



Case report

ACDF and posterior spinal fusion revision for posterior nonunion with deformity, myelopathy, and osteoporosis in an 87-year-old: A case report and literature review

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ABSTRACT

Introduction: Cervical spondylotic myelopathy (CSM) is a spinal degenerative disorder that can ultimately lead to compression of the vertebral column with neurological sequelae. Although CSM is the most common spine pathology in the elderly American population, it remains a challenging disorder to treat among older patients.

Case presentation: We report an 86 year old female patient with CSM with a history of posterior cervical fusion attempt on C3-C6 that progressed to C3-C6 nonunion with loose instrumentation. The patient had severe osteoporosis. With these indications, the patient underwent a combined anterior-posterior decompression and fusion (CAPDF) consisting of anterior cervical discectomy and fusion (ACDF) of the C3-C5, corpectomy of C6 and C7 with off FDA label use of polymethyl methacrylate augmentation (PMMA) fixation of T1 screws anteriorly for C3-T1 plate fixation and second stage instrumented posterior spinal fusion (PSF) of C3-T3. The patient had a successful fusion and reduction of her cervical spine pain with preservation of her neurological status.

Discussion: We report this case of multi-stage combined anterior and posterior fusion as a corrective measure for pseudarthrosis of a prior posterior cervical spinal fusion attempt.

Conclusion: In the event of posterior spinal fusion instrumentation failure in patients with severe osteoporosis, combined multi-stage anterior-posterior fusion is a viable corrective intervention in octogenarians. This case also illustrated the utility of using PMMA for anterior cervical plate and screw stabilization in osteoporotic bone. The authors are not aware of the prior use of PMMA for screw fixation augmentation in the anterior cervical spine.

1. Introduction

By way of osteophytes, hypertrophied ligamentum flavum, deformity, and intervertebral disk herniation, cervical spondylotic myelopathy can compress the cervical spinal cord and/or the exiting nerve roots causing various degrees of disability. Current estimates of degenerative cervical myelopathy measure an incidence of 41 per million with a prevalence of 605 per million, translating into related hospitalization measures of 4.04/100,000 person-years with increased occurrence within the geriatric population [1]. As the elderly population grows there will undoubtedly be more of these cases in the future, requiring greater care. While each case needs an individualized approach for decompressing the spinal cord and preserving neurological function, current data identifies ACDF to be a very acceptable procedure with

proven radiological fusion rates from 90 to 100% and a high level of patient satisfaction [4,7]. Current surgical interventions for CSM consist of anterior, posterior, and hybrid anterior/posterior viable options for cervical canal decompression approaches. In addition to the wide range of spinal degeneration states, surgeons must weigh comorbidities such as kyphosis, osteoporosis, and age when selecting interventions. We report one patient with cervical myelopathy and osteoporosis that underwent a prior C3-C6 instrumented cervical fusion with decompression that developed a pseudarthrosis with pull-out of the screws in the lateral masses, causing pain and dysfunction in the neck and her ability to enjoy a normal life. This patient underwent a combined anterior and posterior fusion revision with correction of the cervical kyphosis with the use of an anterior approach, followed by a posterior approach, in part, using anterior plate and screw fixation using PMMA at T1. This work has been

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written with the SCARE criteria [18].

2. Case presentation

This spry and independent 87-year-old female initially presented to the clinic complaining of cervical spinal pain and a “loose screw” in her neck. She had extensive history with cervical spine issues that led to an instrumented C3-C6 posterior spinal fusion with laminectomy in 2014 using lateral mass screws and rods (Fig. 1). The patient tolerated the procedure well, but she developed complications. During a routine mammogram in 2018 the patient recounted an audible snapping sound upon left lateral motion and afterwards began experiencing intermittent pain, headaches, migraines, and an audible clicking in her neck. The patient demonstrated gait disturbance, ambulating with a walker with straight-line walking impaired. The patient’s history of Meniere’s disease was considered the etiology of her movement difficulties, although her cervical spine condition could not be ruled out as a contributing factor.

