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Case Report

Atlantoaxial Fixation using Rod and Screw for Bilateral High-riding Vertebral Artery

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We report a case of atlantoaxial subluxation with bilateral high-riding vertebral artery with narrow isthmus. Because of the potential risk of bilateral vertebral artery injury, we performed atlantoaxial fixation using rod and screw instead of transarticular screw fixation. Although postoperative computed tomography reconstruction demonstrated slight breach of bilateral vertebral artery groove, postoperative angiography showed no evidence of vertebral artery injury. Though technically demanding, atlantoaxial fixation using rod and screw can be a one of the treatment options for atlantoaxial instability with bilateral high riding vertebral artery.

KEY WORDS : Atlantoaxial · C2 screw · High-riding vertebral artery.

Introduction

Posterior atlantoaxial transarticular screw fixation, which was developed by Magerl[8], has been widely used as a fixation method for atlantoaxial instability[2,6,10,11]. However, vertebral artery injury, one of the major complications of this procedure, sometimes results in fatal condition[12]. An anatomical study showed that in 20% the vertebral artery groove on one side was large enough to prevent the safe passage of transarticular screw[7]. Neo et al[9], who reported atlantoaxial screw fixation for unilateral high-riding vertebral artery, however, suggested that via the safest trajectory - the most medial and posterior part of the isthmus of C2 - transarticular screw fixation was feasible even with a high-riding vertebral artery. But in case of bilateral high-riding vertebral artery, other treatment should be considered because of the potential risk of bilateral vertebral artery injury. We report a case of atlantoaxial instability with bilateral high-riding vertebral artery treated using rod and screw.

Case Report

A 52-year-old female presented with a 3-year history of quadriparesis and, for 10years, tingling sensation on four extremities. On neurological examination, she demonstrated motor weakness (power grade IV) and paresthesia on all extremities. Lateral x-ray of a cervical spine showed atlantoaxial subluxation and extension lateral radiograph showed full reduction of the subluxation (Fig. 1). Cervical magnetic resonance image(MRI) revealed severe cord compression with signal change at C2 (Fig. 2A). Computed tomography(CT) reconstruction images obtained after application of Halo vest in full-extended position revealed full reduction of the subluxation (Fig. 2B, C) and she did not complain any new neurological symptoms. Therefore we decided to perform posterior atlantoaxial fixation. On sections 3mm lateral to the right and left lateral edge of the spinal canal, with imaginary trajectory aiming anterior tubercle of C1, the screws transected bilateral vertebral artery. Internal heights of lateral mass[7] were 1.5mm in right and 1.4mm in left and no cancellous bone was observed at bilateral isthmus (Fig. 3A, B, C).

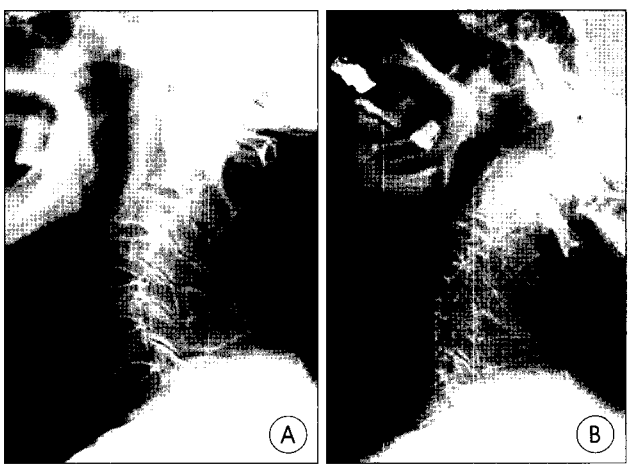

Fig. 1. A : Lateral x-ray showing atlantoaxial subluxation. B : Extension lateral radiograph showing full reduction of the subluxation.

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Fig. 2. A : Cervical magnetic resonance image revealing severe cord compression with signal change at C-2. B : Computed tomography(CT) reconstruction image obtained before apply of Halo vest. C : CT reconstruction images obtained after apply of Halo vest in full-extended position revealing full reduction of the subluxation.

