Surgical Results of Old Distractive-Flexion Injury of Subaxial Cervical Spine: Report of Ten Cases

Torphong Bunmaprasert MD*,
Premchai Tirangkura MD*

** Department of Orthopaedics, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand*

Background: *Acute distractive-flexion injury of subaxial cervical spine (C3-C7) results in facet subluxation or dislocation. However, when the injury is missed or neglected, it may cause serious complications including axial pain, deformity and neurological deficit.*

Objective: *To demonstrate the pathoanatomy, presentation and management of these injuries.*

Material and Method: *The present study was conducted retrospectively at Chiang Mai University Hospital during 2008-2011. Ten patients were classified as to whether 2 unilateral/2 bilateral subluxation or 1 unilateral/5 bilateral dislocation. Pain, neurological status, imaging and bony fusion were recorded.*

Results: *The average timing before achieving treatment was 52 days. Five patients had arm pain and radiculopathy; the other 5 had myelopathy. Nine of 10 patients had posterior element fractures. No disc herniation was found. Pain and neurological status were improved after surgical decompression, realignment, stabilization and fusion. Bony fusions were achieved in all follow-up patients.*

Conclusion: *Most patients have posterior element fractures without any evidence of intervertebral disc herniation. Spinal malalignment is the main cause of neurological impairment. Posterior-anterior approach is the favorable approach for old dislocation. Anterior approach is preferred for subluxation.*

Keywords: *Subaxial cervical facet, Subluxation, Dislocation, Old injury, Presentation and treatment*

J Med Assoc Thai 2015; 98 (1): 100-5
Full text. e-Journal: *http://www.jmatonline.com*

Acute traumatic subaxial cervical spine subluxations and dislocations (C3-C7) are common injuries but their diagnosis is sometimes delayed for various reasons[1]. Misdiagnosis of cervical spine injuries has ranged from 5% to 20%[2-4]. Even using such modern tools as computed tomography (CT) and magnetic resonance imaging (MRI) for improving the accuracy of diagnosis, a recent study found a 4.9% rate of diagnostic failure[5].

Treatment of delayed diagnosis or late presentations of cervical facet subluxation/dislocation is different from acute injuries. Among injuries associated with acute subaxial cervical spine dislocation, intervertebral disc herniation was present in up to 65% of distraction-flexion injuries[6,7]. Other injuries such as fractures of posterior-element structures (e.g. the lamina, the facet joint, the spinous process) were found by computed tomography in 50% of cases with unilateral locked facets of the cervical spine[8].

Correspondence to:
Bunmaprasert T, Department of Orthopaedics, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand.
Phone: 053-945-544, Fax: 053-946-442
E-mail: torpong197@gmail.com

Formerly, there were various approaches to deal with these injuries[9-16]. However, there are no standard treatment recommendations for late/neglected cases of subaxial cervical spine subluxation/dislocation. The authors reviewed 10 such cases for their characteristics, the treatment results and reported our approach in managing.

Material and Method

This was a retrospective review of all patients treated at the Spine Unit of the Department of Orthopedics at Chiang Mai University Hospital during 2008-2011 with delayed/late/neglected diagnosis and treatment of subaxial cervical spine subluxation or dislocation. "Delayed" injury was defined as injury diagnosed or treated more than 3 weeks after the initial event.

The authors reviewed the medical records and operative reports from ICD10 codes S127, S1270, S1271, and S142. For the cases found, the authors examined radiographic and MRI results of the patients to determine the degree of dislocation (total vs. partial disruption of the articular facets) and the extent (bilateral vs. unilateral).

Pain, neurological status and clinical improvement of radiculopathy, myelopathy were examined. The degree of bony fusion was assessed by using the evaluation of clinical symptoms, plain X-rays including dynamic flexion-extension views and CT scans.

Ethical permission was reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University on Study code: ORT-2557-02193/Research ID: ORT-2557-02193.

Results

Demographic data

The authors identified 10 patients from 265 cervical spine injury patients during 2008-2011. Patients included nine men and one woman, mean age 44 years (32-62). The average interval between initial injury until the correct diagnosis and treatment made was 52 days (range 20-94) (Table 1).

Injury

The cause of the injury was falling from heights (n = 5) and road traffic accidents (n = 5). Possible causes of delayed diagnosis were multiple injury (n = 5), large shoulder mass obscuring lateral X-rays (n = 3) and heavy alcohol intake (n = 2). Neck pain was the most common intervening symptom found in 8 of 10 patients. Neurologic abnormalities were classified as radiculopathy (n = 4), myelopathy (n = 4), and radiculo-myelopathy (n = 2).

