

C7 Pars Fracture Subadjacent to C7 Pedicle Screw Instrumentation at the Caudal End of a Posterior Cervical Instrumentation Construct

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Abstract

We report a case of a C7 pars fracture subadjacent to C7 pedicle screw instrumentation at the caudal end of posterior cervical instrumentation construct. To date, posterior cervical instrumentation has been “off label”; however, the US Food and Drug Administration is considering approving label indication of such instrumentation for this common surgical practice. Complications related to the techniques are reported to be relatively low. We know of no previous reports of pars fractures occurring subadjacent to such instrumentation.

A 43-year-old man underwent posterior C5-C7 instrumented fusion. Postoperatively, the patient experienced cervical spine injury after a mechanical fall down stairs.

Work-up detected bilateral C7 pars fractures subadjacent to the posterior instrumentation construct.

After we treated the pars fracture with distal extension of the posterior fusion to the level of T2, the patient progressed to union and marked improvement of initial clinical symptoms that was maintained 2.5 years after posterior instrumentation.

To our knowledge, a C7 pars fracture subadjacent to posterior cervical instrumentation construct has not been reported. We hypothesize that the pars may have been vulnerable to fracture because of excessive bone resection during foraminotomy or decortication. This complication was successfully treated by extending the fusion caudally.

To date, posterior cervical instrumentation has been “off label”; however, the US Food and Drug Administration is considering approving label indication for this common procedure. There is sparse literature about the technique, but few complications have been reported. We present an unusual case of a postoperative fracture occurring subadjacent to instrumentation.

While lateral mass screws are frequently used throughout most of the cervical spine, pedicle screws are common at C7 because of its unique anatomic considerations.¹⁻³ Albert and colleagues⁴ published a review of 21 patients undergoing pedicle screw fixation at this level, concluding that it was a safe procedure that could be facilitated by palpating the medial aspect of the pedicle through laminoforaminotomies. The advantages of pedicle screws compared with lateral mass screws include improved pullout strength and a relatively low risk for pedicle penetration.⁵

We know of no previous reports of pars fractures occurring subadjacent to posterior cervical spine instrumentation. We discuss the presentation and possible causes of this complica-

tion. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

A 43-year-old man presented to our institution with recalcitrant neck-greater-than-arm pain. He had undergone C4-C5 and C5-C6 anterior cervical discectomy and fusion 9 years earlier. Imaging showed union at the fused levels, but the caudal screws had migrated inferiorly into the C6-C7 disc space, with foraminal stenosis at this level (**Figures 1A, 1B**).

The patient underwent posterior cervical decompression at C6-C7 with bilateral foraminotomies and instrumented fusion from C5-C7 (**Figures 2A, 2B**). The construct was not extended to C4 to avoid exposing the C3-C4 joints, because C4-C5 and C5-C6 were fused anteriorly. Bilateral C6-C7 keyhole foraminotomies were performed to address foraminal stenosis and to facilitate instrumentation. This was accomplished by removing a rim of bone from the inferior aspect of the C6 lamina, until exposure of ligamentum flavum was achieved. We used Kerrison rongeurs to remove the leading edge of the lamina, and

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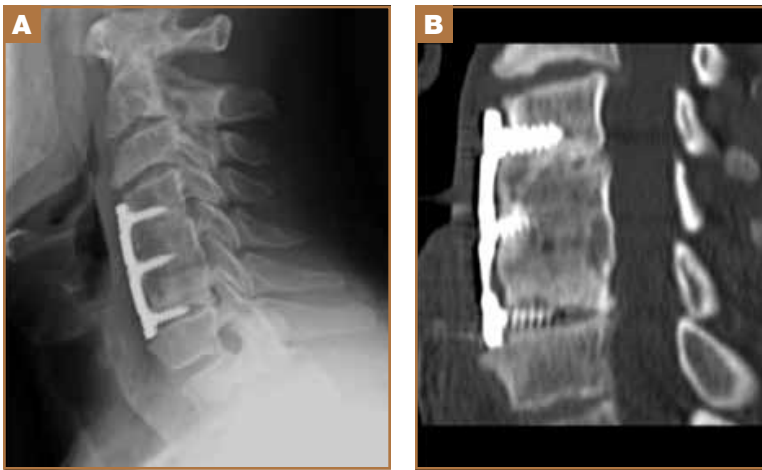


Figure 1. (A) Lateral radiograph and (B) sagittal CT image show osseous union at C4-C5 and C5-C6 with screw migration into the C6-C7 intervertebral disc space.