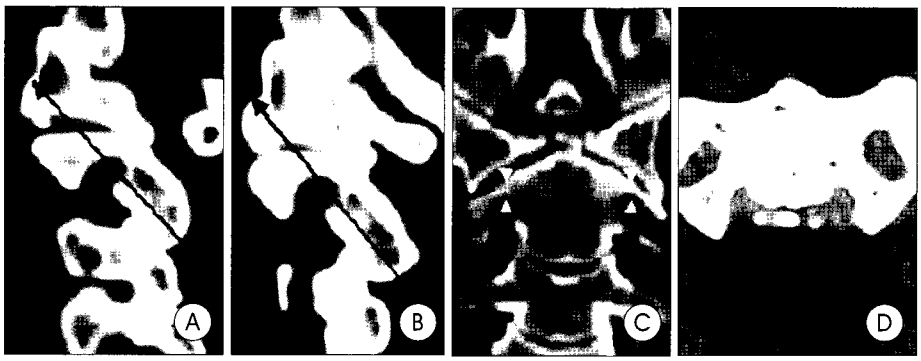

Fig. 3. A and B : On sections 3mm lateral to the right (A) and left (B) lateral edge of the spinal canal, with screw trajectory aiming anterior tubercle of C-1 (arrow), the screws transect bilateral vertebral artery. Note that no cancellous bone is seen at bilateral isthmus. C : Internal heights of lateral mass (arrowheads) are 1.5mm in right and 1.4mm in left. D : The maximum width of bilateral C-2 pedicle is only 3.6mm. Note the presence of cancellous bone at bilateral C-2 pedicle.

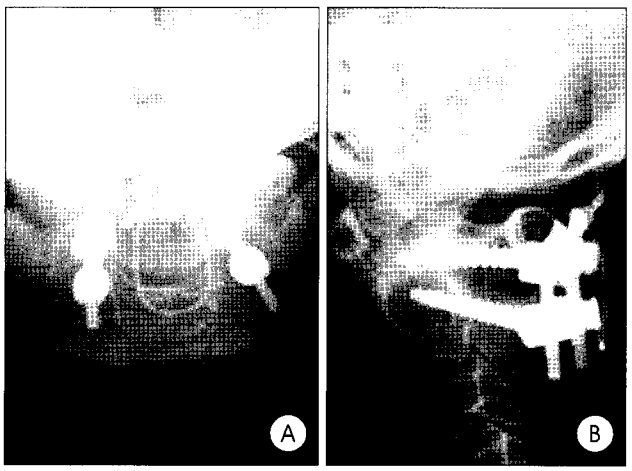

Fig. 4. Anteroposterior (A) and lateral (B) radiographs obtained immediate after operation showing atlantoaxial fixation using rods and screws.

Therefore we thought that it was impossible to perform atlantoaxial transarticular screw fixation without violating bilateral vertebral artery and we decided to perform atlantoaxial screw fixation using rod and screw though maximum width of bilateral C2 pedicle was only 3.6mm (Fig. 3D).

Intervention

Under general anesthesia, the patient was placed in prone position. After identifying medial and lateral edge of C2 pedicle, polyaxial screw of diameter 3.5mm was inserted along superomedial portion of C2 pedicle aiming the base of the odontoid process using fluoroscopy. Then C1 lateral mass screw was placed into atlas aiming anterior tubercle of C1. To pass sublaminar wire under the C1, we performed minimal removal of the occiput. Pulling the sublaminar wire, we performed intraoperative atlantoaxial reduction. Then two screws were connected and fixated with rod. After bilateral fixation, bone graft was fitted and fixated between C1 lamina and C2 spinous process with wire (Fig. 4).

Postoperative course

Postoperatively she did not showed any new focal neurological symptoms and signs. CT reconstruction images obtained immediately after surgery revealed bilateral partial compromise of vertebral artery groove (Fig. 5A). Postoperative cerebral angiography showed, however, no evidence of vertebral artery injury (Fig. 5B, C).

