CASE REPORT

Rod Migration to the Thoracic Subarachnoid Space after C_{1-2} Instrumentation: A Case Report and Literature Review

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Posterior instrumented fusion of the cervical spine is a common surgical procedure in the treatment of cervical subluxation, fractures, and stenosis. Although malpositions are commonly seen, it is rare to observe the malposition of the rod or interconnection because of hardware failure. A 62-year-old woman with spastic tetraparesis as a sequel to pediatric meningitis with C_1–C_2 cervical subluxation and myelomalacia had undergone laminectomy of C_1 and C_1 lateral mass and C_2 bilateral pedicular screw fixation. Three years after the stabilization, she presented with complaints of headache, neck pain, and difficulty walking. There was no history of trauma during that period. A previously unrecorded and unusual migration of a rod through the thoracic subarachnoid space was detected. In this study, we report a case of atlantoaxial stabilization using the screw-rod technique that was followed by rod migration to the thoracic subarachnoid space, and outline the subsequent management of the case. Failure of bony fusion can result in micromotion and subsequent migration of fixation device components. Routine radiographic follow-up could be used to identify migration events.

Key words: Atlantoaxial stabilization; Cervical stabilization; Complication; Migration; Posterior cervical stabilization

Introduction

Posterior cervical stabilization is a method commonly applied in the treatment of several pathologic conditions (e.g. stenotic cervical canal, cervical fracture, or cervical mass) accompanied with cervical instability. Wiring, interlaminar clamps, lateral mass screws, and cervical pedicle screws are among the techniques and instrumentation options that can be used for posterior stabilization of the subaxial cervical spine[1–3]. Wire fixation is an inexpensive and ancient method that requires little expertise, but is not effective if the patient have osteoporotic bones, or the posterior elements are not secure[4]. In many cases, absent or broken posterior elements preclude the use of wires; thus, rigid stabilization devices were developed for better fusion rates.

Lateral mass screws were first introduced by Roy-Camille *et al.* in 1979[5]. The lateral mass screws made it possible to place longer screws due to their angulated trajectories toward the superior-lateral-ventral corner of the lateral mass[3]. In a human cadaveric study, Coe *et al.* studied the stability of the lateral mass plate and confirmed the results of Roy-Camille *et al.* that lateral mass fixation increases segmental stability in flexion by 92% and in extension by 60%[6,7]. However, various complications and malpositioning may be encountered postoperatively. Although malpositions (e.g. screw malpositions) are commonly seen, it is rare to observe the malposition of the rod or interconnection because of hardware failure. Here we present a case of atlantoaxial stabilization using the screw-rod technique that was followed by rod migration to the thoracic subarachnoid space in the late postoperative period.

Case Report

A 62-year-old woman with mental retardation was admitted to our outpatient department with spastic tetraparesis as a sequel to pediatric meningitis; she had no history of additional systemic diseases. After having been diagnosed with C_1–C_2 cervical subluxation and myelomalacia using cervical magnetic resonance imaging (MRI) (Fig. 1), the patient underwent laminectomy of C_1, and the C_1 lateral mass and C_2 were fixed using bilateral pedicular screws (Oasys, Stryker, New Jersey, USA) on 20 June 2011 (Fig. 2A). The final tightening was performed with a torque

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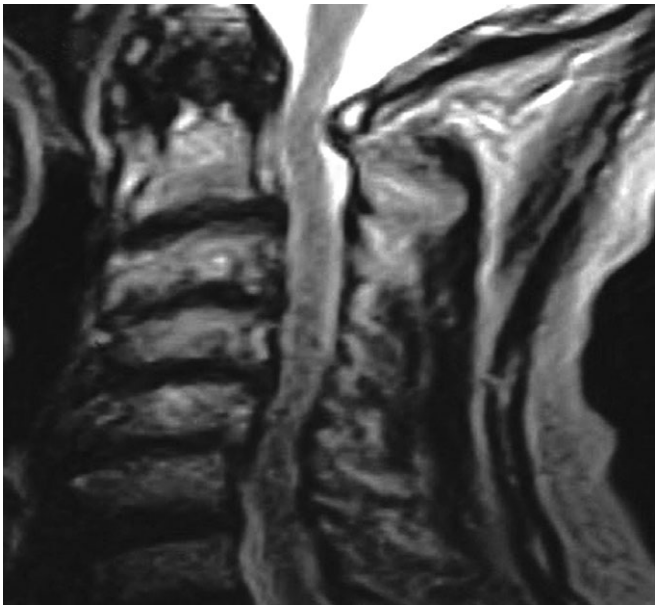

Fig. 1 Preoperative cervical T2WI MRI showing cervical subluxation and myelomalasic changes at C_1–C_2.

screw driver. After drilling the C_{1-2} joint, posterior arthrodesis was performed with bone chips by placing the chips into the joint space for fusion. The rod was not spread outside the screws to avoid touching the C_1 arc, but it was an adequate fit for tightening. Our follow-up policy after posterior cervical fusion was: 10 days, 1 month, 3 months, 1 year after the surgery and then annually. A control X-ray was performed as part our routine at every follow-up visit.

