



Cranial Settling Causing Intracranial Hemorrhage Through Violation of the Skull Base by Cervical Spine Instrumentation

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Key words

- Cranial settling
- Intracranial hemorrhage
- Rheumatoid arthritis

Abbreviations and Acronyms

CS: Cranial settling

RA: Rheumatoid arthritis

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INTRODUCTION

Rheumatoid arthritis (RA) is a chronic inflammatory polyarthropathy that affects many synovial joints favoring the hands, knees, and vertebral articulations. Joint laxity manifests as subaxial instability, atlantoaxial instability, and cranial settling (CS). All of these phenomena may result in neurologic deterioration.¹ Although 7%–34% of patients with RA with radiographic signs of cervical instability initially present with neurologic impairment, the incidence of neurologic deterioration has been shown to be anywhere from 36% to 76%.^{2,3}

In 5%–8% of patients with RA, the ligamentous complex supporting the first and second cervical vertebra and their attachment to the skull base may weaken, leading to upward migration and CS.⁴

We present a unique case of a patient with RA found to have an intracranial hemorrhage in the posterior fossa as a result of her rod/screw construct eroding through the skull base. To our knowledge,

■ **BACKGROUND:** Rheumatoid arthritis (RA) is a chronic inflammatory polyarthropathy that affects many synovial joints favoring the hands, knees, and vertebral articulations. Joint laxity manifests as subaxial instability, atlantoaxial instability, and cranial settling (CS).

■ **CASE DESCRIPTION:** A 70-year-old woman with past medical history of RA, Hashimoto's thyroiditis, osteoporosis, history of C1-2 fusion for instability 15 years prior, with subsequent revision cervicothoracic fusion for degeneration, and trauma 2 years prior presents with new onset headache, nausea, and vomiting of 36-hour duration. Neurologic examination was only notable for mild right dysmetria. Workup revealed acute hemorrhage in the posterior fossa with migration of the right rod implant and screw tulip, as a result of CS. The patient underwent occipital-cervical fusion with removal of the migratory hardware.

■ **CONCLUSIONS:** Intracranial rod migration and hemorrhage secondary to CS is a rare complication that must be brought to the attention of surgeons operating on patients with RA.

there has never been a documented case of CS causing intracranial rod migration and hemorrhage.

CASE PRESENTATION

The patient is a 70-year-old woman with past medical history of RA, Hashimoto's thyroiditis, osteoporosis, remote history of prior C1-2 fusion for instability 15 years prior, and subsequent extension to T2 for degenerative disease 3 years prior, which was followed by extension to T10 due to a traumatic fracture 2 years prior. She presented to an outside hospital with new onset headaches, dizziness, nausea, and vomiting beginning 36 hours before presentation. Her neurologic examination was only notable for mild right dysmetria.

Computed tomography of the head revealed right cerebellar hemorrhage with local edema and mass effect (Figure 1). Initial consideration was given to a hemorrhagic infarct; however, further imaging revealed intracranial erosion of the right rod implant and right C1 screw

tulip through the occipital bone, and into the cerebellar parenchyma (Figure 2). The patient subsequently underwent a cerebral angiogram, which showed fetal posterior circulation, and the right C1 screw abutting the right vertebral artery causing mild stenosis (Figure 3).

The patient was taken to the operating room with neuromonitoring, placed prone in 3-point cranial fixation, and baseline potentials were obtained. Via manual traction, the reduction of the CS was achieved, reducing the head of the C1 screw extracranially. This was confirmed on x-ray (Figure 4). Neuromonitoring remained stable after the closed reduction maneuver. After adequate exposure and explantation of locking caps, a rod-cutting bur was used to section the right rod at the T1-2 level, and a rod holder was used to displace the rod inferiorly out of the skull base. Subsequently, the right C1 lateral mass screw was carefully removed. An occipital plate was implanted along with new cervical rods that were connected to the remaining