Imaging

The most common level of injury was C5-C6 (n = 4), followed by C6-C7 (n = 3), C7-T1 (n = 2) and C4-C5 (n = 1), respectively. They were subdivided as unilateral facet subluxation (n = 2), bilateral facet subluxation (n = 2), unilateral facet dislocation (n = 1) and bilateral facet dislocation (n = 5) (Fig. 1).

Imaging studies showed posterior element fractures (including of the lamina, spinous process or facet) in 9 out of 10 cases. No patients had intervertebral disc disruption. Spinal malalignment was found in all 10 cases. Translation of the upper vertebra to the lower vertebra was found in 38.5% (range 15-58). Cobb's angle between C2 to C7 was 14.53° (-5.47° to 44.9°). The posterior vertebral body tangent angle was 12.3° (-6.92° to 34.8°).

Table 1. Patient's characteristics and results of treatment

Case No.	Gender	Age	Symptom	Timing (day)	Diagnosis	Preop. traction	Surgery	Complications
1	F	55	Myelopathy	21	Unilateral Dislocation	Yes	ACDF OR + lateral mass screw	-
2	M	38	Myelo-radiculopathy	50	Bilateral Dislocation	Yes	ACDF OR + lateral mass/pedicle screw	Mal-positioned screw
3	M	42	Myelopathy	94	Bilateral Subluxation	No	ACDF	-
4	M	32	Radiculopathy	60	Bilateral Subluxation	No	ACDF	-
5	M	45	Myelopathy	52	Bilateral Dislocation	Yes	ACCF	-
6	M	33	Radiculopathy	60	Unilateral Subluxation	No	ACDF OR + wiring	-
7	M	62	Myelo-radiculopathy	41	Unilateral Subluxation	No	ACDF	-
8	M	56	Myelopathy	21	Bilateral Dislocation	Yes	ACDF OR + lateral mass screw	Transient recurrent laryngeal nerve palsy
9	M	42	Radiculopathy	75	Bilateral Dislocation	Yes	Wiring Foraminotomy	-
10	M	35	Radiculopathy	47	Bilateral Dislocation	Yes	ACDF OR + wiring	-

ACDF = anterior cervical discectomy & fusion; ACCF = anterior cervical corpectomy & fusion; OR = open reduction; F = female; M = male

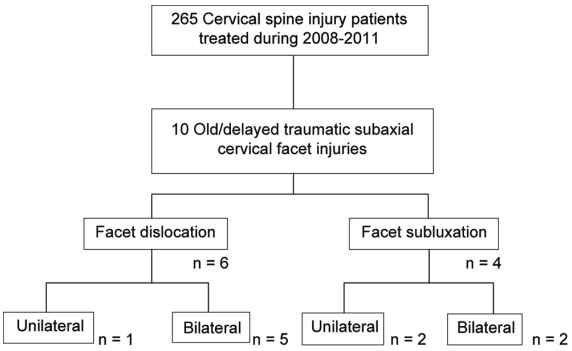

Fig. 1 Flow chart of participants trial.

Surgical intervention

Skull traction was used in patients with old facet dislocations. If the alignment of the cervical spine improved after traction, fusion by anterior approach was performed. For irreducible dislocations, the authors used the combined posterior-anterior approach, involving posterior facetectomy, then attempted reduction and fusion, followed by anterior discectomy and fusion with cervical plating (Fig. 2). For patients with old facet subluxations, anterior cervical discectomy and fusion were performed (Fig. 3).

Posterior-anterior approach was performed in 5 patients, 3 with posterior fusion with lateral mass or pedicle screws, 2 with posterior wiring. The single anterior approach was performed in 4 patients, 3 with anterior discectomy and fusion, and one with anterior corpectomy and fusion. One patient had only posterior foraminotomy.

Follow-up

The mean follow-up period after surgery was 18 months (range 3-51). All patients had improvement of neck pain and arm pain. All 5 patients with myelopathy had improved motor function, sensation and spasticity. Four of 5 patients with radiculopathy were improved in both motor and sensory functions. One radiculopathy patient suffered less pain.