CT imaging of cervical spine in July of 2019 confirmed the historical C3–6 PSF and laminectomy, with lucency about the C3 lateral mass screws and mild lucency about the C4 lateral screws with an overall alignment of kyphosis. CT cervical/thoracic imaging from December 2019 demonstrated nonunion of the superior portion of the fusion construct, with marked lucency around the right C3 lateral mass and complete pull-out or extra osseous position of the left C3 lateral mass screw although signal was observed for C6-C7 (Fig. 2A/B). The patient had significant osteoporosis with a DEXA scan in May of 2020 showing a left hip T-score of -3.7 and a right forearm T-score of -4.1 . The corresponding poor bone quality secondary to osteoporosis presents greater risk for bone grafts and higher failure rate for plate placement with anterior approaches [17]. With months of conservative management consisting of physical therapy without symptom relief, surgical intervention was discussed as the next definitive step. The main concern for consideration of interventions for this patient’s case was the C3-C4/C4-C5 nonunion, the kyphotic deformity, the patient’s age, and her osteoporosis.

The patient underwent ACDF of C3-C4 and C4-C5, insertion of anterior cervical discectomy and fusion cage into C3-C4 and C4-C5 with

8 mm polyethyl ethyl ketone (PEEK) and I-factor (CeraPedics) in the cage, along with a corpectomy of C6 and C7, insertion of interbody fusion femoral head allograft spanning C5-T1. The surgery was performed by a spine fellowship trained orthopedic surgeon with over 30 years of experience. For the anterior procedure, an Ulrich anterior cervical discectomy and fusion plate measuring at 84 mm was inserted spanning C3-T1. 4.5 mm screws were used for all fixation, however the T1 ACDF screws had poor purchase secondary to the known osteoporosis. Off-FDA label screw fixation augmentation was performed with PMMA from Medtronic-Kyphon under C-arm intensification (Fig. 3). This properly secured the T1 screws. PMMA was injected through the screw holes into T1, creating a proper flush associated within the vertebral body on fluoroscopy, and then the screws were inserted. The screw purchase at T1 was robust with the cementation. The patient tolerated the procedure well with no complications, and there was no extravasation of the cement from the vertebral body (Fig. 4). The PSF procedure of C3-T3 occurring approximately 3 weeks later was likewise tolerated well with no complications. Both anterior and posterior procedures were performed under neuromonitoring and there were no signal abnormalities including SSEP and motor evoked potentials (Fig. 5A/B).

3. Discussion

Review of the current literature and patient outcomes indicates the viability and efficacy of anterior, posterior, and anterior-posterior circumferential approaches for CSM intervention. The posterior approach can consist of laminectomy or laminoplasty with or without fusion, while the anterior approach includes the techniques of ACDF and anterior cervical corpectomy with fusion [8]. Considering the progressive neurological nature of CSM, the potential for neurovascular complications, and extensive recovery time, weighing various surgical option benefits over cost is paramount, depending on the spine pathophysiology.

Current clinical outcomes indicate that the anterior approach affords superior viability over the posterior approach in its ability for structural correction in restoring lordosis [10]. In some studies, the anterior approach has demonstrated better postoperative neural function in

