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Letters:

Spinous process plate fixation for cervical spinal fusion after spinal trauma: two case reports

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Posterior cervical fixation with various forms of instrumentation has been used for reconstruction in cases of traumatic disorders and degenerative or tumor-related dysfunction of the cervical spine. Recently, posterior plate and rod techniques using lateral mass screws or pedicle screws have been reported to show excellent fusion rates (Xu *et al.*, 2010). Nevertheless, because such cervical spinal instrumentation requires screw anchorage, which may expose the vertebral artery or neural structures and cause neighboring lateral mass damage, they are not used by some surgeons (Mihara *et al.*, 2001; Xu *et al.*, 2010). A spinous process plate system, S-plate (Kisco Co., Ltd., Kobe, Japan), has been developed for short in situ fusions in selected patients. In this fixation procedure, the spinous processes are securely sandwiched between a pair of spiked plates, which are pressed together by tightening screws that extend through the plates (Neo *et al.*, 2006). To our knowledge, only one report has described this cervical fixation technique, specifically as a salvage operation for failed anterior cervical fusion (Neo *et al.*, 2006).

In this letter, we report our experience applying spinous process plate systems as primary fixation devices for cervical spine trauma. An 86-year-old man showing a displaced left C6 facet fracture with dislocation and a C6 laminar fracture underwent posterior fusion and bone grafting using spinous process plates from C5 to C7. A 67-year-old man showing displacement of the C5 vertebral body with right facet fracture underwent posterior fusion and bone grafting using a spinous process plates from C5 to C6. Their postoperative courses were uneventful and follow-up computed tomography (CT) scans showed posterior bony fusion. This posterior fixation technique is safe and easy to perform for primary cervical fusion.

Case 1: An 86-year-old man was admitted with neck pain and left arm numbness after falling from a tree. Neurological examination revealed no sensory or motor disturbance. A plain radiograph and computed tomography (CT) scan of the cervical spine showed a displaced C6 facet fracture with dislocation (Fig. 1a) and a C6 laminar fracture. Magnetic resonance imaging (MRI) studies demonstrated no damage to the spinal cord or C5–6 vertebral discs. Surgery was performed two days after the fall. Posterior fusion using an S-plate was performed with local bone grafting. The screws of the S-plate were inserted through the spinous processes of C5, C6, and C7 (Fig. 1b). The postoperative course was uneventful and no cervical brace was applied after surgery. Six months after the surgery, the patient had no symptoms and a CT scan showed posterior bony fusion (Fig. 1c).

Case 2: A 67-year-old man was admitted with neck pain after falling. He had no other complaints. Neurological examination revealed no sensory or motor disturbance. A CT scan and MRI of the cervical spine showed a displaced C5 vertebral body with a right facet fracture (Fig. 2a). MRI studies indicated

