U·P·O·J

Dropped Head Syndrome: A Case of Post-Surgical Distal Junctional Kyphosis and Chronic Infection

Bradley Osemwengie, MD[1]
Jennifer X. Hong, BA[2]
Tensae Assefa, MD[1]
Chinedu Okafor, MD[1]
Amrit Khalsa, MD[1]

1Department of Orthopaedic Surgery University of Pennsylvania

2Perelman School of Medicine at the University of Pennsylvania

Introduction

As the adage goes in spine surgery, 'Either you are creating deformity or correcting it.' Post-surgical deformity is a complication of spinal surgery. One of these complications is proximal junctional kyphosis, where segments of the spine proximal to a fusion construct begin to develop a kyphotic deformity.[1] Another less frequent complication is distal junctional kyphosis (DJK), where the spinal kyphotic deformity develops distal to the fusion construct. DJK is defined as the development of a kyphotic angle over 10 degrees below a fusion construct.[2] A risk factor to developing DJK is malalignment of the cervical spine. This can be preoperatively measured by an increased value of the C2-7 sagittal vertical axis (SVA).[3,4] The C2-7 Sagittal Vertical Axis (SVA) is calculated by measuring the horizontal distance between the posterosuperior corner of the C7 vertebral body and a plumb line drawn from the center of the C2 vertebral body. Normal values should be less than four centimeters. Another risk factor for developing DJK is the exclusion of the sagittal stable vertebra in the fusion construct.[2] The sagittal stable vertebra is defined as the first vertebra touched by the posterior sacral vertical line (PSVL).

Infection can also accentuate this deformity because the osseous elements of the spine lose their structural integrity, thereby exacerbating the kyphotic collapse. Large angular corrections of sagittal deformity can occur with the use of posterior spinal osteotomies.[5] These procedures resect a portion of bone from the spine, and the resultant defect is 'closed down' and fixed into place with hardware, thereby restoring the sagittal axis of the spine. A concern with instrumented osteotomies in the setting of infection is with placing fresh spinal hardware into a contaminated surgical field. Another concern is with the adequacy of fixation after deformity correction due to the poor quality of infected bone. We present a case of patient with 'Dropped Head Syndrome' deformity correction in the setting of distal junctional kyphosis after multiple spinal procedures in the setting of chronic infection.

Case Presentation

A 73-year-old female patient presented to an outside surgeon with one year of progressive neck pain that radiated to her left head, eye, shoulder, and left arm. She reported weakness in holding her head up and needing to lay back in the afternoon to get relief. Physical therapy provided no relief and epidural injections provided relief for only a few weeks. The patient had a past surgical history of C5-6 cervical fusion performed in 1990.

Physical exam revealed bilateral deltoid weakness and very limited range of motion of the cervical spine. The patient could attain ten degrees of flexion and essentially had no extension or lateral flexion. A cervical MRI revealed large facet changes at C4-5 and C6-7 with associated degenerative disk disease, and the patient was diagnosed with cervical radiculopathy (Figure 1). On July 2021, the patient underwent left hemilaminectomies and posterior instrumented fusion (PSF) of C4-7 (Figure 2).

Two weeks later, the patient began experiencing pain over the surgical incision site. After suture removal, she developed severe swelling, redness, and tenderness at the site. Physical exam revealed fluctuance at the inferior portion of the incision, which ruptured and drained greenish/yellowish fluid the following day. Two days later, the patient underwent incision and drainage. No purulence was found intra-operatively. Operative cultures grew methicillin-sensitive Staphylococcus aureus (MSSA). Patient was prescribed a six-week course of IV cefazolin.

At 6 months postop from the index laminectomy and fusion, the patient had improved clinically but was still experienced persisting issues. She reported daily worsening neck pain that began mid-afternoon with associated headaches that limited her physical activity. She also noted a sensation of prominent hardware and diarrhea due to her suppressive antibiotics. The patient then underwent removal of posterior surgical instrumentation. Upon exploration, the previously instrumented regions appeared fused.

