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Case study

The relationship between cervical lordosis and Nurick scores in patients undergoing circumferential vs. posterior alone cervical decompression, instrumentation and fusion for treatment of cervical spondylotic myelopathy

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ABSTRACT

The loss of regional cervical sagittal alignment and the progressive development of cervical kyphosis is a factor in the advancement of myelopathy. Adequate decompression of the spinal canal along with reestablishment of cervical lordosis are desired objectives with regard to the surgical treatment of patients with cervical spondylotic myelopathy. A retrospective chart review was conducted in which patients who underwent either a combined anterior/posterior instrumentation and decompression or a posterior alone instrumentation and decompression for the treatment of CSM at our institution were identified. Any patient undergoing operative intervention for trauma, infection or tumors were excluded. Similarly, patients undergoing posterior instrumentation with constructs extending beyond the level of C2–C7 were similarly excluded from this study. A total of 67 patients met the inclusion criteria for this study. A total of 32 patients underwent posterior alone surgery and the remaining 35 underwent combined anterior/posterior procedure. Radiographic evaluation of patient's preoperative and postoperative cervical lordosis as measured by the C2–C7 Cobb angle was performed. Each patient's preoperative and postoperative functional disability as enumerated by the Nurick score was also recorded. Statistical analysis was conducted to determine if there was a significant relationship between improvement in cervical lordosis and improvement in patient's clinical outcomes as enumerated by the Nurick Score in patients undergoing posterior alone versus combined anterior/posterior decompression, instrumentation and fusion of the cervical spine.

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1. Introduction

Maligned sagittal balance has been shown to correlate with persistent pain and disability with regards to overall spinal alignment [1]. Recently there has been more emphasis on examining the effects of sagittal balance on functional outcome scores and neck pain [2]. The physiologic orientation of the cervical spine falls within a wide range of approximately 20–40 degrees of lordosis from C2 to C7 [3]. Shamji et al. recently demonstrated that patients with more severe cervical kyphosis preoperatively show a lesser improvement in their myelopathic symptoms postoperatively [4]. Therefore, the restoration of cervical lordosis is a desirable surgical

outcome with regards to instrumentation of the cervical spine thus contributing to restoration of regional alignment [5]. Traditionally, the surgical objectives involved in the treatment of cervical spondylotic myelopathy (CSM) focus on a thorough decompression of the neural elements. However, not only is decompression of the neural elements paramount but particular attention is placed towards the restoration of the anatomic orientation of the cervical spine. Additionally, posterior stabilization after decompression is needed in preventing the development of worsening kyphotic deformity [6]. Given the conventional emphasis on maintaining and re-establishing cervical lordosis with regard to the surgical treatment of CSM, we sought to specifically examine whether there is a correlation between lordotic improvement of the cervical spine postoperatively and overall clinical improvement in patient's myelopathic symptoms as enumerated by the Nurick score. Two

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Grade 0	Signs of root involvement no evidence of spinal cord disease
Grade 1	Sign of spinal corde diseases but no difficulty walking
Grade 2	Slight difficulty walking which does not prevent full-time employment
Grade 3	Gait difficulty preventing employment
Grade 4	Unable to walk without assistance
Grade 5	Chairbound or bedridden

Fig. 1. Nurick Score Table.

Table 1

Preoperative and postoperative Nurick scores and lordosis values for patient undergoing a posterior decompression, instrumentation and fusion.

Variable	Posterior Cervical Decompression & Instrumentation						
	N	Mean	Std Dev.	Median	Minimum	Maximum	Quartile Range
Pre-op Nurick score	32	2.50	1.11	2	0	5	1
Post-op Nurick score	32	1.34	1.10	1	0	4	1
Pre-op cervical lordosis	32	6.91	6.90	4.00	0.60	30.90	5.85
Post-op cervical lordosis	32	8.07	6.10	6.00	1.40	24.70	5.35

groups of patients were compared in this study, those who underwent posterior decompression and instrumentation alone and those who underwent a combined anterior/posterior decompression, instrumentation and fusion.

