



Case Report

Utility of O-arm navigation for atlantoaxial fusion with Bow Hunter's syndrome

Seiji Shigekawa, Akihiro Inoue, Masahiko Tagawa, Daisuke Kohno, Takeharu Kunieda

Department of Neurosurgery, Ehime University School of Medicine, Ehime, Japan.

E-mail: Seiji Shigekawa - shigekawa.seiji@gmail.com; *Akihiro Inoue - iakihiro3@gmail.com; Masahiko Tagawa - neuro-mt@sunny.ocn.ne.jp; Daisuke Kohno - kouno_daisuke_h0413a@yahoo.co.jp; Takeharu Kunieda - kuny@m.ehime-u.ac.jp



*Corresponding author:

Akihiro Inoue,
Department of Neurosurgery,
Ehime University School of
Medicine, Ehime, Japan.

iakihiro3@gmail.com

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ABSTRACT

Background: In spinal instrumentation surgery, safe and accurate placement of implants such as lateral mass screws and pedicle screws should be a top priority. In particular, C2 stabilization can be challenging due to the complex anatomy of the upper cervical spine. Here, we present a case of Bow Hunter's syndrome (BHS) successfully treated by an O-arm-navigated atlantoaxial fusion.

Case Description: A 53-year-old male presented with a 10-year history of repeated episodes of transient loss of consciousness following neck rotation to the right. Although the unenhanced magnetic resonance imaging showed no pathological findings, the MR angiogram with dynamic digital subtraction angiography revealed a dominant left vertebral artery (VA) and hypoplasia of the right VA. The latter study further demonstrated significant flow reduction in the left VA at the C1-C2 level when the head was rotated toward the right. With these findings of BHS, a C1-C2 decompression/posterior fusion using the Goel-Harms technique with O-arm navigation was performed. The postoperative cervical X-rays showed adequate decompression/fixation, and symptoms resolved without sequelae.

Conclusion: C1-C2 posterior decompression/fusion effectively treats BHS, and is more safely/effectively performed utilizing O-arm navigation for C1-C2 screw placement.

Keywords: Atlantoaxial fusion, Bow hunter's syndrome, Laminar screw, O-arm navigation system, Surgical treatment

INTRODUCTION

Bow hunter's syndrome (BHS) involves the occurrence of vertebrobasilar symptoms following mechanical compression of the dominant vertebral artery (VA) (i.e. contralateral VA hypoplasia) and can result in symptomatic infarctions of the cerebellum and/or brain stem.^[2,3,7] Long-term resolution of BHS typically requires VA decompression with C1-C2 posterior instrumented (screw) fusion.^[2,4] Notably, three-dimensional computed tomography (3D-CT) intraoperative O-arm navigation increases the safety/efficacy of posterior C1-C2 screw placement/fusion.^[10,11] Here, we present a patient with BHS successfully treated utilizing O-arm navigated with atlantoaxial decompression/screw-instrumented fusion.

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CASE DESCRIPTION

Clinical presentation and radiological evaluation of BHS

A 53-year-old male presented with a 10-year history of repeated episodes of transient loss of consciousness following rotation of the head to the right. He did not describe any other symptoms and had no history of trauma. The MR fluid-attenuated inversion recovery study was normal [Figure 1a and b]. However, MR angiogram of the VA and a vertebral angiography showed dominant left-sided VA and a hypoplastic right VA. Since the complaints of the patient aggravated on rotation of the head to the right, dynamic digital subtraction angiography (DSA) and 3D-CT angiography (CTA) was performed; when the head was rotated to the right, flow was reduced in the left VA at the C1-C2 level [Figure 2a and b]. Cervical X-rays were unremarkable [Figure 2c].

Surgery for BHS

The patient underwent an IRB-approved C1-C2 posterior fusion using O-arm navigation. C1 lateral mass screws were placed using the Goel-Harms technique [Figure 3a].^[5,6] However, the O-arm documented that a C2 pedicle screw should not be inserted; rather a translaminar left-C2 screw was placed, while a routine pedicle screw was placed on the right [Figure 3b-d]; The C1-C2 rods were finally applied and the fusion was completed without incident; postoperative cervical X-rays and 3D-CT studies confirmed good fixation [Figure 4]. Postoperatively, the patient did well and was discharged 7 days later; he was neurologically intact within 1-year.

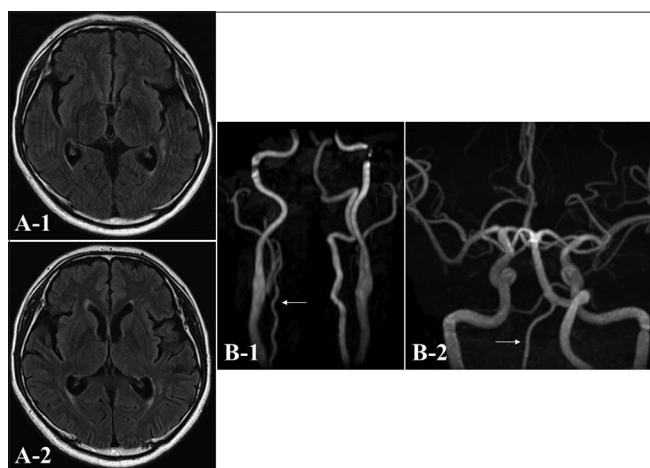


Figure 1: Magnetic resonance imaging on admission. (a) Fluid-attenuated inversion recovery imaging reveals no abnormal changes. (b) Cervical and intracranial magnetic resonance angiography show hypoplasia of the right vertebral artery (white arrow).