Discussion

In the present case, we thought that it was impossible to perform atlantoaxial transarticular screw fixation, which provides the highest degree of stiffness as a threepoint fixation[3]. With Occipito-cervical fusion technique, however, long segment should be fixated. Furthermore it does not provide stiffness

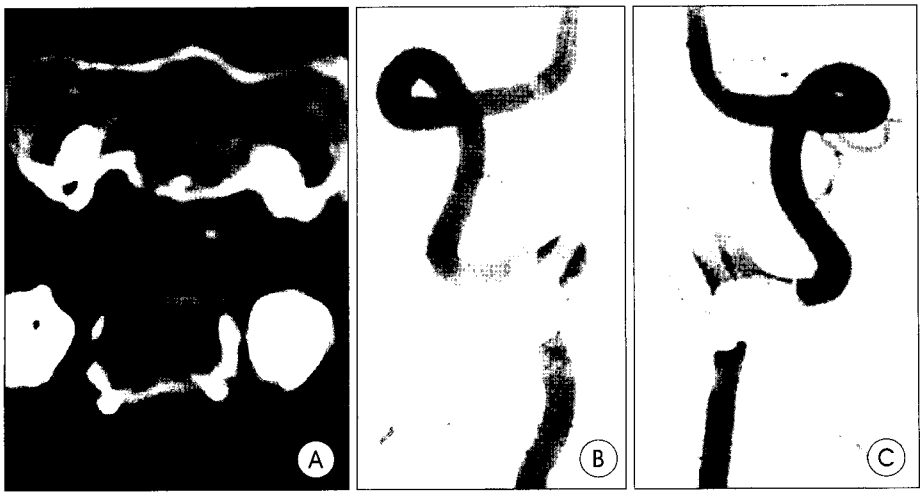

Fig. 5. A : Axial computed tomography images showing breaching of bilateral vertebral artery groove by screws. B and C : Postoperative cerebral angiography shows no evidence of vertebral artery injury.

equivalent to that of the three-point fixation technique. Therefore in this case we decided to perform atlantoaxial fixation using rod and screw, which also provides high biomechanical stiffness[5].

Among several parameters predicting safety of atlatoaxial transarticular screw fixation[4,7,9], we measured the internal height of lateral mass. According to the anatomical study of Madawi et al.[7], even with a most accurate alignment, vertebral artery might be damaged by transarticular screw when the internal height of lateral mass is less than 2mm. Bloch et al[1] defined high-riding vertebral artery as follows - an internal height less than 2mm, an isthmus height less than 5mm, or both. Neo et al.[9] suggested that isthmus height itself was more important than internal height, because the screw went through the isthmus itself regardless of the internal height and two of their cases had internal heights less than 2mm but an isthmus height exceeding 5mm. In our case bilateral internal height was less than 2mm. From our clinical experience, however, we thought the presence of cancellous bone at isthmus was more important parameter than the isthmus height itself. Because when cancellous bone was absent at isthmus, it was usually impossible to place screw safely through the isthmus. Therefore, when there is no cancellous bone at isthmus on CT reconstruction like our case, we think it better to abandon transarticular screw fixation.

Because the maximum width of C2 pedicle of the present case was only 3.6mm, the passage of C2 pedicle screw with diameter 3.5mm seemed to be dangerous. But it is empirically known that a slight breaching of vertebral artery groove dose not necessarily injury the artery[8]. Furthermore cancellous bone was present at bilateral C-2 pedicle. Therefore we carefully performed C-2 pedicle screw fixation along superomedial portion of the pedicle. CT reconstruction images obtained after operation revealed bilateral breaching of the vertebral artery groove but bilateral vertebral artery was intact on angiography, as expected.

Conclusion

Although technically demanding, atlantoaxial fixation using rod and screw can be one of the treatment options for atlantoaxial instability with bilateral highriding vertebral artery.

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