

Original Article

Unilateral cervical facet fracture: presentation of two cases and literature review

M Kalayci*¹, F Çağavi¹, B Açikgöz¹

¹Department of Neurosurgery, Zonguldak Karaelmas University Medical School, Kozlu, Zonguldak, Turkey

Study design: Two patients with diagnosis of unilateral cervical facet fracture due to motor vehicle accident (MVA) are presented, and the literature is reviewed.

Objective: To discuss the diagnostic difficulties and management strategies in two patients with post-traumatic cervical facet fracture.

Setting: Department of Neurosurgery, Zonguldak Karaelmas University, Faculty of Medicine, Turkey.

Subject: Nonoperative treatment with immobilization was preferred in two female cases (33–34 years old) with diagnosis of C6-7 facet fracture following MVA. Magnetic resonance imaging (MRI) could be performed in acute period in the first case, but not in the second because of inadequate technical condition.

Result: The first case with a good compliance to immobilization recovered without any neurological complication. However, the second case mobilized earlier and used a collar irregularly. Instability developed in the second case on the second month and surgical intervention with anterior approach was performed.

Conclusion: The diagnosis of unilateral facet fractures is often missed and the treatment is still controversial. The compliance of the patient to cervical immobilization in nonoperative treatment plays a very important role in the development of late complications. MRI in the acute period may be useful in determining instability.

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Keywords: cervical spine; facet fracture; dislocation; spinal trauma

Introduction

The cervical spine is the most frequently injured portion of the spinal column after high-velocity trauma.¹ Unilateral facet fracture of the cervical spine constituted an important subgroup of cervical spine injuries, and motor vehicle accidents (MVAs) have been reported as the leading cause.^{1,2} It is difficult to detect this fracture by routine plain radiographs.^{2,3} Although a relatively uncommon type of injury, facet fracture-dislocations are associated with a high incidence of severe neurological morbidity and represent difficult management problems. The fracture is the result of the hyperextension, lateral tilt and rotation of the cervical spine.⁴ It may extend rostrally or caudally into either one of the adjacent facets, ventrally into the foramen transversarium, transverse process, or pedicle or dorsally into the lamina. The lower cervical spine, specifically C5-6 and C6-7, has been reported as the most frequently injured portion.^{1,2,4,5}

In this study, we present two cases with a diagnosis of cervical unilateral facet fracture due to MVA. Although nonoperative treatment with immobilization was the first choice in both the cases, operative intervention was required in one case because of the late developed dislocation. The causes of late instability are discussed.

Case reports

Case 1

A 33-year-old female patient was admitted to our Neurosurgery Department 30 min after a rollover MVA. She had no loss of consciousness. She suffered from excruciating neck pain radiating to the left shoulder, which was markedly aggravated by neck motion. She was driving the car. Although she was buckled up, the rest of the seat was not at an appropriate position. She stated that her neck was rapidly jerked to the left side. She was diagnosed as having C4-5 cervical disc herniation. Her first physical and neurological examination revealed no abnormality.

*Correspondence: M Kalayci, Bahçelievler Mah. Elmas Sok. Kardelen Apt. No: 13/3, 67100 Zonguldak, Turkey

Her neck was immediately immobilized with a Philadelphia cervical collar. Plain cervical X-rays were considered normal, except slightly diminished cervical lordosis (Figure 1). Cervical computerized tomography (CT) imaging revealed C6-7 facet fracture with a tiny bony fragment obliterating the left foramina (Figure 2). Cervical magnetic resonance imaging (MRI) showed a minimal central disc protrusion at C4-5 space without any root, spinal cord compression or ligamentous damage (Figure 3). Owing to the difficulty in neck motion, flexion and extension X-rays could not be obtained. On the second day, she suffered from pain and decreased sensation in her left C7 dermatome, while sitting in bed. The dose of analgesics was increased, and immobilization was strengthened with chest support, added to the Philadelphia collar and she was kept under bed rest until the 10th day. Repeated cervical lateral X-rays with erect posture on the 15th day did not yield any pathology and she was discharged with analgesics. Mild pain continued until the second month. No angulation or subluxation was seen on the flexion–extension X-rays obtained on the second month, and CT revealed that the bony fragment obliterating the foramen had necrotized.