DISCUSSION

BHS is caused by posterior circulation insufficiency resulting from occlusion or compression of one of the VA during rotation of the head, most typically occurring at the C1-C2 level.^[2,7-9] In this case, dynamic DSA and 3D-CTA were performed to document that cerebral blood flow and loss of consciousness occurred when the head was turned to

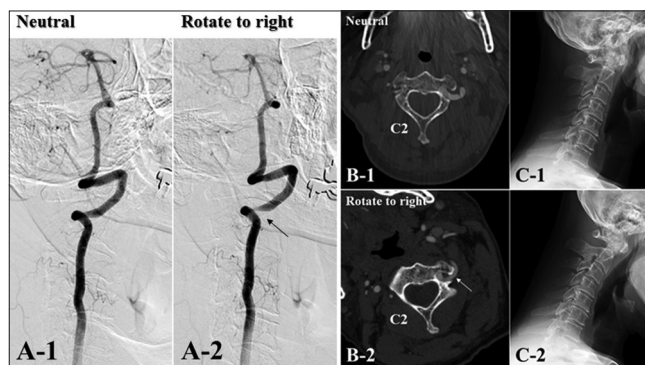


Figure 2: Preoperative dynamic digital subtraction angiography (a-1: neutral head position, a-2: head rotation to the right side) and three-dimensional computed tomography angiography (b-1: neutral head position, b-2: head rotation to the right side). When the head is rotated to the right side, near-complete occlusion of the left vertebral artery is observed at the C1-C2 level (white and black arrow). Cervical X-ray (lateral view) and dynamic X-ray images. Lateral view in the neutral position shows an atlantodental interval of 3.2 mm (c-1) and in the flexed position shows an atlantodental interval of 2.4 mm (c-2).

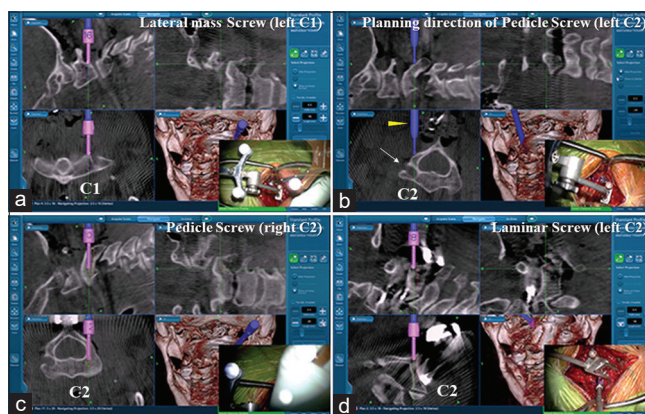


Figure 3: Operative imaging for C1-C2 posterior fusion using O-arm navigation systems. (a) C1 lateral mass screws are placed using the Goel-Harms technique. (b and c) For C2 screw placement, a pedicle screw is inserted on the right side (b). However, intraoperative real-time planning using the O-arm navigation system shows a risk of left vertebral artery injury during tapping the tract for left pedicle screw insertion (white arrow: transverse foramen; yellow arrowhead: trajectory on the navigation system) (c). (d) We switch to performing a translaminar technique for left-side fixation of C2 and the laminar screws are inserted.

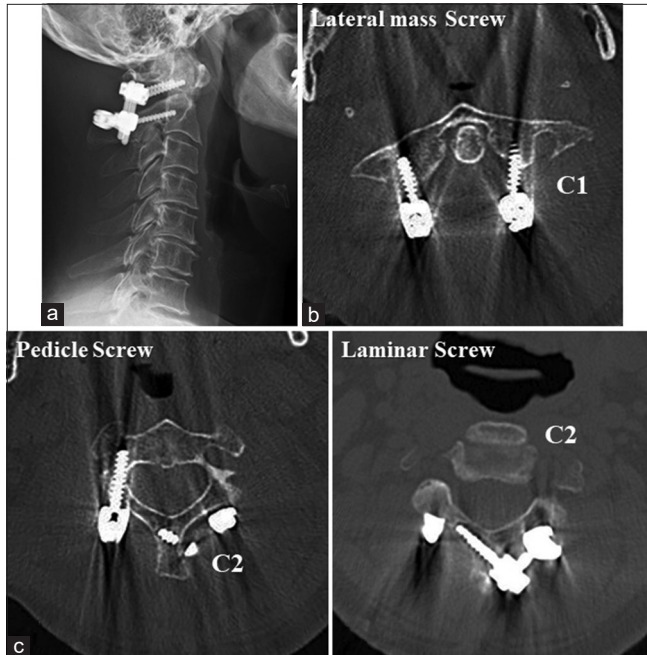


Figure 4: Postoperative cervical X-ray and three-dimensional computed tomography (3D-CT) show good fixation. (a) Lateral view cervical X-ray in the neutral position. (b and c) Axial-view 3D-CT imaging (b: C1 portion; c: C2 portion).

the right. BHS is typically treated with C1-C2 posterior decompression of the VA and fusion.^[2,3,7,9]

Screw placement facilitated with O-arm intraoperative navigation

The C1-C2 posterior fusion technique offers higher fusion rates and obviates the need for rigid immobilization. However, Acosta *et al.* reported that 24% of C1-C2 could not have been safely placed without intraoperative imaging.^[1] Recently, intraoperative 3D-CT combined with O-arm navigation allows for the safe/effective trajectory of each screw largely avoiding the risk of a VA injury (i.e., misplacement rate of 1–11.1%).^[11,12] Here, using intraoperative O-arm navigation, a C2 translaminar screw had to be used instead of a C2 pedicle screw, while it was safe to place a right-sided C2 pedicle screw. The resultant C1-C2 fusion in the presence of BHS was then safely completed.

CONCLUSION

We have described a case of BHS in successfully treated with decompression/fusion using an O-arm navigation for C1-C2 screw placement.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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