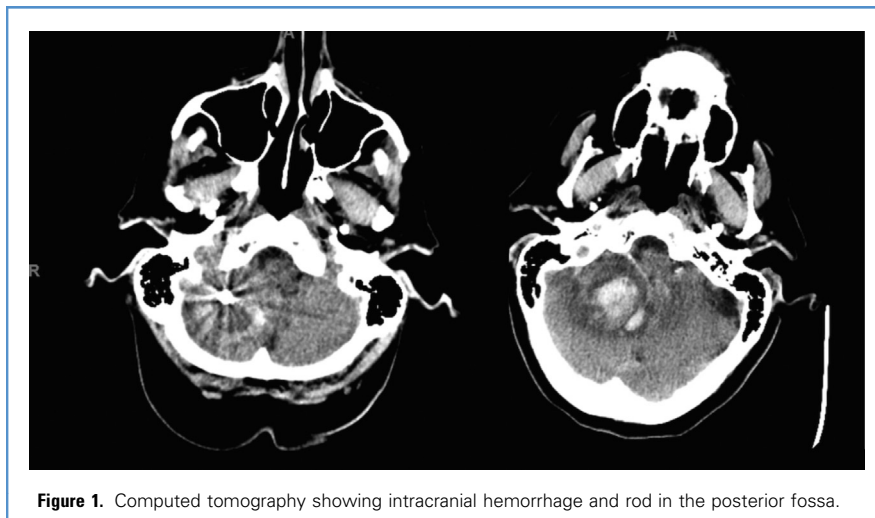


Figure 1. Computed tomography showing intracranial hemorrhage and rod in the posterior fossa.

inferior rods, bilaterally. Arthrodesis was performed from occiput to the C1–C2 fusion mass using harvested iliac bone graft and demineralized bone matrix. Because of the associated dural defect, duraplasty and lumbar drain insertion were performed. The patient tolerated the procedure without any complications, and neuromonitoring signals remained stable throughout the case.

The patient had an uneventful hospital course. After 5 days of lumbar drainage, the patient was discharged to rehab without further incident. At 6-week follow-up, the patient is at her neurologic baseline, and imaging shows stable evolution of her intracranial hemorrhage,

as well as stable craniocervical alignment.

DISCUSSION

Although CS and craniocervical instability are known sequelae of RA, there is a paucity of literature exploring management and outcomes for patients experiencing CS with spinal instrumentation already in place. Patients with RA and cervical spine instrumentation must be serially monitored to avoid this unfortunate and rare complication.

Early considerations for rheumatoid patients should include closer outpatient follow-up to establish any migratory

trends in the spinal instrumentation. If follow-up imaging is obtained identifying CS or concern for cranial erosion, intracranial violation and hemorrhage might be avoided by offering an occipital-cervical fusion. This patient presented 2 years after her most recent cervicothoracic revision fusion due to a traumatic fall, and 10 months after her most recent outpatient visit without findings of CS or instrumentation encroaching the posterior fossa. Review of the patient's imaging also showed a cervical kyphosis, which caused a compensatory extension to aid in her vision. More importantly, evaluating her serial postoperative imaging after each prior fusion shows that her cervical

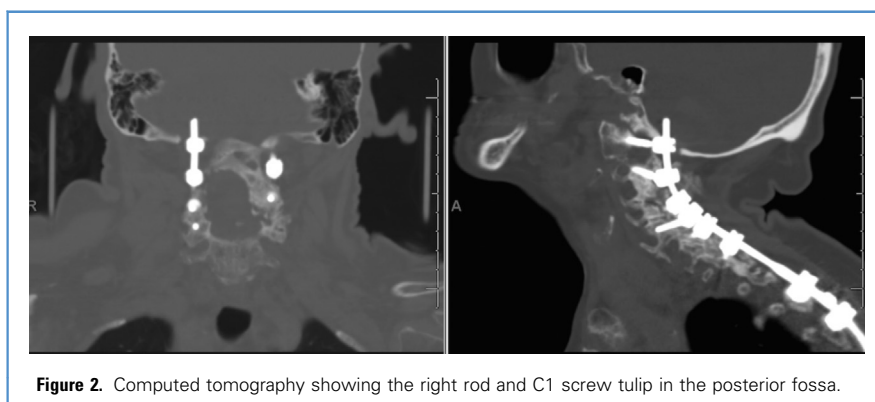


Figure 2. Computed tomography showing the right rod and C1 screw tulip in the posterior fossa.