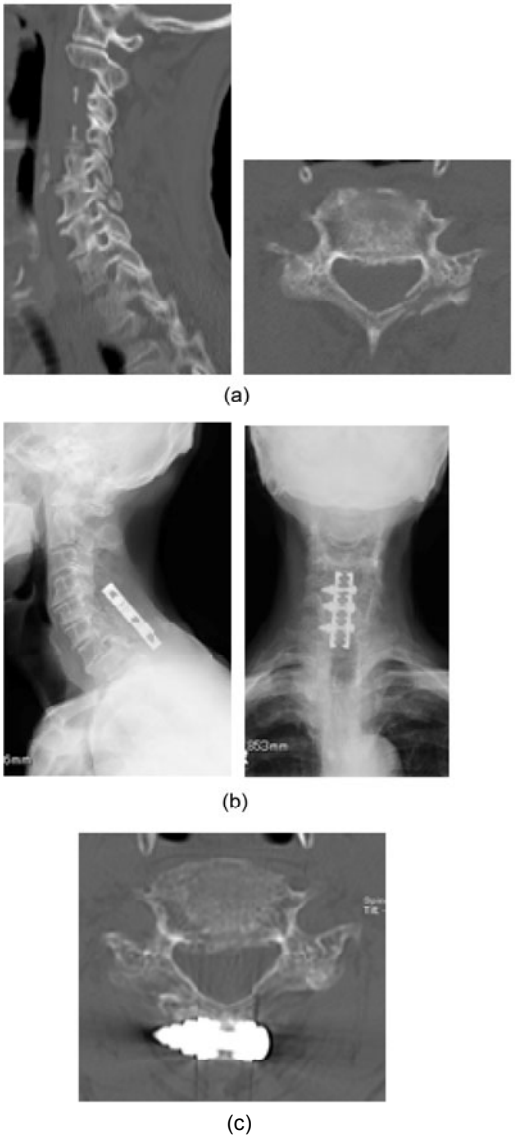

Fig. 1 CT scans and plain X-ray images of Case 1
(a) Cervical CT scans demonstrating displacement of left C6 facet fracture with dislocation, and C6 laminar fracture (left: sagittal image; right: axial image); (b) Plain X-ray images showing posterior spinous process plate fixation after surgery (left: lateral view; right: anterior-posterior view); (c) Axial cervical CT scan showing posterior bony fusion and fracture healing at the C6 vertebra

displacement of the C5 vertebral body with hematoma at the C5–6 level, which compressed the spinal cord (Fig. 2b). Posterior fusion using an S-plate was performed with a local bone graft. The screws of the S-plate were inserted through the spinous processes of C5 and C6 (Fig. 2c). The postoperative course was uneventful and no cervical brace was required after surgery. Nine months after surgery, the patient had no symptoms and a CT scan showed posterior bony fusion (Fig. 2d).

Both spinal instrumentation and surgical techniques have provided surgeons with expanding capabilities in spinal reconstruction and fixation. Traditionally, the Rogers technique (Camille *et al.*, 1992), a simple wiring procedure involving the adjacent spinous process, has been widely used in trauma cases. This technique depends on spinous process bone strength for wire cutout resistance. More recently, posterior plating or rod techniques using lateral mass screws or pedicle screws have been reported with excellent fusion rates (Levine *et al.*, 1992; Abumi *et al.*, 1994; Abumi and Kaneda, 1997). However, there are potential risks associated with the screw misplacement, such as nerve root injury, vertebral artery injury, and neighboring lateral mass damage (Xu *et al.*, 2010). An S-plate is simple to implant and there are no known risks of neurovascular injury. Furthermore, damage to the posterior soft tissue is reduced, compared with the lateral mass screw fixation (Neo *et al.*, 2006). Mihara *et al.* (2001) compared the biomechanical properties of four posterior cervical fixation techniques: the Wavy Rod system, Rogers posterior wiring, Bohlman triple wiring, and lateral mass plate fixation. They concluded that the Wavy Rod system was the most effective of these techniques for stabilizing a cervical motion segment. Wang *et al.* (2006) biomechanically compared the SPIRE spinous process lumbar spinal stabilization plate with other posterior lumbar fixation methods. They concluded that the SPIRE plate effectively stabilized the lumbar spine, and the test results compared favorably with other fixation techniques. The Wavy Rod system and the SPIRE plate system are based on the same concept as the S-plate system, providing an alternative to the clinical use of traditional interspinous fixation techniques. The S-plate provides an attractive alternative to pedicle screws or lateral mass screws for selected patients requiring instrumentation-augmented fixation, while decreasing the common risk associated with screw misplacement in posterior plating or rod techniques. To our knowledge, only Neo *et al.* (2006) have described this fixation technique, used as a salvage operation for failed anterior cervical fusion. We believe that this