Case 2

A 34-year-old female was admitted to our Neurosurgery Department 1 h after a MVA. Her husband was driving the car, and she was sitting on the front seat unbelted. The headrest of her seat was in poor position. The car turned upside down. There was a period of amnesia



Figure 1 Case 1. Cervical lateral plain radiograph revealed loss of the normal cervical lordosis

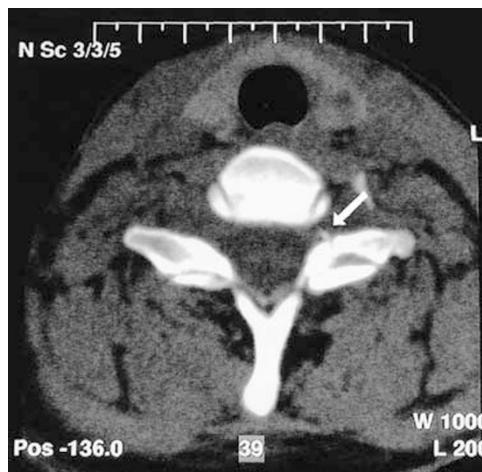


Figure 2 Case 1. Left C6-7 facet fracture on cervical computerized tomography and small bony fragment obliterating the foramen was observed

lasting nearly 1 h. She suffered from nausea and vomiting, neck pain radiating to the right arm and numbness in her right hand. Her neck was immediately immobilized with a Philadelphia cervical collar. Her medical history was unremarkable. Her physical examination revealed no abnormality. On neurological examination, she had sensation loss in C7 dermatome and the right triceps strength of 4/5. In plain X-rays, only C1-4 vertebrae could be evaluated, with no abnormality. Cranial CT imaging was considered normal and cervical CT imaging revealed right C6-7 facet fracture (Figure 4). Owing to the neck pain and muscle spasm, cervical flexion–extension X-rays could not be performed. MRI equipment was not available in our hospital, and the nearest equipment was 300 km away. She was discharged with a collar and analgesics on the second day. On the 15th day, she was pain free and sensation loss in C7 dermatome was the only sign. Repeated cervical lateral plain X-ray revealed no abnormality (Figure 5). In the second month, the patient explained that she has been doing daily household activities for 45 days and using the collar intermittently. Cervical lateral plain X-rays revealed dislocation of C6 more than 3 mm on C7 (Figure 6). Cervical MRI was now available, and anterior longitudinal ligament (ALL) rupture was observed (Figure 7). The patient was operated with an anterior approach for unstable cervical facet fracture and dislocation. Rupture of ALL was observed and posterior longitudinal ligament (PLL) was also identified after C6-7 discectomy. Bicortical autogenous grafts obtained from the right iliac wing were used to establish a fusion with Cloward method, and Codman anterior cervical plate was used to stabilize the two interspaces. No reduction was made as the dislocation was reduced to an insignificant degree on supine position (Figure 8a, b). The patient was mobilized on the first postoperative day with Philadelphia collar and discharged with analgesics on the third day. She used a collar for 8 weeks and was



Figure 3 Case 1. Minimal disc protrusion was observed on the sagittal sequences of cervical MRI examination. No abnormal appearance at C6-7



Figure 5 Case 2. Dislocation or angulation was not observed on the cervical lateral plain radiograph obtained with collar on the 15th day



Figure 4 Case 2. Right C6-7 facet fracture was observed on cervical computerized tomography

taken off it after observing that no abnormality was present on the flexion–extension X-rays (Figure 9a, b).

Discussion

Unilateral facet fractures of the cervical spine constitute an important subgroup of cervical spine injuries. Although cervical unilateral facet fractures were thought to be harmless fractures in the past, we currently know that they are very unstable fractures because of the coexisting spinal cord and root injuries.⁴ In a series of 50 patients by Lifeso *et al*,⁴ the spinal cord was affected in

nine (18%) cases and root injury was identified in 17 (34%) cases.

It is difficult to diagnose cervical unilateral facet fractures with lateral plain X-rays.^{1–6} Although oblique views are the best plain radiographic views to diagnose a lateral mass fracture, they are still not as sensitive as CT and the rotation of the neck is dangerous in cervical traumas. Another reason for the lack of sensitivity is the difficulty in imaging the cervical lower spine on lateral plain radiographs.² In addition, it is not uncommon for patients with cervical spine injuries to have associated head injuries and alcohol or drug intoxication. Also, in cases of trauma, most initial radiographs are taken with patients' supine, perhaps minimizing anterior displacement.⁴ In a series of 24 patients by Halliday *et al*,² the authors reported that pathological images could only be identified in six of the 24 patients with plain radiographs even when they used swimmer's position.