Figure 3. Right anterior oblique vertebral artery angiogram showing V3 stenosis due to right C1 screw abutment.

sagittal imbalance was never addressed (**Figure 5**). Although CS is the primary driver of her hemorrhage and rod migration, we believe that the long rod fixation in conjunction with kyphotic and sagittal imbalance must be noted as a contributing factor. The hyperextension of her upper cervical segment to compensate for the sagittal imbalance is likely responsible for the rod erosion. If alignment and sagittal balance was addressed in the prior operative planning, this complication may have been avoided.

Furthermore, the decision to operate in a delayed fashion was in the setting of no neurologic deficits, and repeat imaging shows stability of the hemorrhage. Although the patient was monitored for 5 days before surgical intervention, consideration may be given to operating in a

shorter interval to limit the risk of rehemorrhage, or neurologic injury. Finally, removal of the rod and screw extending in the posterior fossa was deemed necessary for limiting further intracranial injury. However, with an angiogram demonstrating vertebral artery abutment and stenosis secondary to compression by the hardware, one must weigh the risk and benefits of removal of the C1 screw in this circumstance.

In our review of the literature, no similar case was previously presented. There are sparse reports of sublaminar wires migrating after fracture causing intracranial hemorrhage.^{5,6} Our institution also published a report in 2013 of a cerebellar hemorrhage after remote occipital-cervical fusion presumably caused by erosion of the instrumentation through the occipital bone.⁷ There was also a previously published

report of subaxial cervical instrumentation migration due to presumed failure of final tightening, which was also surgically removed.⁸ However, a case of intracranial rod migration due to CS has not yet been established and is a unique contribution to the literature.

CONCLUSIONS

The case presented highlights a patient with CS leading to rod migration and intracranial hemorrhage. This rare complication, not previously reported in the literature, must be a consideration for physicians when discussing operative planning and follow-up for patients with RA. This case will hopefully provide greater awareness and experiential knowledge to surgeons and clinicians caring for this patient population.



Figure 4. Intraoperative x-ray showing the right C1 screw extracranially.

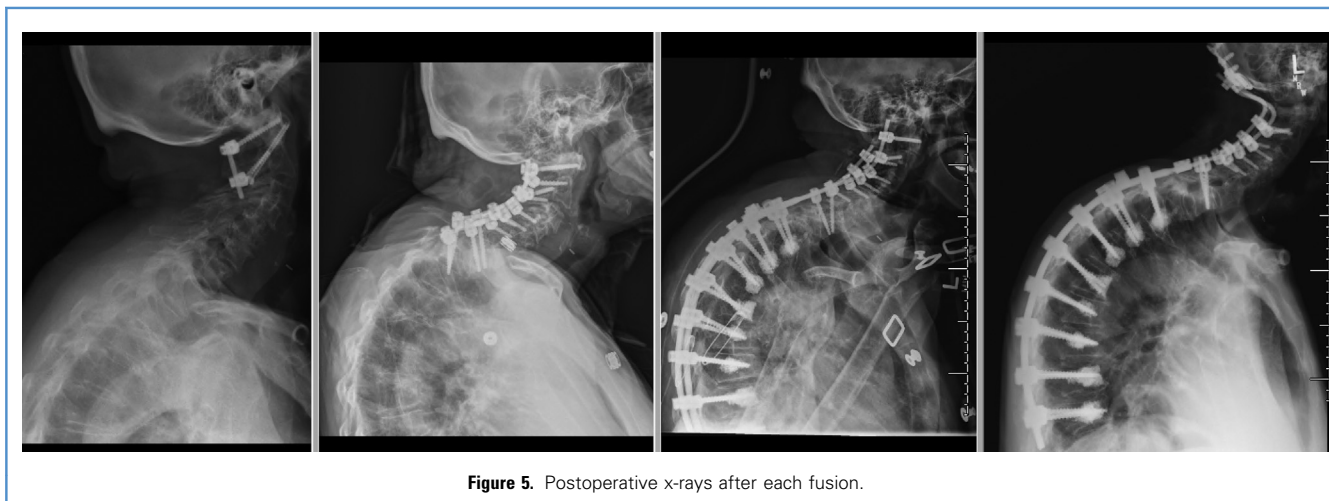


Figure 5. Postoperative x-rays after each fusion.

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