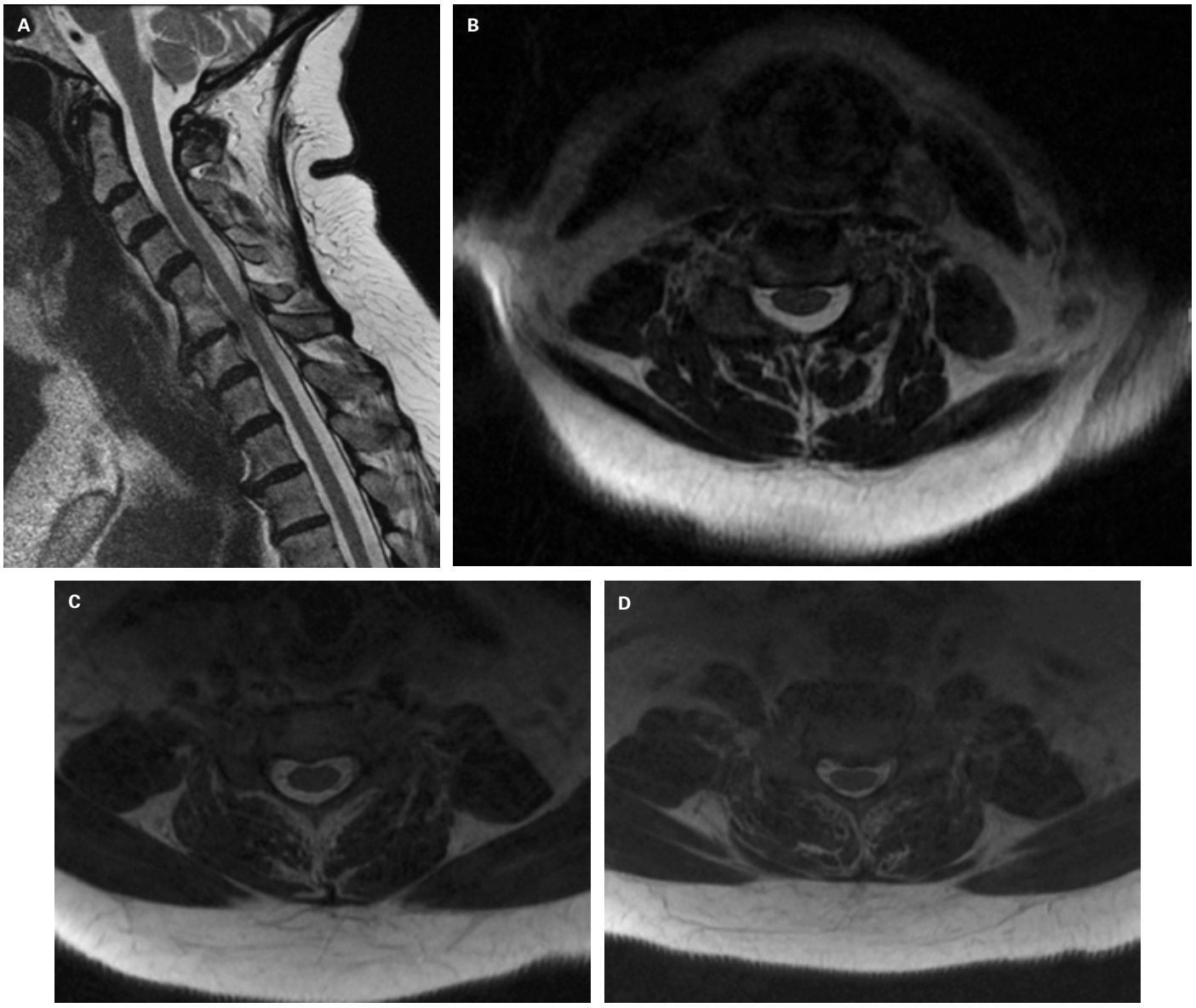

Figure 1. MRI of the cervical spine. **(A)** T2 sagittal MRI of the cervical spine showing evidence of spinal canal narrowing at C5/6 and C6/7. C 5/6 appear to be auto fused; **(B)** Axial cut at C4/5 level showing patent spinal canal; **(C)** Axial cut at C5/6 showing mild posterior disc bulge with mild spinal canal narrowing; **(D)** Axial cut at C6/C7 showing moderate disc bulge with moderate spinal canal narrowing.