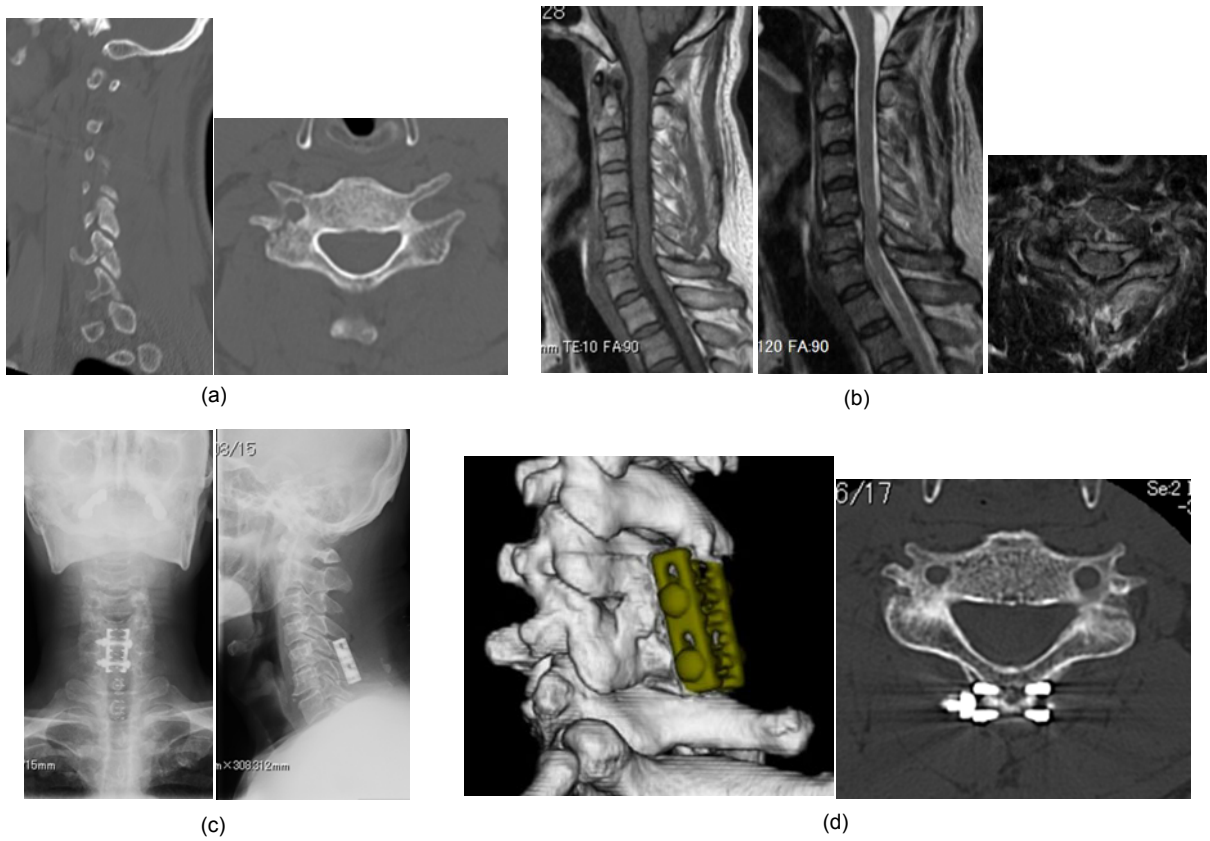

Fig. 2 CT scans, magnetic resonance images, and plain X-ray images of Case 2

(a) Cervical CT scans demonstrating displacement of right C5 facet fracture (left: sagittal image; right: axial image); (b) T2-weighted magnetic resonance images revealing a high signal intensity in the anterior cervical spinal canal at the C5–6 level, which may represent spinal epidural hematoma. Displacement of the C5 vertebral body was also noted (left: T1-weighted sagittal image; middle: T2-weighted sagittal image; right: T2-weighted axial image); (c) Plain X-ray images showing posterior spinous process plate fixation after surgery (left: anterior-posterior view; right: lateral view); (d) Cervical CT scan showing posterior bony fusion at the C5–6 level, and fracture healing at the C5 vertebra (left: 3D reconstructed view; right: axial view)

technique is also a practical option for use in primary operations for cervical spinal trauma.

In summary, we demonstrated the utilization of an S-plate for treating cervical spinal trauma for the first time. We believe that this posterior fixation technique is safe to perform. Furthermore, it may be applicable to primary cervical fusion as well as salvage operations.

Compliance with ethics guidelines

Hiroki HIRABAYASHI, Jun TAKAHASHI, Hiroyuki HASHIDATE, Nobuhide OGIHARA, Keijiro MUKAIYAMA, Shugo KURAISHI, Masayuki SHIMIZU, Hiroyuki NAKAGAWA, Renzo MATSUE, and Hiroyuki KATO declare that they have no conflict of interest.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000(5). Informed consent was obtained from all patients for being included in the study.

Additional informed consent was obtained from all patients for which identifying information is included in this article.

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