

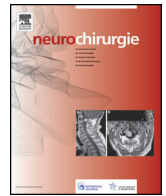


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Original article

Dorsal open reduction with pedicle screw rod internal fixation for lower cervical spine dislocation: A retrospective analysis of 12 cases

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ABSTRACT

Background. – Lower cervical spine dislocation remains a surgical challenge.

Methods. – Twelve patients with lower cervical dislocation due to articular process injury underwent dorsal open reduction and manual pedicle screw rod fixation. Patients with cervical spinal cord injury received simultaneous open door expansive laminoplasty. Neurological function was evaluated using ASIA Impairment Scale 12.

Results. – Median time from injury to operation was 10 days (range, 5 to 52 days). Anatomic reduction was achieved in all patients. In nine patients with cervical spinal cord injury, 55.5% (5/9) showed improvement in ASIA grade following surgery. Unilateral numbness of the superior radicular area in one patient resolved 2 weeks post-surgery and two cases (11.1%, 2/9) had postoperative leakage of the cerebrospinal fluid, which resolved in 11 days and 13 days, respectively.

Conclusion. – Dorsal open reduction and manual pedicle screw rod fixation is safe and effective for lower cervical spine dislocation due to articular process injury.

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1. Introduction

Management of lower cervical spine dislocation due to articular process injury remains a surgical challenge. Conventional treatment includes preoperative closed skull traction reduction while awake or manual closed reduction under general anesthesia followed by anterior or posterior cervical spine fusion with fixation [1–5]. Some surgeons prefer ventral open reduction by leverage followed by anterior or combined anteroposterior fusion with fixation [6], but these conventional procedures risk reduction failure and/or worsening neurological impairment.

Several modifications have been proposed to increase the success rate and reduce the risk of neurological impairment during reduction. Some surgeons believe that in cervical spine dislocation, intervertebral disc injury and disc herniation into the spinal canal are the major causes of worsening neurological impairment

following cervical spine reduction, and oppose simple dorsal reduction [7,8]. Recently, however, other surgeons have raised doubt about this cautious approach and feel that simple dorsal reduction is safe and reliable [9]. There have been few reports in the literature on dorsal open reduction with pedicle screw fixation for cervical spine dislocation, and there has been no previously reported study on dorsal open reduction in combination with laminoplasty for lower cervical dislocation with cervical spinal cord injury. We carried out a retrospective analysis of 12 patients who received dorsal open reduction with pedicle screw rod internal fixation for lower cervical dislocation including nine patients with associated cervical spinal cord injury.

2. Patients and methods

2.1. Patients

Our study protocol was approved by the institutional review boards at all affiliated institutions who waived informed consent due to the retrospective nature of the study.

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We retrospectively reviewed the surgical records of 12 patients from several institutions who presented with lower cervical spine dislocation due to lower cervical articular process injury between October 2007 and December 2011. Patients were included in our study if they had lower cervical articular process injury including unilateral or bilateral articular process fracture, unilateral or bilateral articular process dislocation, or locked facet. Patients were excluded if they had multi-segment vertebral or lamina fracture, or regional kyphosis due to vertebral compression fracture.

2.2. Surgical procedure

All operations were performed by a single surgeon with more than 20 years experience in spinal surgery and operations were performed at multiple hospitals. All patients underwent dorsal open reduction and manual pedicle screw rod fixation under lateral fluoroscopy. Those patients with cervical spinal cord injury were placed in the prone position with the head fixed by a Mayfield frame with the cervical spine maintained in an approximately neutral position, and received general anesthesia via endotracheal intubation. Patients without spinal cord injury were placed in a prone position with their forehead on a soft pillow and received regional anesthesia while awake.

Bilateral mass and its lateral margin were exposed sufficiently by the posterior midline approach. Decompression and reduction were performed according to the type of fracture dislocation. Bilateral fixation of the involved segment and immediately adjacent segments was carried out in all cases.