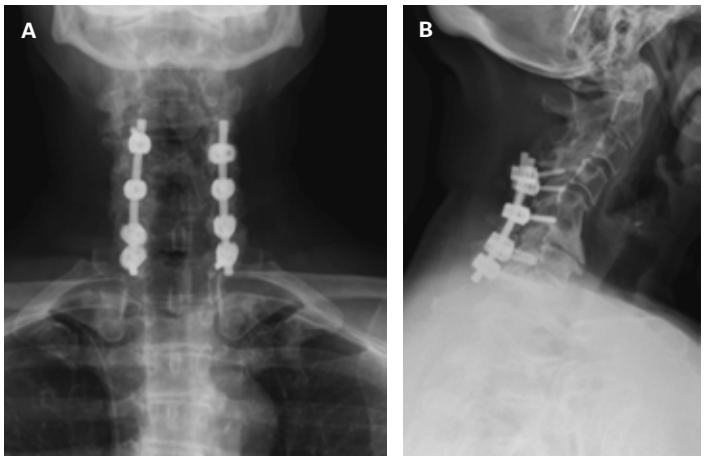

Figure 2. (A) AP and **(B)** lateral of the cervical spine showing C4-C7 posterior spinal fusion with hardware in adequate position.

One year postop from the removal of hardware, the patient presented again with worsening neck pain radiating into the left arm, left thumb, and right shoulder. She reported associated headaches and the need to support her head with her hand suggesting ongoing cervical instability. The pain worsened throughout physical therapy and was not relieved by a soft cervical collar. Reclining helped to alleviate her pain. Cervical x-rays revealed a fixed kyphotic deformity at C4-5 (Figure 3). Two years after the index C4-C7 PSF, the patient underwent surgery. The plan for surgery was to perform facetectomies to increase the mobility of the cervical spine. The patient would then undergo and anterior fusion with an extended posterior instrumented fusion. Intraoperatively, however, the C3 through T1 vertebrae were found to be completely fused, and the surgeon determined that deconstructing the

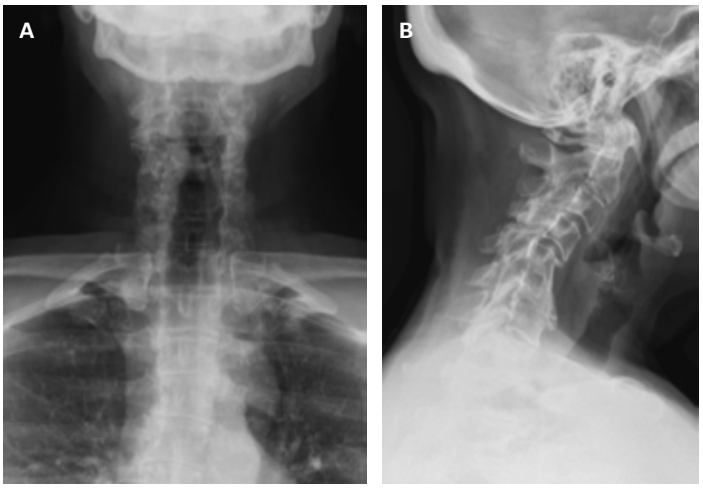

Figure 3. (A) AP and **(B)** lateral of the cervical spine showing removal of PSF. There is a fixed kyphotic deformity at C4-5.

existing fusion would create unnecessary risk. Instead, the patient underwent C2-T3 posterior spinal fusion (PSF) with C2/3 and T2/3 posterior column osteotomies (Figure 4).

Five weeks after the revision fusion procedure, the patient developed debilitating interscapular stabbing pain radiating to her armpits and diaphragm and a progressive head drop. Physical exam revealed two small subcutaneous fluid collections. Cervical X-rays a new kyphotic deformity distal to her cervicothoracic instrumentation and pullout of the T2 and T3 pedicle screws.(Figure 5). MRI revealed fluid adjacent to T2 and T3 vertebral bodies concerning for discitis, osteomyelitis, and epidural abscess (Figure 6). With these findings, the patient underwent posterior cervical irrigation and debridement. Purulence was encountered deep to the fascia. Operative cultures grew MSSA and the patient was placed on six weeks of IV cefazolin.

