment (CSA) often cited as a primary factor in surgical approach planning [5–7]. Further, CSA has been demonstrated to correlate both with baseline disease severity [8,9] as well as postoperative outcomes [10,11]. Recent studies have shown that when baseline kyphosis is present, increased sagittal vertical axis (SVA) and more kyphosis are associated with worse myelopathy and poor outcomes [8,10]. Other studies have shown discrepancies in the associations between CSA parameters and outcomes based on the overall cervical alignment (lordotic vs. kyphotic) [8,9] and surgical approach (anterior vs. posterior) [10]. Therefore, focusing on a more homogenous patient population with CSM may allow for a better understanding of the potential correlations between CSA and outcomes.

Studies have discovered a seemingly paradoxical relationship between overall sagittal alignment and the associations found between CSM disease severity and CSA parameters. Mohanty et al. did not find an association between CSA and severity of myelopathy, function, or disability in patients with maintained lordosis [8]. However, when kyphosis was present, increasing SVA was associated with qualitative magnetic resonance imaging (MRI) parameters and myelopathy severity. Similarly, Smith et al. demonstrated paradoxically opposite correlations between MRI parameters and disease severity based on whether overall cervical alignment was lordotic or kyphotic [9]. Animal and human cadaveric models have also shown that kyphosis can result in decreased perfusion, increased intramedullary cord pressure, and increased neuronal loss [12–14]. Considering these results, patients with lordosis versus kyphosis should likely be considered independently when evaluating potential associations between CSA parameters and outcomes.

Recent studies have also demonstrated associations between CSA and outcomes following surgery for CSM. Tang et al. looked at a heterogeneous group of patients undergoing posterior cervical fusion, and found correlations between postoperative SVA and patient outcomes [11]. However, only a minority of these

patients had myelopathy and there were no baseline radiographic or patient outcomes, making the interpretation of these results problematic. Roguski et al. found increased postoperative SVA to be associated with worse patient outcomes and myelopathy in those undergoing either anterior or posterior surgery [10]. Interestingly, they also found postoperative SVA to be an independent predictor of outcomes in those undergoing posterior surgery, but not in those who had anterior surgery. Thus, surgical approach may also impact associations found between CSA parameters and outcomes.

The purpose of the present study was to investigate the possible association between CSA parameters and patient-reported outcomes (PROs) following posterior decompression and fusion in the treatment of CSM for patients with maintained cervical lordosis. Based on the results of the aforementioned studies, we hypothesized that greater lordosis and lower SVA would be associated with less patient disability and myelopathy severity both at baseline and postoperatively.

Materials and methods

Patients

With institutional review board approval, all adult patients who underwent posterior cervical laminectomy and instrumented fusion for CSM from 2010 to 2013 at a single academic institution were retrospectively reviewed. All patients were enrolled in an outcomes registry at baseline. The diagnosis of myelopathy was made based on physical examination findings in combination with cervical spinal cord compression demonstrated on MRI or computed tomographic myelogram. No cases of trauma, tumor, or infection were included. Patients were excluded if they (1) did not have standing cervical radiographs at baseline and at 3 months postoperatively; (2) did not complete PRO measures at 12 months postoperatively; or (3) had previous cervical spine surgery or (4) had cervical kyphosis. Cervical kyphosis was defined as a C1–C7 Cobb angle greater than zero degrees.

Surgical treatment

All patients reviewed underwent posterior cervical central laminectomy with lateral mass screw and rod instrumentation. The operations were performed by four separate spine surgeons at our institution, each with at least 5 years of postgraduate experience in spine surgery. Patients were in the

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