For patients with vertebral fracture or pedicle fracture, additional cephalad or caudal segments were also fixated. Horizontal drill holes (3–4 mm) were made at the base of the spinous process in the segment to be instrumented or to be decompressed was to be performed. A 1 mm stainless steel wire was passed through the instrumented segment to provide temporary fixation after reduction. The cephalad portion (2 to 5 mm) of the superior articular process with locked facet was excised with narrow Kerrison rongeur, and then a narrow osteotome or a periosteal elevator was inserted between the superior and inferior articular processes for leverage reduction. A Backhaus towel forceps was passed through the drilled hole at the base of the spinous process, and the rostral spinous process was elevated dorsally and the caudal inferior spinous process and lamina were depressed to assist reduction. Mayfield head frame or forehead pillow was elevated by a surgical assistant off the surgical theatre to maintain the cervical spine in an overextended position for reduction of interlocking articular processes. The above mentioned stainless steel wire was rounded and tightened to achieve temporary fixation. Lateral fluoroscopy indicated incomplete reduction of vertebral subluxation. The cartilaginous surface of the facet joint to be fixed was removed with a rongeur and cancellous bone fragments were implanted. Multi-axis 3.5 mm diameter pedicle screws were inserted manually under the guidance of lateral fluoroscopy, as previously described [10]. Suitable rods were selected, bent, and placed, and caudal caps were screwed tightly. The rostral cap was tightened, a distance of approximately 5–6 mm in height was maintained between the rod and rostral screw, and the distance between the rostral and caudal screws was properly compressed. While the rostral cap was tightened, the rostral screws were elevated to achieve anatomical reduction for the rostral vertebra with anterior subluxation. Finally, the stainless steel wire used for temporary fixation was removed.

In patients with cervical spinal cord injury, simultaneous unilateral open door expansive laminoplasty was performed to achieve extensive spinal cord decompression, including the cephalad and caudal 2 to 3 vertebral laminae of the dislocated segment (total of 4 to 6 vertebral laminae) with the superior most border extending to the C3 vertebral lamina. No. 10 silk thread was passed through the

preserved hole at the base of the spinous process and was sutured to the facet joint capsule or passed under the above mentioned rod and tied to maintain the opened door of laminae.

2.3. Patient evaluation

The neurologic function of the 12 patients was evaluated using the American Spinal Cord Injury Association (ASIA) Impairment Scale 12. Preoperative anteroposterior and lateral radiographs of the cervical spine and computed tomography (CT) of the entire cervical spine with sagittal reconstruction were performed. In addition, 11 patients underwent preoperative cervical spine magnetic resonance imaging (MRI). X-rays, CTs and MRIs were also performed 1 to 4 weeks after surgery to assess stability, deformity, and fusion. The primary endpoints of this analysis were degree of anatomical reduction and changes in ASIA grade. All patients were followed-up by telephone interview.

3. Results

3.1. Patient demographics and baseline characteristics

The demographics and baseline characteristics of the 12 patients [nine males and three females with a median age of 40.5 years (range, 17 to 65 years)] are studied. Three patients (25%, 3/12) had unilateral fractures of the inferior articular process with semi-dislocation of the ipsilateral articular process, and three patients (25%, 3/12) had unilateral locked facet of the articular process. Six patients (50%, 6/12) had bilateral locked facets of the articular processes including interlocking on one side and locked facet on the other side in one case, a mild inferior vertebral fracture without compression in one case, a mild superior vertebral fracture without compression and pedicle fracture in one case, mild superior and inferior vertebral fractures without compression in one case, and fracture of bilateral articular processes in two cases.

Nine patients (75%, 9/12) had cervical spinal cord injury of varying severity including six cases of grade A ASIA impairment, two cases of grade B impairment, and one case of grade C impairment. Preoperative MRI of the cervical spine revealed impingement of the spinal cord in eight cases with cervical spinal cord injury (Fig. 1). In one patient with locked facets at bilateral articular processes and cervical spinal cord injury at C4–5, MRI was not performed due to urgent tracheostomy. Preoperative tracheostomy was performed in three patients due to breathing difficulties. Three other patients (25%, 3/12) had no cervical spinal cord injury after trauma. Neck pain was present in all patients.

3.2. Surgical outcomes

The median time from injury to operation was 10 days (range, 5–52 days). In nine cases without vertebral fracture, only immediate adjacent segments received fixation. In three cases, patients had a vertebral fracture without compression or pedicle fracture, in two cases patients underwent fixation involving three vertebral segments and in one case patients underwent fixation involving four vertebral segments. Postoperative X-ray examination, CT with sagittal reconstruction, or MRI revealed that anatomic reduction was achieved after cervical spine dislocation in all patients, and the cervical spine was well aligned.

In the nine patients with cervical spinal cord injury, over half (55.5%, 5/9) showed postoperative improvement in ASIA grade compared with baseline. One case improved from preoperative ASIA grade A to grade C following surgery, one case improved from grade A to grade B, one case improved from grade B to grade D, one case improved from grade B to grade C, and one case improved

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