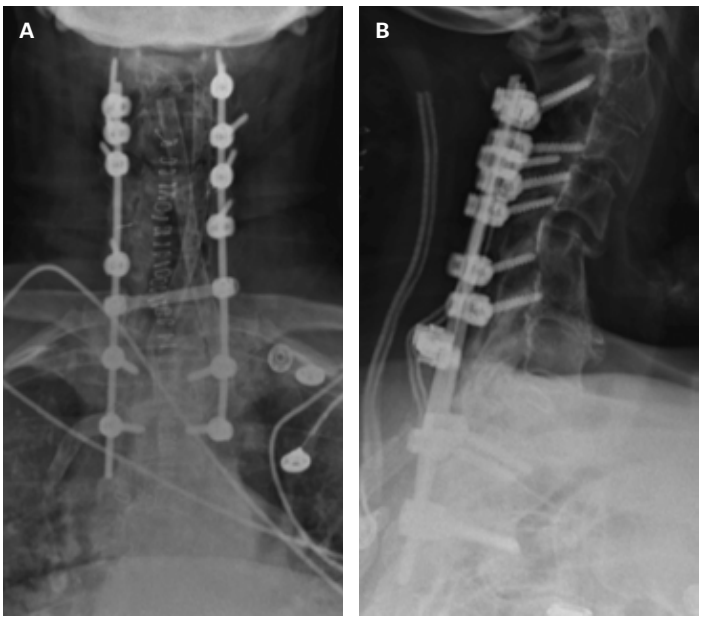

Figure 4. (A) AP and **(B)** lateral of the cervical spine showing a PSF extending from C2-T3.

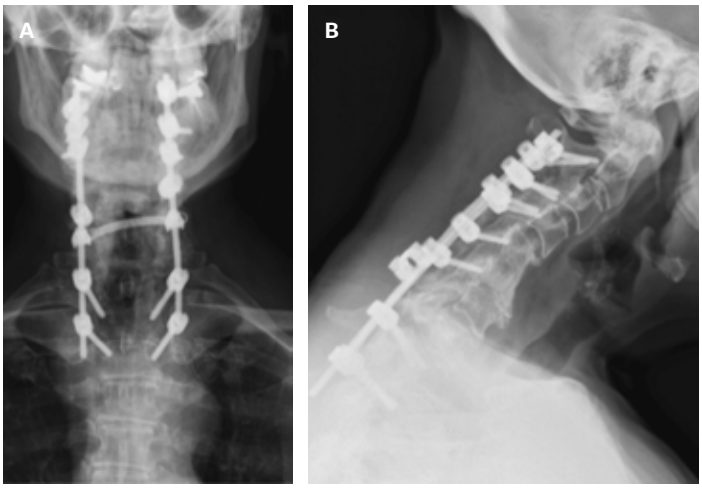

Figure 5. (A) AP and **(B)** lateral of the cervical spine showing a PSF extending from C2-T3 with a new kyphotic deformity distal to the instrumentation. Pullout of the T2 and T3 pedicle screws is also noted.

Figure 6. STIR sagittal MRI of the cervical spine showing increase in signal intensity in the vertebral bodies and discs of T2 and T3 as well as a fluid collection concerning for osteomyelitis, discitis, and epidural abscess.

Two months after the posterior cervical irrigation and debridement, the patient reported continued persistent debilitating neck pain and was referred to the orthopaedic surgery department. The neck pain radiated into her lower back and limited her upward and horizontal gaze, which impeded her activities of daily living as she was unable to remain upright for more than twenty minutes at a time before needing to recline due to pain. Cervical X-rays showed multilevel degenerative changes with post-surgical changes spanning C2-T3 with interval osteolysis, screw pull-out at T2-T3, and 70 degrees of kyphosis spanning C2-T4 (Figure 7). CT of the cervical and upper thoracic spine also displays a kyphotic deformity, osteolysis of the vertebral bodies, as well as pedicle screw cutout in the osteolytic bone (Figure 8).

The decision was made to pursue surgical management in the form of C2-T10 posterior spinal fusion, lower cervical and thoracic osteotomies, and a T3 pedicle subtraction osteotomy. Prior to positioning, neuro-monitoring ran baseline sensory and motor evoked potentials which showed baseline deficits. Posterior column osteotomies

Figure 7. (A) AP and **(B)** lateral of the entire spine showing the C2-T3 PSF with 70 degrees of kyphosis spanning from C2-T4.