2. Materials and methods

After institutional review board approval was obtained a retrospective chart review was conducted identifying patients who underwent either posterior alone or combined anterior/posterior cervical decompression, instrumentation and fusion. All cases were performed by three fellowship trained spine surgeons at our institution between 2010 and 2014. The minimum follow up time for this study was 2 years. Those patients presenting for surgical intervention secondary to tumor, infection or trauma were excluded from this study. Additionally, patients with constructs extending beyond the levels of C2–C7 were excluded from this study. Generally these patients with constructs spanning the cervicothoracic junction were being operated on within the context of a revision surgery and were therefore not included in our study. Our patient population was limited to those undergoing a primary procedure whether that be a posterior or a circumferential procedure for the treatment of CSM. Of note those patients treated with an anterior procedure had a degree of variability in terms of the surgical procedure performed. Of the 35 patients who had anterior procedure 27 underwent discectomy, placement of wedged intervertebral allograft and anterior plating; 4 underwent corpectomy, placement of fibular strut graft and anterior plating and lastly 4 underwent corpectomy, placement of PEEK cage and anterior plating. However, all patients who underwent a circumferential reconstruction did so in a uniform sequence; with all patients undergoing an anterior surgery prior to any posterior procedure.

Preoperative radiographs of the cervical spine were analyzed for each patient using the C2–C7 sagittal Cobb angle to determine the amount of preoperative cervical lordosis present. Follow up postoperative radiographs were reviewed in a similar fashion to determine the amount of lordotic correction obtained.

A review of the patient's medical records was performed to determine the severity of their preoperative myelopathy as enumerated by the Nurick score. Of the available clinical outcome measures only the Nurick scale was used in assessing patient's clinical progression. This was the only uniform outcome score utilized by all three spine surgeons at our institution. Clinical scores ranged between 0 and 5. A score of 0 corresponding with

symptoms of root involvement only without spinal cord compromise. A score of 5 corresponding with severe myelopathy with patient's being bedridden/wheelchair bound secondary to their myelopathic symptoms (Fig. 1).

Statistical analysis was performed to determine the relationship between the lordotic changes postoperatively and overall change in the Nurick score for each group of patients (SAS/STAT v9.4, SAS Institute, Inc., Cary, North Carolina). Additionally, analysis was performed to determine whether there was a significant difference in the amount of lordotic correction and overall improvement in Nurick score obtained between those patients undergoing posterior alone surgery and those who underwent a circumferential procedure.

3. Results

A total of 67 patients met the inclusion criteria for this study, $n = 32$ for the posterior decompression group with an average age of 65 years and $n = 35$ for the anterior/posterior group with an average age of 61 years. The indication for surgical intervention in all patients was clinical evidence of myelopathy. The average mid-sagittal canal diameter at the level of greatest stenosis as evidenced by MRI imaging was determined to be 6.08 mm in the posterior alone group and 9.31 mm in the combined anterior/posterior group. The average preoperative Nurick score in patients in the posterior alone group was determined to be 2.50. Additionally, the average preoperative lordosis in this patient group was determined to be 6.91°. For the posterior alone group the collective post-operative lordosis improved to 8.07° with an overall improvement in Nurick score of 1.34 (Table 1). For patients undergoing an anterior/posterior procedure the average preoperative lordosis and Nurick score were determined to be 7.8° and 2.0 respectively. Postoperatively these values improved with an average lordosis and Nurick score of 9.31° and 1.29 respectively (Table 2).

Statistical analysis was subsequently performed to firstly determine whether there is a significant relationship between the degree of lordotic correction obtained post-operatively and improvement in patient's clinical picture as measure by the Nurick score for all patients in our study. For all patients there was an average of 1 point decrease in Nurick score after surgery and an average of 1.3° increase in cervical lordosis after surgery (Table 3). There appears to be an inverse relationship between Nurick scores and degree of cervical lordosis. Indicating that for every degree of increase in lordosis there is a decrease in Nurick score. However,

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