Postoperatively, the patient's complaints were resolved and no radiological or additional neurological findings were determined at her follow-up period, until she presented with complaints of headache, neck pain and walking difficulty, all of which started at the end of the third postoperative year (Fig. 2B). Physical examination revealed tetraparesis with 4/5 muscle strength. There was no history of trauma during that period. On radiological evaluation, the left rod was not detected, but there was no apparent sign of compression on MRI. Thoracal X-ray and computed tomography demonstrated an intradurally-placed rod of 2 cm in length at the level of T_7 vertebral body level (Fig. 3). On cervical exploration, the left rod was found to be displaced, the set screws were within the paravertebral muscles, and a dural defect was observed just above C_1. Although fusion was achieved, the instruments were removed and the defect was repaired; we did not extend the fusion and did not recommend the use of a cervical collar in the postoperative period. A T_7 laminectomy was performed as a second-look surgery and the migrated rod was removed, which was situated intradurally at that level (Fig. 4). No additional complications were encountered after the operation. At the third year follow-up after the second surgery the patient had no additional neurological deficit (Fig. 5).

Discussion

The instruments used for posterior cervical stabilization have recently shown a rapid evolution and the lateral mass C_{1-2} screw-rod technique is relatively new among them. Ease of rod manipulation in all three dimensions, more precise placement due to the flexibility during screw placement, and the resulting lower failure (malposition) rate are the most important advantages of this technique[8]. The malposition rate is reported between 2 and 5% and is seen mostly as screw malposition[9,10]. Plant and Ruff describe a migrated rod through the skull and into the cerebellum following C_1–C_2 instrumentation[11]. In this case, the rod was migrated through the thoracal region subdurally, and we

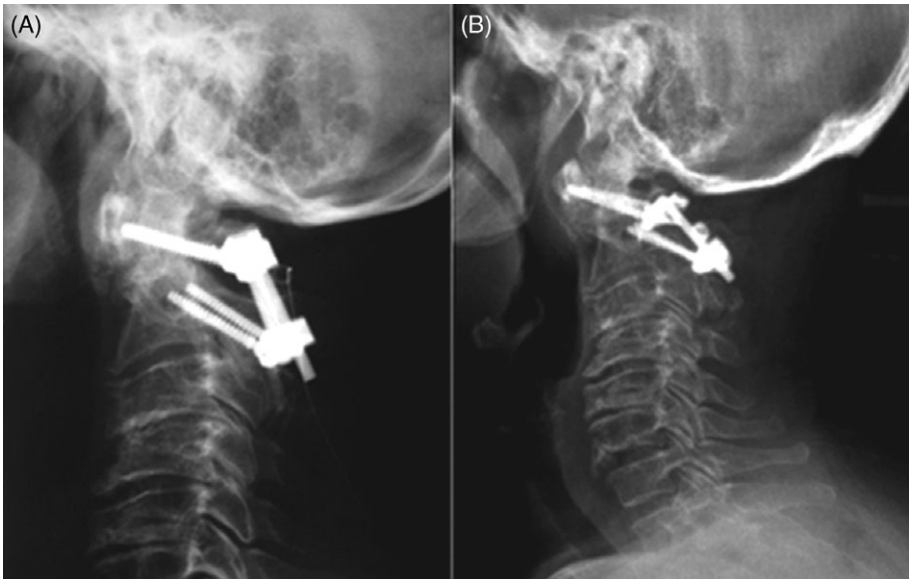

Fig. 2 (A) Postoperative radiography after C_1 laminectomy and posterior stabilization at the level of C_1–C_2. (B) Control radiography demonstrating missing rod 3 years after the surgery.

