

Significant Surgical Improvement in Neurological Function in an Older Female with Cervical Spondylotic

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1. Abstract

1.1. Introduction

Cervical spondylotic myelopathy (CSM) is a progressive disorder that is the most common cause of spinal cord dysfunction worldwide. No case studies known provide an in-depth report of an older woman with severe CSM and the effect of prompt intervention. Here we present a case study to fill this gap.

1.2. Case Report

A 75-year-old female presented with bilateral upper and lower extremity weakness, radiating neck pain to her right arm, and wheelchair-dependence. Magnetic resonance imaging of the cervical spine revealed severe degenerative changes that resulted in spinal cord compression at levels C3-C4 and C4-C5. The patient was diagnosed with CSM based on clinical and radiographic findings. Her initial Neck Disability Index (NDI) and modified Japanese Orthopaedic Association (mJOA) scores were both in the severe range. After the patient failed conservative management, an anterior cervical discectomy and fusion followed by a posterior cervical fusion were performed to decompress the spinal cord and correct the degenerative changes. The patient's NDI improved to moderate disability, and her mJOA scores improved to mild myelopathy. At six months follow-up, the patient no longer required a wheelchair.

1.3. Conclusion

Despite the patient's advanced age and initial severity of disease, she had significant functional improvement following surgery, highlighting the potential therapeutic benefits of this approach for an older female with CSM.

2. Introduction

Cervical spondylotic myelopathy (CSM) represents 54% of nontraumatic spinal cord injury in North America, making it the most common form of spinal cord injury in adults [1]. This progressive condition is marked by degenerative changes that affect the vertebrae, intervertebral discs, and associated ligaments, ultimately leading to compression of the spinal cord and/or surrounding blood supply [2]. Hallmark symptoms include loss of manual dexterity, weakness, stiffness, sensory loss, increased urinary urgency, frequency or hesitancy, spasticity in the extremities, balance disturbance, and gait dysfunction [1]. Without surgical intervention, the natural history of CSM suggests 20% to 60% of patients deteriorate neurologically over time [3]. Surgery for CSM tends to be associated with significant improvement [4]. What is known within the literature of surgical intervention for patients with CSM, however,

stems predominantly from larger group studies that focus on a majority of male patients

Yet, we know that males and females have key anatomical and biological differences that may predispose them to experience and recover from CSM differently. For example, current research shows differences in aging based on sex, including divergence in bones during development [5] and menopause [6]. Specifically, post-menopause can be a time of heightened musculoskeletal symptoms for females [7]. Furthermore, females experience significantly increased rates of osteoporosis [8], bone fractures [8] and osteoarthritis [9] compared to males. All of these factors may be important to consider, specifically within the treatment of a degenerative spinal disease like CSM.

A literature search revealed that there is a dearth of information specific to relative older females with CSM. For instance, one representative study focused on the outcomes of patients after decompression surgery for treatment of CSM (57 males and 24 females with a mean age of 57 years), and revealed significant functional gains for patients. Very few patients in this sample were older adults, however, and even fewer older females [4]. We know of only one larger study in the literature that examined an older patient population with a majority of female patients. This study documented 36 older patients with CSM (> 75 years old; 17 males and 19 females), and 34 younger patients with CSM (< 65 years old; 16 males and 18 females). Findings indicated that age did not predict neurological outcome [10]. While this study included males and females, the analyses focused only on the variable age, leaving it unclear the extent to which males and females differed in their surgical outcomes. Larger group studies are valuable in that they describe overall mean-level trends, but they lack the rich detail of a case report, which can document protocols and specific neurological and functional improvement that may be relevant to a particular demographic.

The extant case studies fill this gap somewhat, but they also fail to report comprehensively on any older females. Several of these cases depicted the surgical intervention of patients with CSM and their significant improvement in symptoms. For instance, one case focused on a 50-year-old male with CSM whose pain, function, and weakness improved significantly following surgical intervention [11]. Another case study featured a 79-year-old male who suffered significant CSM symptoms leading up to surgery, including the inability to walk without a frame. He underwent a posterior cervical decompression and fusion from C3-C5 which resulted in reduced arm numbness, and the ability to ambulate with two sticks three and a half weeks postoperatively [12].

We found one case study that featured a 62-year-old female, but her postoperative recovery following spine surgery was not extensively

detailed [13]. For example, the case did not report her standing on specific measures post-operatively such as the Modified Japanese Orthopaedic Association (mJOA) or the Neck Disability Index (NDI). We also found a case study featuring a 65-year-old female, but it also did not report on these measures [14]. There still remains a gap in the literature for an extensive case study of an older female with CSM.