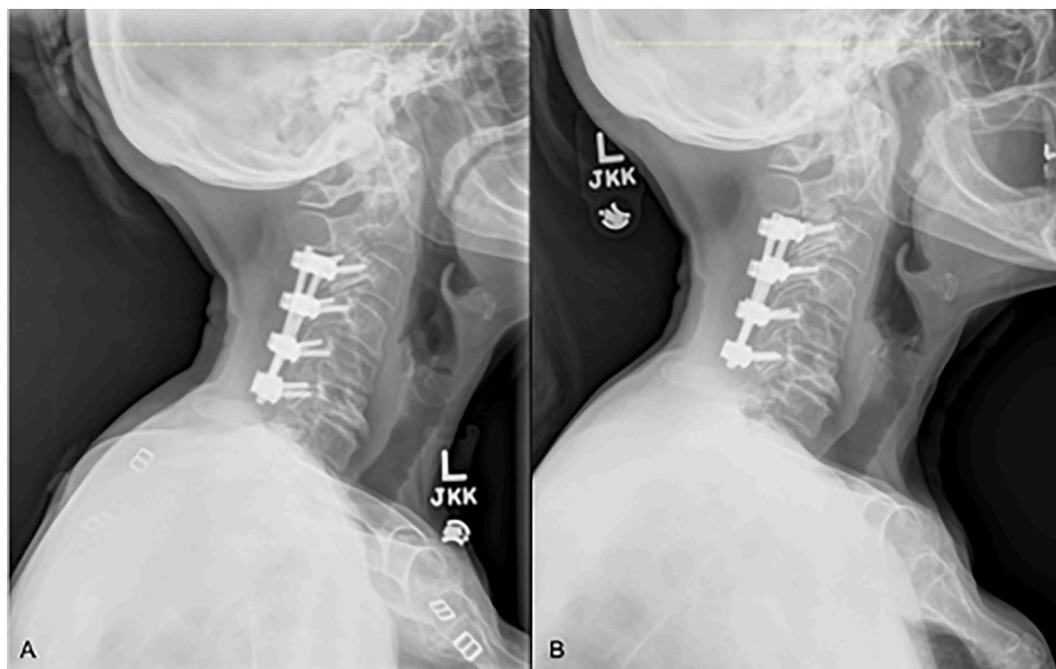


Fig. 1. A/B: Pre-operative X-Ray of historical C3-C6 posterior spinal fusion.

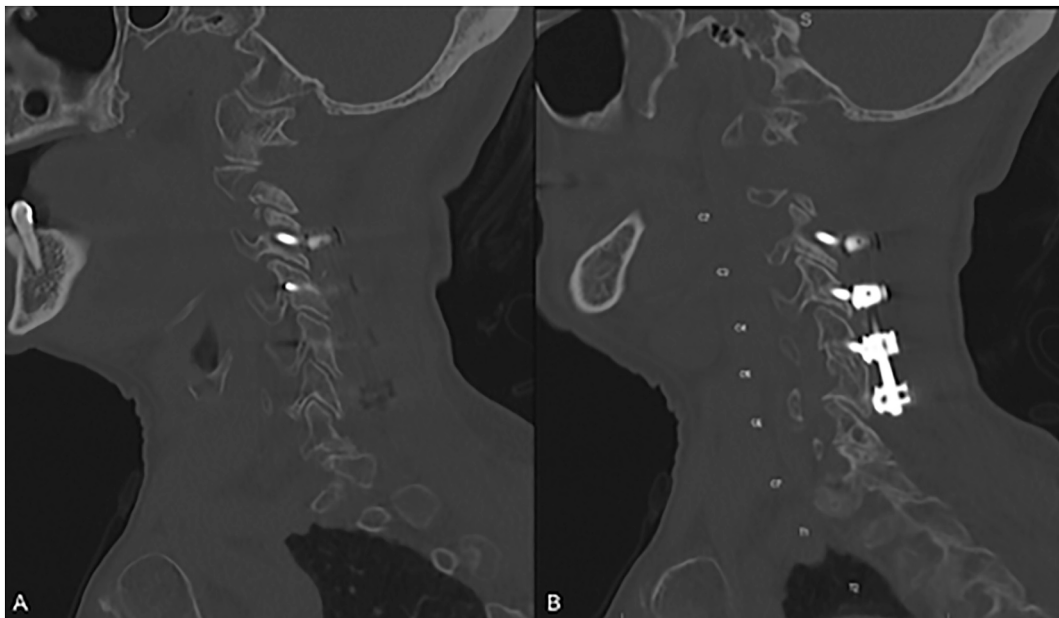


Fig. 2. A/B: Pre-operative CT scan showing lucency in vicinity of C3 lateral mass screws.