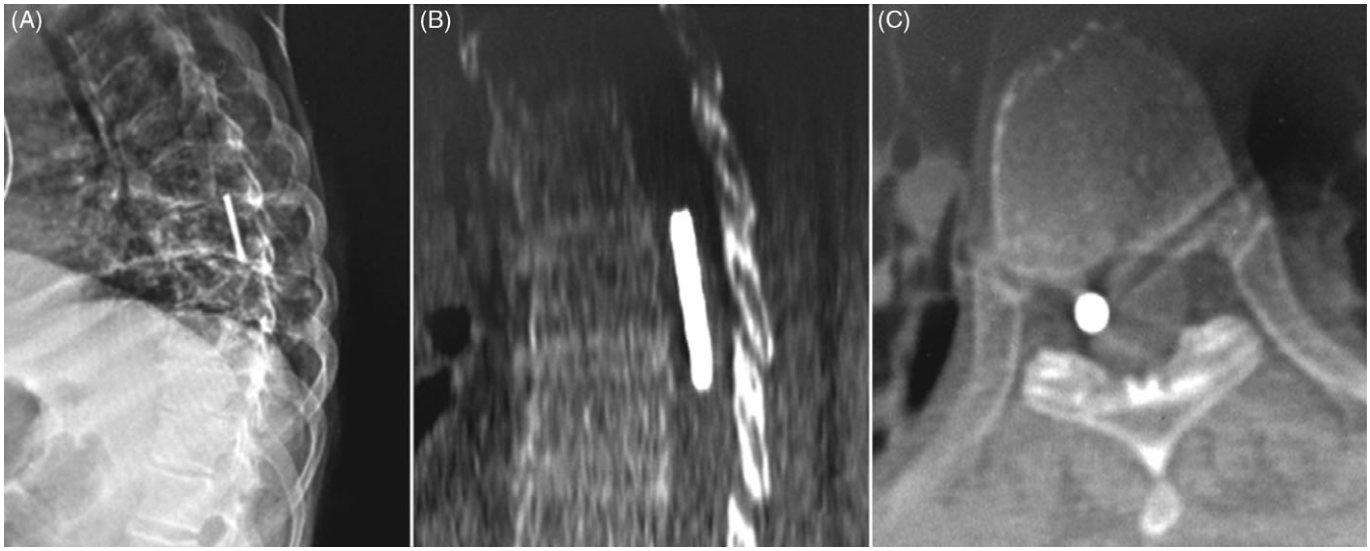

Fig. 3 (A) Thoracal X-ray and (B, C) computed tomography demonstrate a rod of 2-cm length located at the level of T_7.

speculated that the rod was migrated to the thoracic subdural region because of gravity.

The complication rate has been reported to decrease after the first postoperative year[10]. After atlantoaxial fixation, some authors report a minimum follow-up of 2 years[11]. However, the hardware failure presented here manifested in the third postoperative year. Our follow-up policy after posterior cervical fusion was: 10 days, 1 month, 3 months, 1 year after the surgery, and then annually. The control X-ray is routine at every follow-up visit. The patient quit the follow-up after the first year postoperatively and was admitted to hospital at the third year postoperatively with neck pain, headache, and walking difficulty. There was no

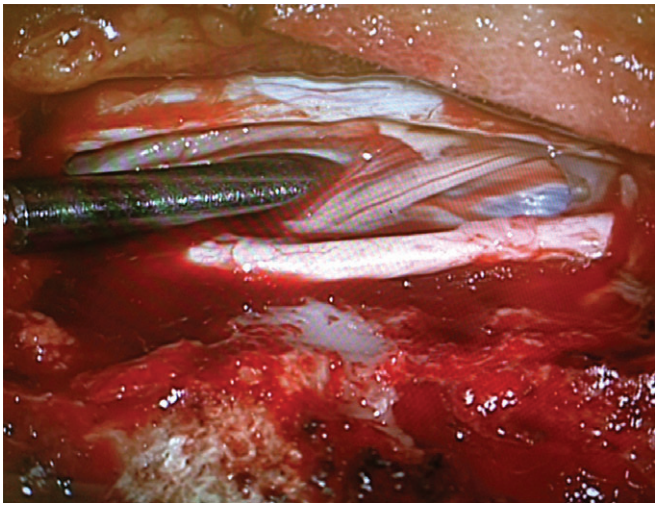

Fig. 4 Intraoperative photograph showing intradurally migrated rod at T_7.

Fig. 5 Cervical T2WI MRI showing cervical fusion with no additional neurological deficit at postoperative third year.

indication of hardware failure 1 year after surgery. The screw heads were not broken, so we speculate that the rod migration was due to an absence of nuts. This case is likely to be a result of hardware failure, rather than an error by the surgeon, because a surgeon's error would have manifested itself earlier. It is important to remember that, even after the 1-year regular postoperative follow-up, the possibility of a late hardware failure (and its potentially life-threatening effects) persists. The experience of the surgeon and knowledge of the 3D anatomy of the region are key factors in decreasing complication rates. In the presented case, early diagnosis and intervention prevented further morbidity.

Conclusion

Although the lateral mass screw-rod technique has high success and low complication rates in the hands of an experienced surgeon, care should be taken for prevention and early diagnosis of probable hardware failure.

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