3. Case Report

A 75-year-old female with a history of carpal tunnel, cubital tunnel, and osteoarthritis presented to the office with neck pain that radiated down her right arm and had persisted for three months. There was no relevant family or social history. The patient first saw spine pain management for her discomfort, underwent several weeks of physical therapy, and was prescribed Meloxicam, but neither pain nor functional disability improved. The patient scored the pain in her neck a 10/10 in severity, had limited manual dexterity, and significant proximal upper limb weakness. Furthermore, her NDI score was 64%, which indicated severe disability due to neck pain.

On the initial exam with the surgical providers, the patient was wheelchair dependent due to combined lower limb weakness and pain. On muscle strength testing, the patient's right deltoid muscle and right triceps were 4/5, the right bicep and right wrist extensors were 4-/5, the right finger flexors were 4/5, and the left finger flexors were 4+/5. Otherwise, the patient had full strength in the remaining deltoid, triceps, bicep, wrist extensors, and interosseous muscles. On neurological assessment, the patient had positive Hoffman's signs bilaterally. However, sensation was intact from levels C5-T1 bilaterally. +2 deep tendon reflexes were also observed in the bicep, triceps, and brachioradialis tendons bilaterally.

A cervical spine radiograph and cervical spine magnetic resonance imaging (MRI) without contrast were obtained. The radiograph revealed significant multilevel cervical instability: grade 2 anterolisthesis, or forward slip, of C3 on C4 and C4 on C5; retrolisthesis of C5 on C6; a grade 1 anterolisthesis of C6 on C7; and a grade 2 anterolisthesis of C7 on T1 (Figure 1). There was disc space narrowing and vertebral body osteophyte formation at multiple levels. There was also moderate to severe diffuse facet hypertrophy and uncovertebral hypertrophy. In



Figure 1: Radiograph of cervical spine instability C3-C5 preoperatively. Upper arrow indicates C3-C4 level instability, and lower arrow indicates C4-C5 level instability.



Figure 2a: MRI of open canal at C2-C3 preoperatively.

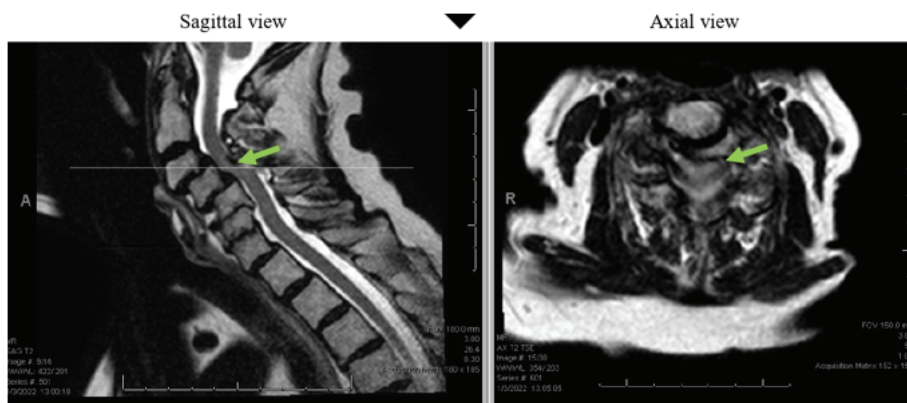


Figure 2b: MRI of cord compression at C3-C4 preoperatively.

addition, the MRI revealed a disc/osteophyte complex with posterior element hypertrophy, resulting in spinal cord compression at levels C3-C4 (Figure 2b) and C4-C5. The spinal compression at C3-C4 was matched against a view of a patent central canal without compression at C2-C3 for comparison (Figure 2a). There was also significant bilateral neural foraminal narrowing at levels C3-C4, C4-C5, C5-C6, and C6-C7. The cervical MRI revealed ventral and caudal cord compression, and the ventral cord was compressed at the levels of both the disc spaces and the vertebral bodies.

Based on the clinical presentation and radiographic findings, the patient was diagnosed with CSM and then referred to spine surgery. To address the spinal cord compression and cervical instability, an anterior cervical discectomy and fusion with partial corpectomies of C3-C5 was performed, as well as a C2-T1 posterior spinal fusion. Postoperatively, MRI imaging showed that the spinal canal was open (Figure 3a). For the anterior construct, interbody cages were placed at C3/4 and C4/5 and anchored to a plate spanning C3-C5 with two screws invertebral bodies C3-C5 (Figure 3b). To provide further stability to the cervical spine, a C2-T1 interval posterior spinal fusion was performed, with pars screws placed on the left and right of C2, lateral mass screws were placed in C5-C7, and transpedicular screws were placed in T1.