CT is sensitive in diagnosing the fracture, but not in predicting instability. Dislocations might not be identified even in the reconstruction studies carried out by CT.² In the series of Allen *et al*,⁷ the pattern of fracture did not differ between patients with anterorotatory displacement and those with normal alignment. In the series of Halliday *et al*, 12 patients were treated conservatively and 12 were treated surgically. The only difference between the CT examinations of these two groups of patients was that in all the three patients whose facet fractures were affecting both the superior and the inferior facets, subluxations that would



Figure 6 Case 2. Significant dislocation was observed on the erect cervical lateral plain radiograph obtained on the second month

necessitate surgical interventions developed. Additionally, three patients in the nonoperative group had indications for surgery due to instability. There was no difference between the CT examinations of these three patients and the remaining nine.²

Flexion–extension radiographs can give information about the extent of ligamentous injury and can be helpful in determining which fractures require surgical stabilization. However, flexion–extension radiographs obtained acutely are often inadequate because of lack of



Figure 7 Case 2. In the preoperative cervical MRI examination, anterior longitudinal ligament rupture was identified on T1-weighted sequences

movement of the cervical spine from muscle spasm. Also, obtaining flexion–extension radiographs in the acute setting may cause spinal cord injuries.^{2,8} If the patients have accompanying head traumas, then the patient may not be able to cooperate and it will be difficult for him/her to perceive the increases in the pain and the neurological changes that will develop.

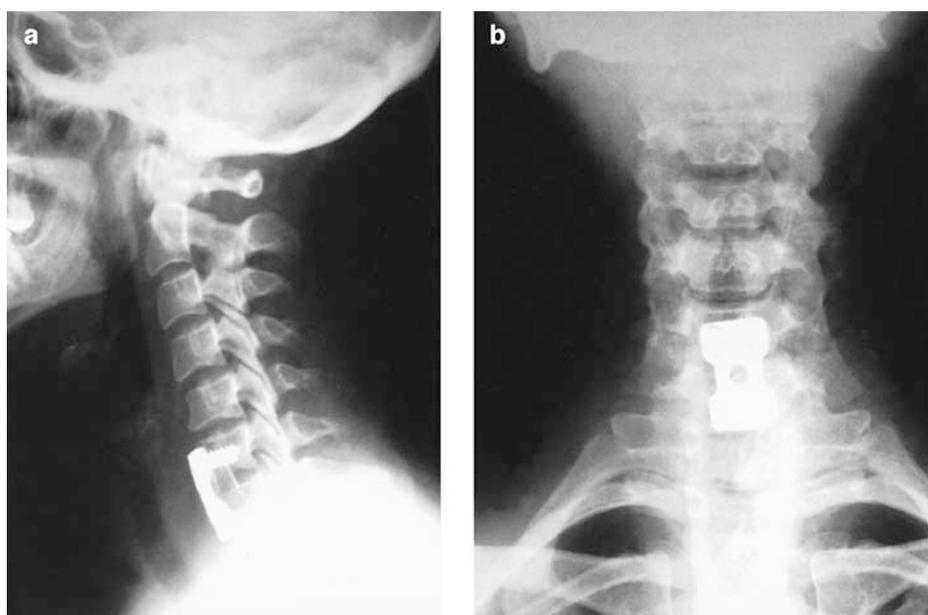


Figure 8 Case 2. Postoperative cervical lateral (a) and anterior–posterior (b) plain radiographs

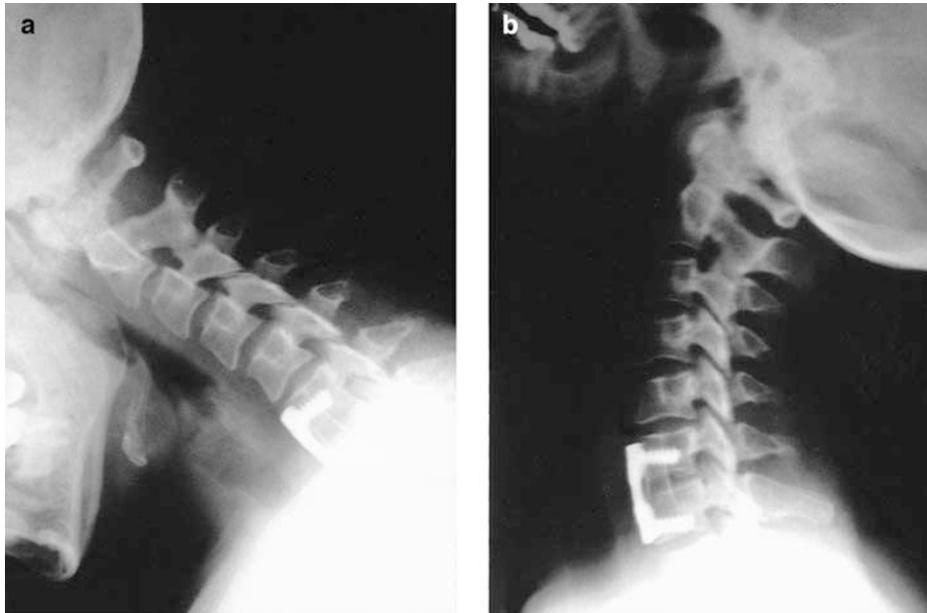


Figure 9 Case 2. Hyperflexion (a) and hyperextension (b) plain radiographs on the second postoperative month