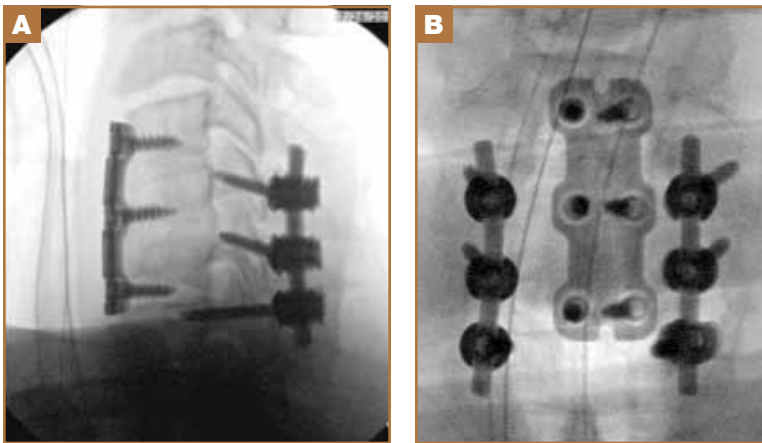


Figure 2. (A) Lateral and (B) anteroposterior intraoperative fluoroscopic images of lateral cervical spine during C5-C7 posterior spinal fusion.

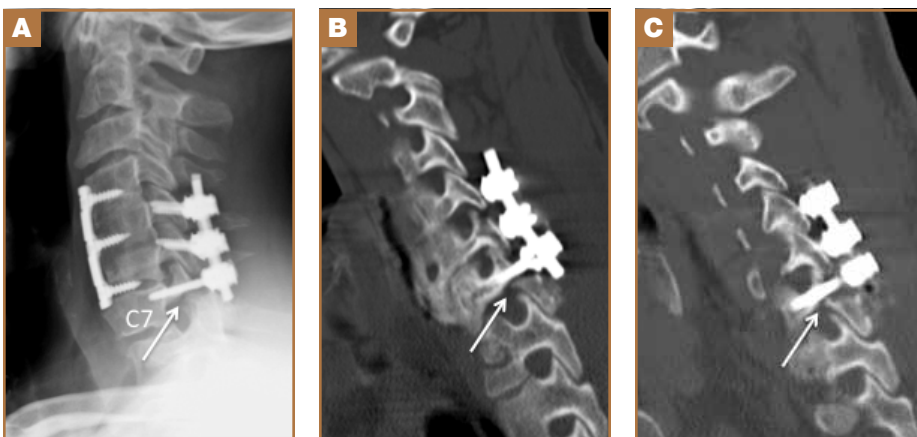


Figure 3. Images after patient had a mechanical fall down a flight of stairs soon after the posterior instrumented fusion. (A) Lateral radiograph suggests C7 pars fracture (arrow). Sagittal CT images from the (B) right and (C) left show bilateral pars fractures at the C7 level (arrows).

decompression was continued laterally toward the C6-C7 foramina bilaterally. Decompression was complete when the lamina was resected as close as possible to the medial aspect of the C7 pedicle and a nerve hook could be passed into the C6-C7 foramina. After bur decortication of the C6 and C7 levels posteriorly, we placed bilateral C7 pedicle screws by using direct palpation of the C7 pedicles and intermittent, canted posteroanterior fluoroscopy. We achieved start points for the pedicle screw with a single attempt using a bur, and the pedicles were drilled 1 time to prepare them for screw insertion; no excess bone loss was noted. Bone grafting was done with local and iliac autograft. Iliac graft was chosen due to the patient's history of smoking. No complications occurred, and the patient had an uneventful hospital course.

Five days later, the patient had a mechanical fall down a flight of stairs. He was evaluated in an emergency department and discharged when a head and cervical computed tomography (CT) scan showed no acute findings. At outpatient follow-up, a review of radiographs and CT scans showed bilateral pars fractures of C7 subadjacent to the posterior instrumentation construct (Figures 3A-3C). Because we were concerned about instability at that level, we operated to revise his posterior fusion to extend caudally to T2.