Screws were not placed in C3 or C4 posteriorly due to inadequate facet joints. Rods spanning from C2 to T1 were placed on the right and left side of the cervical spine and locked to the screws with set cap screws (Figure 3b).

Following surgery, the patient continued to have residual neck pain. However, her NDI improved from 58% to 50% to 46% (moderate disability) at the three-month, four-month, and six-month follow-up visits, respectively. The mJOA score is a validated measure of remaining

function with CSM and disease severity. Specifically, the validity of the mJOA scores is strengthened when verified by patient-reported outcome scores, such as the NDI [15]. This patient's mJOA score improved from 9/18 (50%) preoperatively to 16/18 (88.9%) at 6 months post-op.

Her score rank improved from severe (<12) to mild (15-17) myelopathy, with a remarkable recovery rate of 78%. For comparison, one study showed that the mean recovery rate of relatively older patients (> 75 years old) was 59% [10]. While another study expressed average recovery rates comparable to that of our patient, their age range spanned from 30 to 70 years old [16], without distinguishing relatively older patients. Indeed, a published meta-analysis highlighted that postoperative mJOA scores in relatively older adults are significantly lower than those of middle-aged patients [17].

At six-months post-operation, this patient was able to ambulate without a wheelchair or assist device. She maintained a positive Hoffman's only on the left side, and her upper extremity strength was 5/5 in all previously tested muscle groups bilaterally.

4. Discussion

The 75-year-old female patient suffered primarily from CSM, received prompt surgery, and realized significant subsequent gains in both neurological and functional domains. At six months post-op, her NDI improved to moderate disability, her mJOA score improved to 16/18, and her myelopathy improved from severe to mild. Furthermore, her upper extremity strength improved, and her ability to ambulate improved from wheelchair dependent to walking independently. This patient's significant functional improvement following surgery supports surgical consideration for CSM management in relatively older female patients.

The patient's recovery was substantial, considering her age and the typical improvement levels at the six-month postoperative period. Her recovery may be partially attributed to the lack of comorbidities present at the time of surgery, revealing a clear example that a relatively older female CSM patient can benefit from surgical intervention. It is also important to note that this patient experienced these improvements post-surgery even with a prior history of osteoarthritis, a very common affliction of the relatively older female demographic. Contributing to her success may have been the surgeon's decision to intervene promptly. While age, deficit, and symptom severity could act as prognostic indicators when contemplating surgery, this case stands as an example of the potential for significant return of neurological and functional abilities in relatively older female postsurgical patients with severe CSM. Though age should play a cautionary role when contemplating surgery, this case reveals that certain relatively older females can experience favorable outcomes.

Our surgical rationale for this case was guided partially by structural issues that affected this patient's cervical spine. Her kyphosis and anterolisthesis deformities created an alignment problem (see Figure 1) that can lead to a poor outcome if addressed entirely through a

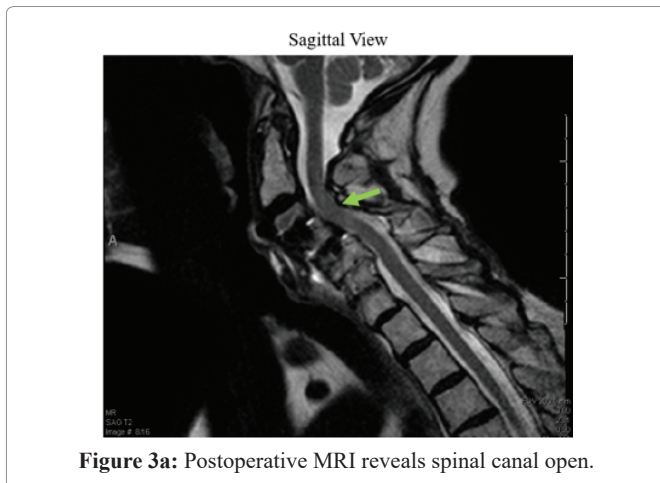


Figure 3a: Postoperative MRI reveals spinal canal open.