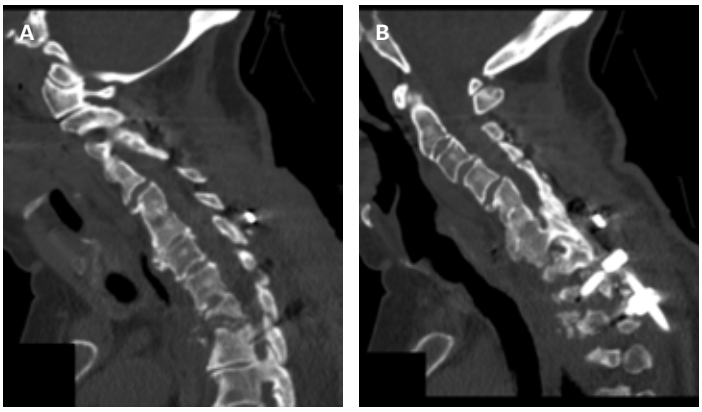

Figure 8. CT of the cervical and upper thoracic spine. **(A)** Mid-sagittal view showing kyphotic deformity and osteolysis of the vertebral bodies; **(B)** Parasagittal view showing pedicle screw cutout in the osteolytic bone.

were performed at every segment spanning C7 to T10. Next, the previous C2-T3 hardware was identified. Pedicle screws were placed at T1 and T4-10. The prior cervical rods and the loosened bilateral T2 and T3 screws were removed. The bilateral C2 screws and cervical lateral mass screws were all well-fixated and left in place. The T3 pedicle subtraction osteotomy was the next step. The bilateral T3 pedicles were resected. The spinal cord and bilateral T2 and T3 nerve roots were visualized directly and shown to be free of compression during this step. Two transition rods were then placed and a compression reduction maneuver was performed across the T3 region. Neuromonitoring was stable, and then screws were locked into place. The C5 to T10 facet joints and lamina were decorticated and bone graft was placed to help with the fusion. Vancomycin powder was applied into the surgical bed. Plastic surgery then performed a layered closure and the incision was closed with an incisional vacuum.

At 6 weeks follow-up, the patient reported improving post-operative pain and numbness to the occiput and surrounding the incision. Physical exam revealed a well-healing incision with no drainage, erythema, or warmth. X-ray of cervical and thoracic spine revealed spinal hardware in adequate position with no evidence of loosening or failure (Figure 9). The patient was placed on chronic suppressive doxycycline by the infectious disease team.

Discussion

Distal junctional kyphosis can be a complication of spinal surgery in the setting of infection as well as fusion constructs that do not extend far enough distally. Dropped head syndrome can ensue if the kyphotic deformity progresses further leading to significant patient morbidity. Dropped head syndrome occurs when there is a severe kyphotic deformity in the cervicothoracic spine.6 Risks and benefits should be weighed as far as correcting deformity and inserting instrumentation in the setting of infection due to concerns of seeding hardware.

A variety of posterior spinal osteotomies exist for the correction of spinal deformity. Ponte or Smith-Peterson osteotomies are used for minor corrections of sagittal imbalance and can be used at multiple spinal levels for roughly ten degrees of correction per level.7 Pedicle subtraction osteotomies at the apex of the kyphosis provide a reliable way to achieve sagittal plane deformity correction

