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Anterior pedicle spreader reduction for unilateral cervical facet dislocation

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ABSTRACT

Objective: The anterior only surgical procedure including discectomy, open reduction and fusion is used as a recommended approach in the treatment of unilateral cervical facet dislocations, but is difficult to achieve satisfactory anterior open reduction by vertebra distractor to spread the facet joints, especially for delayed management of unilateral cervical facet dislocation (7–21 days). The goal of this study was to report an anterior pedicle spreader technique to distract directly the facet joint for anterior reduction and the results of 4 patients with successful application and describe safety.

Methods: Four patients with unilateral cervical facet dislocation who failed to open anterior reduction by vertebra spreader procedure were surgically treated by the anterior pedicle spreader reduction. In these 4 patients (3 males and 1 female), the distribution of spine level was from C4/5 to C6/7; the neurological status was comprised 2 patients with ASIA E, 1 with D and 1 with A; the surgical management was ranged from 7 to 18 days. After discectomy, if failed to open anterior reduction procedure, the anterior pedicle spreader was inserted along the pedicle axis with the fluoroscope-assisted view imaging. The spreader was distracted directly to the facet joint and pushed in a caudad direction to achieve posterior translation of the upper segment.

Results: Postoperatively, all patients had obtained successful reduction and satisfactory anatomic sagittal alignment. There was no complication owing to the use of this technique. The ASIA A showed no neurological improvement; the patient with ASIA D was improved neurologically to ASIA E; no ASIA E patients showed neurological deterioration.

Conclusions: Anterior pedicle spreader reduction represents an efficacious but technically challenging option for the delayed treatment of unilateral cervical facet dislocation.

Introduction

Unilateral cervical facet dislocations represent 5% of substantial cervical spine injuries and are treated surgically with decompression, reduction, fixation and fusion. The treatment of cervical facet dislocations is highly variable including anterior alone, posterior alone, anterior-posterior, posterior-anterior, and anterior-posterior-anterior approaches according to closed, anterior open or posterior open reduction [1,2]. Among these approaches, the anterior only approach including discectomy, open reduction and instrumental fusion are recommended, especially for presence of a traumatic intervertebral disc herniation but without spinal cord injury [2–7]. It carries less risk for spinal cord injury compared with the closed reduction or posterior alone approach, and minimizes the surgical injury and operative time compared with posterior reduction followed with anterior fusion. However, it is difficult to achieve satisfactory reduction using an anterior approach and about 25% to 40% anterior open reductions failed requiring posterior surgery, because the vertebra distractor failed to spread the facet joints [4,8]. We have therefore developed an anterior pedicle spreader technique to distract directly the facet joints for reduction of unilateral facet dislocation. This technique is especially useful for delayed management of unilateral facet dislocation with traumatic intervertebral disc herniation patients who failed the conventional anterior open reduction to avoid a posterior procedure. We have performed this procedure on 4 patients with satisfactory outcomes.

Patients and methods

During the 3-year period from January 2013 to December 2015, 15 patients with unilateral cervical facet dislocations were admitted or transferred to and treated surgically in the investigator's group (Z. Z.). Among them, 11 patients who presented no traumatic intervertebral disc herniation underwent a closed

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reduction attempt in an awake or under general anesthesia with Gardner-Wells traction. 5 of these 11 patients achieved a successful closed reduction. The remaining 6 patients who failed to closed reduction and other 4 patients who presented a traumatic intervertebral disc herniation underwent open anterior reduction by typical vertebra spreader procedure after discectomy [4]. Among these 10 patients, 4 patients (4/10, 40%) failed to open anterior reduction by vertebra spreader procedure and treated by the anterior pedicle spreader reduction. In these 4 patients (3 males and 1 female), the distribution of spine level was from C4/5 to C6/7; the neurological status was comprised 2 patients with ASIA E, 1 with D and 1 with A; the surgical management was ranged from 7 to 18 days; follow-up ranged from 12 to 18 months (Table 1).

Before and after surgery, all patients underwent CT scans to define the precise spinal injury, spinal alignment and fusion, and a 1.5-T MRI to define cord compression and the extent of intramedullary signal intensity change by sagittal and axial planes, T1-weighted and T2-weighted MRIs signal. Standard AP, lateral and two oblique films were obtained before and after surgery to assess spinal injury, reduction, and instruments. Neurological status of all patients on admission and at each follow-up was evaluated according to the International Standards for Neurological and Functional Classification of Spinal Cord Injury determined by ASIA-IMSOP [9].

