We describe a patient with traumatic right-sided invagination of two consecutive laminae into the spinal canal. The injury resembled a greenstick fracture and resulted in an acute Brown-Séquard syndrome. There was also an undisplaced hangman’s fracture of the axis vertebra. These injuries were caused by an acute hyperextension and axial compression of the cervical spine. Open reduction and internal fixation of the laminar fractures without fusion was followed by full neurological recovery within six weeks.

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Case report

An 18-year-old man was involved in a head-on vehicle collision. Sitting unrestrained in the passenger seat, he hit the dashboard with his forehead and felt a sudden electric pain shooting down his right side while his head was forced backwards. He was immediately aware of right-sided weakness, more pronounced in the upper limb than in the lower. Clinical examination revealed mild neck pain, right-sided hemiparesis from C5 downwards and patchy paraesthesiae on the left side, more pronounced in the lower limb but right-sided weakness was more obvious in the upper. Plain lateral radiography revealed an undisplaced ‘hangman’s’ fracture of the C2 lamina and a barely discernible step in the spinolaminar line from C4 to C5 (Fig. 1a). The anteroposterior (AP) radiograph showed a shift of the fourth and fifth cervical spinous processes to the right (Fig. 1b). CT demonstrated an undisplaced asymmetrical hangman’s fracture (Fig. 2a) and invagination of the right hemilaminae of the fourth and fifth cervical vertebrae with a shift of the spinous processes towards the right side (Figs 2b and 2c). The injury to the laminae resulted in partial reduction in the volume of the spinal canal on the right side. The midline AP diameter of the spinal canal was reduced from 10.5 mm to 7 mm at the level of the C5 vertebra. The patient was initially treated by skeletal traction (3 kg) applied using Crutchfield tongs. As the neurological deficit did not recover during the following week operation was undertaken.

Through a posterior approach, exposing the laminae and lateral masses from C3 to C6, the invagination of the right laminae of the C4 and the C5 vertebrae was confirmed. All other posterior elements such as the facet joints, ligamentum flavum, interspinous ligaments and spinous processes were intact. The fracture at C2 was not exposed. Reduction of the invaginated laminae was achieved by gentle traction on the spinous processes. Mild flexion of the neck helped to maintain the reduction. As the neck was extended there was a tendency for the laminae to reinvagate. Transverse wiring of the two involved spinous processes was undertaken with tension towards the left-sided lateral masses to maintain the position of the reduced laminae.

Adequate decompression was confirmed on a postoperative CT scan (Figs 3a and 3b). Skeletal traction was continued. The left-sided paraesthesiae, and the motor impairment of the right lower limb recovered fully within one day of surgery. Motor power in the right upper limb had improved within one week. The patient complained of increasing pain in the distribution of the right C5 nerve root. Three weeks after operation the motor power throughout the right upper limb was grade 4 except for elbow extension which was grade 3. The pain in the distribution of the right C5 nerve root had improved. There was full neurological recovery six weeks after the injury when he was taken off traction and was given a hard collar for the next four weeks. At ten weeks lateral radiographs demonstrated healing of the hangman’s fracture. He had no pain, but marked stiffness of the neck. After four months he had no discomfort in the neck and by 14 months a full range of movement had returned. Lateral radiographs showed that the hangman’s fracture had healed and that there was minimal narrowing of the disc space at the C3-C4 level (Fig. 4).
Radiographs of the cervical spine showing a) a lateral view of an undisplaced hangman’s fracture and a step in the spinolaminar line and b) an AP view of a lateral displacement of the C4 and C5 spinous processes to the right.

CT confirmed a) the undisplaced hangman’s fracture, b) the right-sided laminar invagination of C4 with shift of the spinous process to the same side, and c) the right-sided laminar invagination of C5 with reduction of the AP diameter of the spinal canal from 10.5 to 7 mm.

Postoperative CT of a) the C4 and b) C5 vertebrae.
Discussion

Isolated fractures of the laminae are rare,1-6 and were not seen in the large series of fractures of the cervical spine described by Bohlman.1 If neurological changes occur they are usually caused by other injuries such as to an articular facet or the lateral mass.1,2 Our patient had an unusual combination of a hangman’s fracture with traumatic plastic invagination (greenstick-type fracture) of the C4 and C5 laminae causing an incomplete right-sided Brown-Séquard syndrome. Surgical reduction and fixation of the laminae were followed by full neurological recovery five weeks after surgery. As there were no radiological or intra-operative findings suggesting instability we did not perform a fusion. In two other reported cases5,6 the bony injury was described as a laminar fracture and the CT images were similar to Figure 2. In one patient laminectomy and fusion were followed by neurological recovery from complete quadriplegia.5 In the other laminectomy without fusion resulted in neurological recovery from an incomplete hemiparesis.6

Hyperextension and axial compression were the mechanisms of the injury, confirmed by the history and the presence of an associated undisplaced hangman’s fracture. Hyperextension and axial compression led to crowding of the posterior vertebral elements causing the spinous processes to be forced to one side. The lamina on that side invaginates causing compression of the spinal cord. The ligamentous structures remain intact, and the spinal column as a unit remains stable. Cervical fusion should not be required, allowing the movement segments to be preserved.

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References