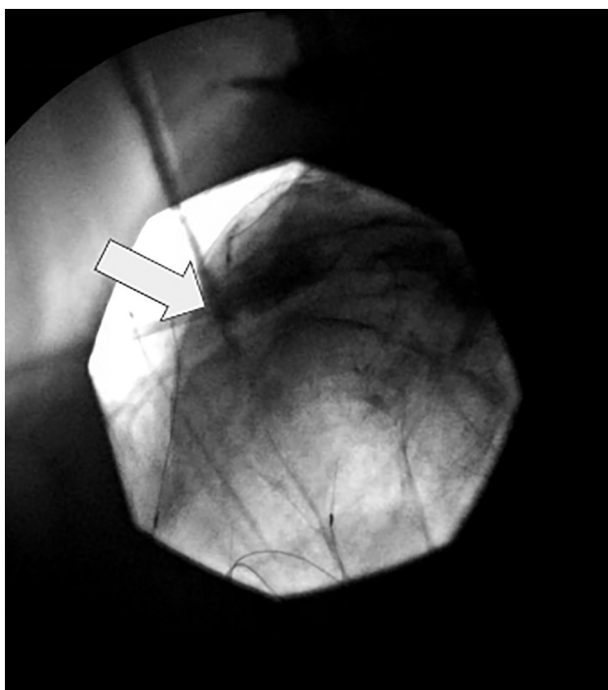


Fig. 3. Intraoperative T1 cementation.

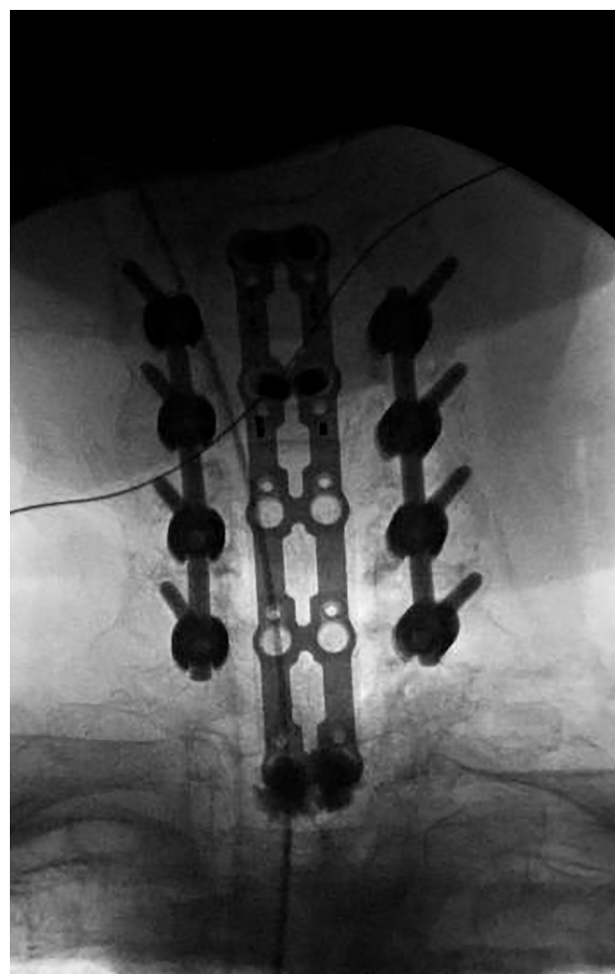


Fig. 4. Post-operative T1 cementation.

comparison to the posterior approach for multilevel CSM based on improved Japanese Orthopedic Association (JOA) scores [3,15]. Outside of the correction of kyphosis, however, some studies indicate that posterior approaches may be preferred for multilevel decompression [2,10]. While not of consideration in this patient, posterior surgery via laminoplasty offers unique advantages in allowing continued neck motion while preserving stability and lessening the risk of postoperative hematomas [16]. In another study, posterior surgery required less operating time, had better improvement JOA scores and fewer complications in comparison to anterior surgeries [11]. There is a lack of statistically significant differences in neurological outcomes when considering anterior, posterior, and combined approaches as measured with Nurick