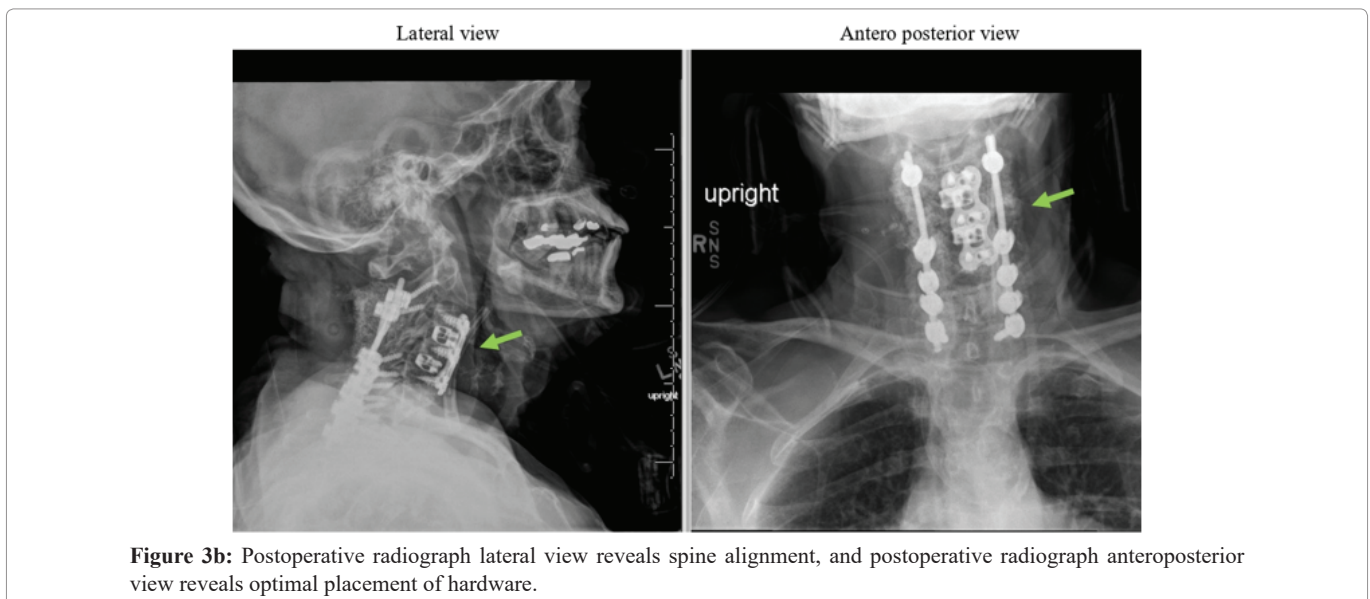


Figure 3b: Postoperative radiograph lateral view reveals spine alignment, and postoperative radiograph anteroposterior view reveals optimal placement of hardware.

posterior surgery. If one were to address this as a posterior procedure alone, the spinal cord would remain draped over the anterior structures and potentially be inadequately treated. We showed that this alignment problem can be effectively addressed through a two-phase procedure that includes an anterior structural correction followed by a posterior fusion. This procedural strategy led to a very positive outcome; this case demonstrates how a combined anterior and posterior strategic structural correction can yield a positive clinical result. Future work will reveal the extent to which this approach may be useful for a patient from this particular demographic with this particular presentation.

This case study extends current research as it focuses specifically on a relatively older female patient, which is a patient demographic that has not been well-represented within the CSM surgical intervention literature. Much of the current research focuses on a majority male demographic, which is consistent with research that supports a higher prevalence of CSM in males [18]. However, it is important to represent females in the research of CSM because they represent a significant proportion of CSM patients as the ratio of males to females with CSM is 2.7:1, and there are various relevant factors to consider for this demographic [18]. For example, females experience greater rates of osteoporosis [8], bone fractures [8], and osteoarthritis [9], especially during or post menopause [8].

Future research should examine whether findings from this case generalize to other relatively older females who undergo surgery for CSM. Details from the case can be used to begin to establish protocols for selecting patients for surgery or for improving their likelihood of neurological and functional improvement. For instance, certain considerations might include the extent of disease progression at the time of consultation, the ability of the surgeon to intervene early and promptly, and the extent of comorbid conditions.

5. Report From Patient

The patient reported significant neurological improvement after surgery when compared to pre-surgery symptoms. She also reported improvements functionally and satisfaction in her walking abilities without use of a wheelchair. Like many spine surgical patients, she reported neck clicking, loss of range of motion with turning her neck, and pain, for which she consults a pain management specialist.

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