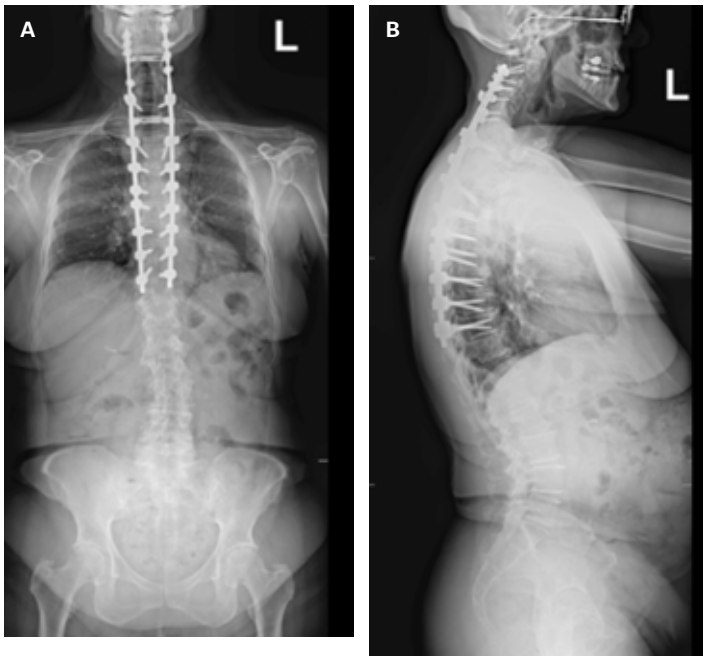

Figure 9. (A) AP and **(B)** lateral of the entire spine showing the C2-T10 PSF showing hardware in appropriate placement and a marked improvement of kyphosis.

of up to forty degrees at a singular level.8 Care must be taken to ensure pedicle screws provide adequate purchase in bone that may be compromised due to osteoporosis or infection.

Consideration should also go into whether the osteotomies and instrumentation should occur in one stage versus two stages in the setting of infection. Performing the entire corrective surgery in one stage limits operating room exposure and is less of a physiologic insult to the patient. However, a one stage operation risks seeding hardware. A two-stage procedure would give the patient more time to clear the infection in between procedures but risks a period of spinal instability in the interim. In the case of a severe kyphotic deformity and infected vertebral osseous structures, there is a concern that the bone integrity after removal of instrumentation would not support physiological demands. This could lead to further progression of deformity and neurological complications from cord or nerve root compression. The provider should also pay special attention to neuromonitoring signals as corrections of chronic deformities can precipitate neurologic damage. Finally, adequate postoperative antibiotic coverage in the setting of infection should be administered to minimize the chance of seeding hardware.

Conclusion

In the setting of a multiply-revised posterior spinal construct in the setting of chronic infection and significant distal junctional kyphotic spinal deformity, a thoughtful approach should be used to ensure adequate spinal stability and deformity correction while preventing neurological deficits in the process. This case illustrates the complex decision-making that goes into providing adequate care to a patient with significant spinal pathology, deformity, and infection to prevent deformity progression and give her the best chance at improved quality of life.

References

1. Dubousset J, Diebo BG. Proximal Junctional Kyphosis in Modern Spine Surgery: Why Is it So Common?. *Spine Surg Relat Res*. 2022;7(2):120-128. Published 2022 Jun 28.

2. Sawada Y, Takahashi S, Terai H, *et al.* Short-Term Risk Factors for Distal Junctional Kyphosis after Spinal Reconstruction Surgery in Patients with Osteoporotic Vertebrae. *Asian Spine J*. 2024;18(1):101-109.

3. Lee JJ, Park JH, Oh YG, *et al.* Change in the Alignment and Distal Junctional Kyphosis Development after Posterior Cervical Spinal Fusion Surgery for Cervical Spondylotic Myelopathy - Risk Factor Analysis. *J Korean Neurosurg Soc*. 2022;65(4):549-557.

4. Passias PG, Horn SR, Lafage V, *et al.* Effect of age-adjusted alignment goals and distal inclination angle on the fate of distal junctional kyphosis in cervical deformity surgery. *J Craniovertebr Junction Spine*. 2021;12(1):65-71.

5. Kose KC, Bozduman O, Yenigul AE, *et al.* Spinal osteotomies: indications, limits, and pitfalls. *EFORT Open Rev*. 2017;2(3):73-82. Published 2017 Apr 27.

6. Martin AR, Reddy R, Fehlings MG. Dropped head syndrome: diagnosis and management. *Evid Based Spine Care J*. 2011;2(2):41-47.

7. Hyun SJ, Kim YJ, Rhim SC. Spinal pedicle subtraction osteotomy for fixed sagittal imbalance patients. World *J Clin Cases*. 2013;1(8):242-248.

8. Gupta MC, Gupta S, Kelly MP, *et al.* Pedicle Subtraction Osteotomy. *JBJS Essent Surg Tech*. 2020;10(1):e0028.1-11. Published 2020 Feb 3.