When the patient was seen at 18-month follow-up (Figures 4A, 4B), he was asymptomatic except for occasional, nonlimiting axial neck pain. He was seen 3 years after surgery for unrelated complaints of axial low back pain; he denied cervical complaints.

Discussion

Posterior cervical spine instrumentation has been described as being a safe and effective procedure.^{1,3,6} Kast and colleagues⁷ reported the results of 96 cervical spine pedicle screw fixations and found a 9% rate of critical pedicle breach, most of which were at C3 through C5. Abumi and colleagues⁶ reported a series of cervical spine pedicle screw fixations and noted pedicle penetration for 6.7% of screws, with the highest risk at the C4 level, followed by C7.

In the thoracolumbar spine, postoperative fractures after pedicle screw placement occur in only 0.7% of cases.⁷ To our knowledge, no published cases describe pars fractures occurring after cervical spine pedicle screw placement. Several factors may have predis-

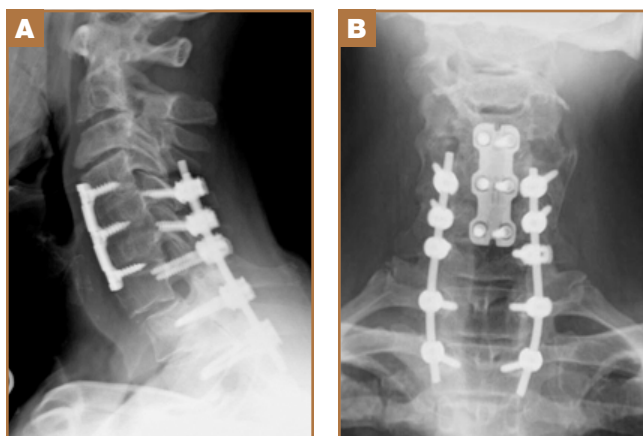


Figure 4. (A) Lateral and (B) anteroposterior radiographs of cervical spine 18 months after C5-T2 posterior fusion with caudal extension of the fusion construct.

posed the patient to the unusual C7 pars fracture described in this case report. With the patient's history of fusion at C4-C6, creating an anterior fusion mass, the construct may have created a stress riser subadjacent to the instrumentation. With the pars intra-articularis known to be the weakest area of the neural arch,⁸ the significant energy trauma could have led to force concentration and fracture. Such a complication is possible given the foraminotomies, even without the use of instrumentation. Patients who have long lever arms, such as those with ankylosing spondylitis, are at risk for fracture adjacent to this bony mass. Because multilevel posterior cervical fusions are common, this explanation alone is thought to be insufficient. Other factors may have predisposed to fracture in this case. The bony anatomy may have been weakened during the foraminotomies at the C6-C7 level or during decortication of the C7 posterior elements.

This case represents an unusual complication caused by a posterior cervical fusion. Strategies for preventing this complication include avoiding excess bone resection during foraminotomy or decortication, which has the potential to weaken the bone adjacent to the fusion construct. In addition, use of a longer fusion construct during the index procedure might have prevented this complication. Certainly, ending a fusion construct at C7 increases stress concentration at the cervicothoracic junction. However, fusion to C7 is a common practice for many surgeons, and extension to the thoracic spine increases the extent of the surgery, further limiting neck mobility and

increasing operating time and blood loss. The use of pedicle screws at the C7 level has been described as a safe procedure, and one with certain biomechanical advantages over use of lateral mass screws.^{4,5} In this case, C7 pedicle screws were chosen to improve stability and reduce risk for pullout at the caudal end of the construct. The use of lateral mass screws may have reduced the likelihood of this complication, by allowing less bone loss and maintaining the native pedicles. We believe, however, that using pedicle screws at the caudal extent of a fusion construct has benefits that outweigh the risks for this unusual complication.

Conclusion

Patients may be predisposed to develop pars fractures at adjacent levels after posterior cervical spine fusion. We advocate minimizing bony resection or burring of the pars below posterior instrumentation. In this case, caudal extension of the construct led to a good long-term outcome.

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This paper will be judged for the Resident Writer's Award.