All operations were performed by the author (Z. Z.). After discectomy, if an anterior open reduction by vertebra spreader procedure was failed, anterior pedicle spreader was inserted along the pedicle axis with the fluoroscope-assisted view imaging, which was similar as previous protocol [10,11]. Briefly, with one rotated c-arm, an accurate AP and lateral view with endplate overlapping of the surgical level of the cervical spine were set on to obtain the cranial or caudal angle of inclination of pedicle axis and facet dislocation (Fig. 1A). Two oblique views with maximized circular portion of the pedicle cortex and maximized length of pedicle were set on to obtain the pedicle axis inclination and unilateral facet dislocation (Fig. 1B). The pedicle ipsilateral to the facet dislocation is the one that is supposed to be cannulated. The centre of the cortical circular area visualized with the image intensifier indicated the insertion point of the spreader on the vertebral body. The contralateral oblique view confirmed the cranial or caudal angle of inclination. The entry hole was created with a 1.8 mm straight awl. With the definite angle of inclination from the sagittal and coronal plane, the awl inserted to posterior margin of vertebral (usually 1.7 cm), which was situated at the circular area by the oblique views (Fig. 1C and D). A 1.4 mm guidewire of cannulated screw was inserted into the pedicle cavity using a drill, and was confirmed repeatedly on AP, lateral and pedicle axis views by fluoroscopy (Fig. 1E and F). After inserting guidewire, anterior pedicle spreader was performed (Fig. 1G). With an intervertebra spacer, the spreader was distracted directly to the facet joint and pushed in a caudad direction to achieve posterior translation of the upper segment (Figs. 1H and 2). After reduction and insertion of an autogenous bone cage, an anterior cervical plate or an anterior cervical pedicle screw plate (Z3; Wego; Weihai, Shandong, China) was used for fixation (Fig. 1I and J). The pedicle screws were 4 mm in diameter and 30, 32 or 34 mm in length. The vertebral screw was 4 mm in diameter and 14 or 16 mm in length [11]. Postoperatively, a cervical hard collar was used to protect patient's neck for 6 weeks. The accuracy of pedicle screw placement was examined postoperatively by reviewing axial CT scans (1 mm slice thickness).

Results

The clinical data are summarized in Table 1. Mean operative time was 115 min (range 90–130 min) and average blood loss was 93 ml (range 50–210 ml). All patients achieved anterior reduction. The patients with ASIA E and D were permitted to ambulate the next day with a cervical collar. Pre- and postoperative plain radiographs and MR and CT images showed good cervical alignment (Fig. 1K, L, M, N, S, T) and accurate placement of pedicle screws within the pedicle cortex (Fig. 1Q and R). The patients achieved successful spinal fusion 3 months postoperatively by plain radiographs and CT scan. There was no complication or instrument failure owing to the use of this technique. The ASIA A patient showed no neurological improvement; the patient with ASIA D was improved neurologically to ASIA E; 2 patients with ASIA E showed no neurological deterioration.

Discussion

The typical anterior reduction is using a Caspar vertebral body pin retractors, an intervertebra poker or a laminar spreader inserted into the disc space for axial traction to reduce dislocated joints, under fluoroscopic guidance and with or without spinal cord monitoring. Once the facet joints are cleared, the instrument is pushed in a caudad direction or/and cephalad rotated to achieve posterior translation of the upper segment [4,7]. However, this distraction is only spread to vertebra but not to facet joints directly, that is the reason for reduction failed. Even in setting of technique to insert the distractor as far posteriorly as possible to the posterior wall of the upper vertebra, or to place the Caspar retractor pins in a slight amount of kyphosis manner during the distraction maneuver, the anterior reduction is failed ranging from 25% to 40% [4,8]. The present technique not only distracts directly to the facet joint but also pushes the facet joint directly in a caudad direction (Fig. 3). A satisfactory outcome of reduction was observed in patients who failed to open anterior reduction by vertebra spreader procedure, as indicated by restored saggittal alignment (Fig. 2).

Comparing the closed reduction with Gardner-Wells traction, which success rates are reported ranging from 30% to 100% [12–15], the present technique takes less risk for spinal cord injury especially for presence of a traumatic intervertebral disc herniation but without spinal cord injury. Although posterior- only approach for reduction and fusion affords the greater stability by posterior instrumentation [16], it cannot allow for removal of extruded disc material before reduction of a dislocated segment, which maybe a potential risk of spinal cord injury [6,17,18]. Comparing posterior reduction with anterior-posterior, posterior-anterior, and anterior-posterior-anterior approaches, the anterior only approach minimizes the surgical injury and operative time. In case of anterior cervical pedicle fixation, which offers higher three-column cervical spine stabilization [19–22], the anterior pedicle

Table 1
Patients data chart.

Case NO.	Sex/Age (y)	Levels	Facet fracture	Time to surgery (d)	Pedicle/vertebral Plate	Operation time (min)	ASIA Preop/postop/follow-up(M)
1	M/57	C5/6	N	14	V	90	E/E/18
2	F/47	C4/5	Y	18	P	130	E/E/12
3	M/45	C5/6	Y	9	P	120	D/E/12
4	M/49	C6/7	Y	7	P	120	A/A/12
Average	-/49.5	–	–	12	–	115	–

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