Therefore, the use of acute cervical spine flexion–extension radiographs for diagnosing ligamentous injury is questionable.²

MRI has high sensitivity in identifying ligamentous injuries.^{2,4,6,9–11} As the quality of MRI images has increased due to technological advances, identification of ALL and annulus ruptures have become more successful in time.^{4,6,9,10} Moreover, MRI is the best method for evaluating cord parenchyma.⁹ When such fractures are identified with plain films or CT, this would bring about the suspicion of ligamentous insufficiencies and routine cervical MRI should be obtained to reach the decision of possible surgery.⁴ Lifeso *et al*, Halliday *et al*, and Vaccano *et al* have used MRI in the acute period for trauma screening in their series. They reported that early use of MRI in trauma is sensitive for diagnosing the ligamentous injury to predict instability.^{2,4,11} Dynamic MRI performed on flexion and extension positions can demonstrate previously unidentified subluxations, and the relationship of the pathological segment with the spinal column can be evaluated.¹² Muscle spasm that lacks the adequacy of films in the early post-traumatic period is also a limiting factor for the utilization of dynamic MRI. Routine utilization of functional MR studies will decrease the diagnosis of spinal cord injury without radiographic abnormality (SCIWORA) as well.

The goals of treatment of unilateral facet fracture and fracture-dislocations are primarily preservation of the functional and anatomical continuity of the spinal cord and nerve roots, restoration of spinal canal alignment to relieve neural compression, establishment of spinal stability to provide freedom from postinjury pain or delayed neurological problems and, finally, quick restoration of the highest functional level consistent with the patient's neurologic complication.⁵ In the

literature, there are controversies concerning the treatment of unilateral facet fractures. If there is coexisting subluxation, cervical spine traction and reduction are tried. Open reduction is considered when closed reduction proves to be insufficient or when early decompression is required due to neurological deterioration. For postreduction immobilization, halo thoracic devices and internal fixation are the two choices.^{4,5} The nonoperative treatment of unilateral facet fractures without subluxation is immobilization with halo-vest or hard-collar. Several series of cervical spine fractures immobilized in a halo vest have documented a high failure rate of facet fractures with subluxation. One problem with halo immobilization is the movement of the cervical spine, a snake-like movement of the middle and lower cervical vertebrae that occurs even with a properly placed halo-vest.^{2–4,6,13,14} In Rorabeck *et al*'s¹³ series of 26 patients, spontaneous fusion rate of the unilateral facet fractures following nonoperative treatment was only 20% and they stated that chronic cervical pain might occur because of late dislocations. In a series of 36 patients by Beyer and Cabanela, 24 patients were treated nonoperatively and the spontaneous fusion rate was reported as 50%. In the operatively treated 10 patients (wiring by posterior approach and fusion), they reported that residual subluxations or angulations were not seen at late period and suffering from pain was less than nonoperatively treated group.⁵ In the series by Lifeso *et al*,⁴ none of the six patients treated by halo-vest and 12 patients treated with hard-collar had success. Buchoz and Cheung suggested that patients with unilateral facet fractures with perched facets should be surgically stabilized rather than a trial of halo-vest immobilization. However, this does not address the issue of those patients who do not initially have subluxation and who subsequently sublux despite a

cervical orthosis.³ Halliday *et al* evaluated ALL, PLL, interspinous ligaments and facet capsules with MRI during the acute period and recommended early surgical treatment in patients with injury at least in three of these structures.² Surgery in the early period for these patients will prevent the chronic cervical pain or radicular pain that might develop via complications such as kyphosis, rotation and subluxation.^{2,3,13} As MRI can also successfully demonstrate cervical disc herniations, it is useful for the selection of surgical procedure, anterior or posterior approach.^{2,4,15,16}