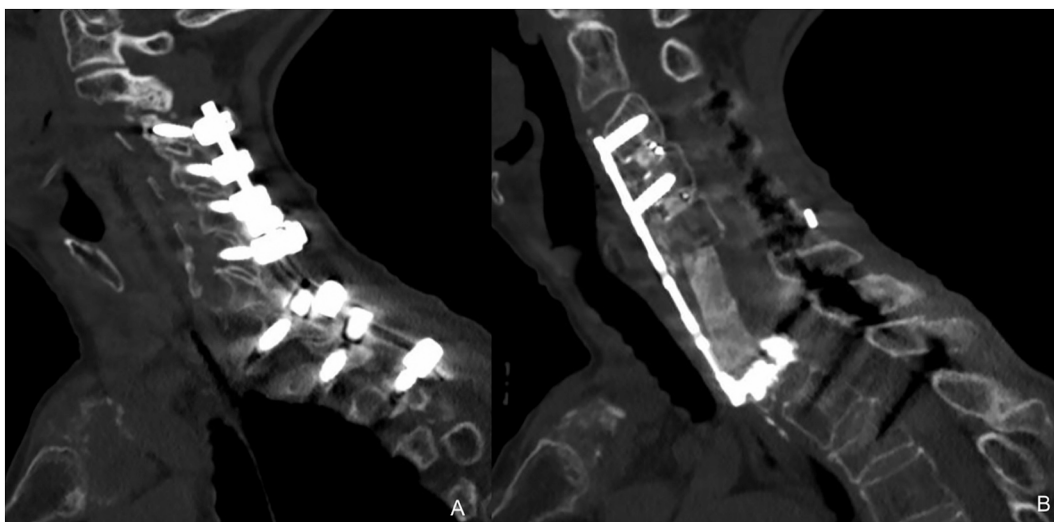


Fig. 5. Post-operative CT scan of CAPDF consisting of Posterior Spinal Fusion Revision (A) and C3-C6 ACDF (B).

grades and modified JOA scores [12].

Indications for CAPDF as described by Kim and Alexander include structural considerations such as those found in degenerative disease of two or more vertebra, kyphosis, and revision surgery for failed multi-level fusions or taking into consideration medical comorbidities with diminished bone health as found with osteoporosis and rheumatoid arthritis [13]. Cabraja et al. found in their study that in cases involving multi-level diseases with kyphosis that the combined approach using anterior release with reconstruction of lordosis and posterior decompression with instrumentation would be effective [9]. Furthermore, the clinical outcomes of the CAPDF approach offer the mechanical advantage of posterior osteotomy and segmental fixation to supplement return to lordosis while also allowing for effective kyphosis correction [12]. While differences such as shorter surgery time and fewer complications for posterior approach in contrast to anterior approach have been observed, current long-term recovery between anterior, posterior and CAPDF approaches indicates a lack of statistical difference and is a need for further study [11].

The structural abnormality in our patient is associated with a higher risk of developing neurological defects or pain, and clinical outcomes currently demonstrate that correction of the kyphosis is contraindicated for posterior-only approach due to limitations posed by osteoarthritis and spondylosis [9]. As such, while the single stage anterior and posterior approaches both hold robust viability in the context of CSM, the constellation of PSF revision, osteoporosis, kyphosis, and spondylosis made multi-stage CAPDF approach the most viable option for our patient. Despite the increased risk of thromboembolism or pulmonary complications, a two-stage approach for the CAPDF in this case was warranted considering the patient's age, the corresponding risk of longer periods under anesthesia, the localized cervical kyphosis, and the pseudarthrosis of C3 through C5 [6,13].

Efficacy of results for this patient's surgical intervention was measured with the Neck Disability Index (NDI), a 10-item questionnaire measuring disability in patients; scores range from 0 to 5 measuring neck pain disability [5,6,14]. The patient had an NDI prior to the surgery of 27 at the highest, while almost 12 months post-surgery she reported a value of 2 at one year. The patient had multiple chronic conditions that overlap into NDI questions, and therefore likely skewed some results for earlier survey responses. However, upon thorough interview of the patient, she made clear that her disabilities measured with the NDI are largely related to her other medical conditions and that her chief complaint of instrumentation loosening was resolved following the surgery. Structurally, her neck has a desirable fusion, confirmed on CT scan and plane radiographs, as noted in Fig. 5A and B.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request. No alteration of scientific meaning was derived from identifying data omission.

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Patient gave us informed consent and ethical approval was not required.

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Registration of research studies

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CRediT authorship contribution statement

Matt Porter, Chart review, data collection, patient interview, writing the paper
Dr. Miguel Schmitz, performed surgical intervention, supervisory/editing role for paper.

Declaration of competing interest

None.

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