In the surgical treatment of unilateral facet fractures by the posterior approach, wiring or stabilization and fixation with plate and screw systems are implemented.^{1,2,4,5} In human cadaver studies performed by Coe *et al*,¹⁷ posterior stabilization techniques (Rogers wiring, sublaminar wiring, Bohlman wiring, Roy–Camille posterior plate fixation, oblique posterior hook plate fixation) were evaluated and any significant biomechanical difference was not found between them. Unfortunately, with the high association of laminar and lateral mass fractures in this fracture pattern, posterior wiring often involves stabilizing a minimum of two motion segments, whereas a single wire or wires between intact spinous processes inadequately controls rotational instability. Furthermore, posterior approaches to the cervical spine may lead to inadvertent damage to adjoining muscle and facet complexes and cause late deformity at adjacent levels.⁵ Posterior plating techniques have been reported to be better in controlling rotational instability; however, because of the weakness of the posterior structures, collapse of the disc space or kyphosis may develop in the late stage.^{4,18,19} Lifeso *et al* have reported that posterior stabilization and fusion procedures led to unsuccessful results in five of the 11 patients (45%), related either to late kyphosis because of disc collapse or the inability of midline stabilization procedures to control rotational instability. In the retrospective part of this study, the 2-year follow-up of 29 patients who were treated with halo-vest, hard-collar or posterior surgical approach was evaluated. A total of 19 patients had persistent displacement at the fracture or fusion site, 14 had late anterior disc space collapse, 10 had persistent neurological deficit and one patient at 5-year follow-up had significant cord myelopathy. Adequate results were found in only six (21%) patients.⁴ These results demonstrate that in unstable unilateral facet fractures, nonoperative treatment and posterior surgical approach have a high failure rate.

Surgical treatment with the anterior approach is in the form of discectomy, fusion or stabilization with anterior cervical plate.^{2,4} Some authors have suggested that anterior stabilization techniques are biomechanically inferior to posterior stabilization techniques, specifically in the treatment of distractive flexion-type injuries.^{17,20} As the fracture is the result of a hyperextension injury, soft tissue rupture develops anteriorly and if the anterior plaque application is performed at this region a good stabilization can be achieved. This method has been reported to provide adequate long-term clinical stability

without significant complications.^{4,21,22} Garvey *et al* noted the lower complication rate with the anterior approach than the posterior approach, and, similarly, a lower cord injury rate with the anterior approach than the posterior approach.²⁰ In the prospective part of Lifeso *et al*'s series, 18 patients were treated with anterior cervical decompression at a single space, fusion with autogenous tricortical iliac crest graft and stabilization with anterior cervical plate. In the follow-up of these cases (for at least 2 years), there was no evidence of inadequate fusion or nonunion, and no patient necessitated further surgery. Disc collapse to the operation field or neighboring spaces or signs of instability was not observed in these cases.⁴

The two cases that we presented were female subjects and were of similar age. In the first case, as there was no finding of ligamentous injury in the first MRI, nonoperative treatment was preferred and Philadelphia collar was placed. Chest support was placed when her pain increased and she was immobilized in her bed for 10 days. In the second case, nonoperative treatment were preferred according to the plain radiograph and cervical CT imaging, as cervical MRI could not be obtained. Philadelphia collar was placed and she was discharged on the second day. She mobilized earlier, by herself. The first patient regularly used her collar during the first 2 months; however, the compliance of the second case to the treatment was poor. As a result of this attitude, she developed a dislocation of more than 3 mm by the second month and was operated with the anterior approach. Preoperative MR examination of the second case identified ALL rupture, but during surgery both ALL and PLL ruptures were identified. If MRI had been performed at an earlier period, it might have identified the ligamentous damage. This might have resulted in the implementation of a more rigid immobilization or an early surgery without any delay. Moreover, this case had the risk of developing more severe neurological damage because of instability. We cannot anticipate which patient is to comply with the nonoperative treatment and the possibility of late neurological deterioration needs to be taken into account. Therefore, MRI performed at acute period might reveal more detailed information about instability, and late complications can be eliminated by operative treatment. The reason behind choosing anterior approach in the surgical intervention is that vertebral column that has lost its stability due to the ruptured ALL can be stabilized more successfully with this technique. Moreover, the anterior approach is simple, safe and has yielded excellent results to date.

Conclusion

The diagnosis of unilateral facet fractures is often missed and the treatment is still controversial. The compliance of patient to cervical immobilization in nonoperative treatment plays a very important role in the development of late complications. Instability is an important factor in planning surgical management, and

needs to be identified as early as possible in order to avoid the possible neurological deterioration and pain. As the injury of ligamentous structures, intervertebral disc and spinal cord can be demonstrated easily with MRI, we believe that MRI performed at acute phase can give more information about instability and will be helpful in planning the kind of management. However, this opinion still needs to be evaluated with a clinical study in a larger sample.

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