Postoperative imaging showed improvement of the spinal alignment. Translation of the upper

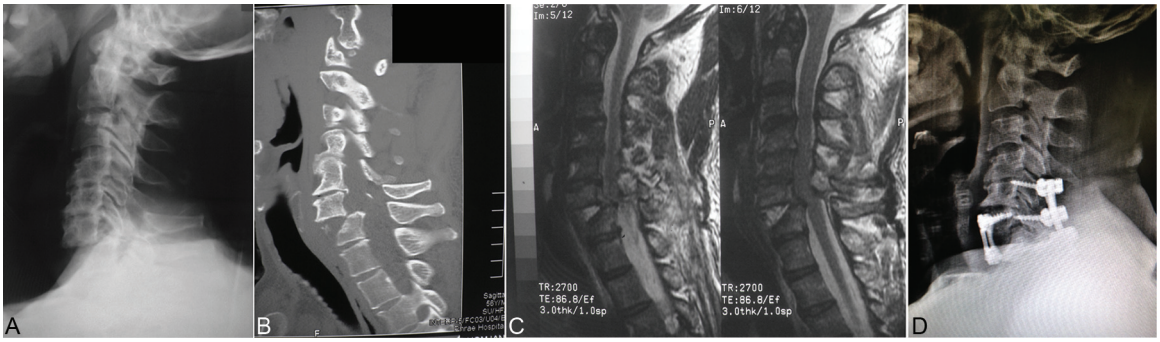

Fig. 2 Old/delayed bilateral facet dislocation with myelopathy (case No. 8). A) Lateral view of the cervical spine showed old bilateral C6-C7 facet dislocation. B) CT scan showed anterior translation C6 over C7 with posterior element fracture. C) MRI showed spinal cord compression without intervertebral disc herniation. D) Combined posterior-anterior fixation was performed.

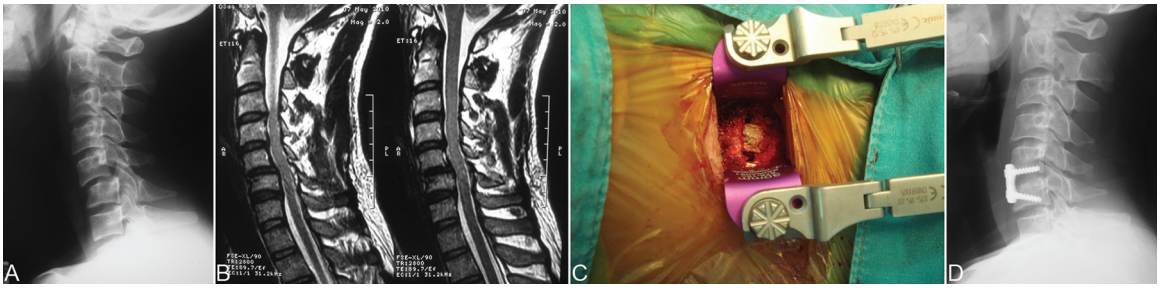

Fig. 3 Old/delayed unilateral facet subluxation with myeloradiculopathy (case No. 7). A) Lateral view of the cervical spine showed unilateral C5-C6 facet subluxation with rotational component. B) MRI showed anterior translation C5 over C6 without intervertebral disc herniation. C) Anterior Cervical Discectomy and Fusion was performed. D) Postoperative radiograph showed anatomical reduction of C5-C6 facet joint. Solid bony fusion was achieved 3 months after surgery.

vertebra to the lower vertebra decreased from 38.5% to 12.90%, Cobb's angle decreased from 14.53° to 3.67° and the posterior vertebral body tangent angle decreased from 12.3° to 2.74°.

All patients had solid bony union without graft-related problems. Two complications occurred. One was are recurrent laryngeal nerve injury, who recovered spontaneously about 4 months after surgery. Another patient had malpositioning of the 7th cervical pedicle screw. Although revision surgery had been performed, the patient had improved regarding the clinical symptoms but still had weakness of the extensor carpi radialis muscle and extensor digitorum communis muscle.

Discussion

Distractive-flexion injury to the subaxial cervical spine causes mechanical trauma to the facet joints unilaterally or bilaterally. Missing such diagnosis is more likely in unconscious or intoxicated patients, or those with polytraumatized major organ injuries elsewhere in the body, which then puts the patients at risk. The incidence of delayed diagnosis of facet dislocation was reported to be relatively high (11-40%)[6,17]. Therefore, patients with undiagnosed cervical spine subluxation or dislocation may meet the physicians with symptoms and signs that differ from acute injuries.

Injuries that occur more than 3 weeks earlier usually cause contracture of the surrounding structures, making it more difficult to perform simple reduction. We found that the main causes of neural compromise in late injuries were spinal malalignment and facet fracture. The authors also found an absence of intervertebral disc herniation in neglected cases, in contrast to an incidence of 65% in acute cases[7,8].

Shapiro reported that facet fractures were found in 12 out of 24 cases (50%) in case with unilateral facet dislocation[18]. However, our study found that posterior element structures were fractured in 90% of our cases. These findings are important when we consider performing operative fixation for the patients. For spinous process fractures, interspinous wiring of indexed levels is impossible. So facet screws, lateral mass screws, or pedicle screws may be considered. With laminar fractures, concomitant laminectomy is needed. Facet fractures that are partially fused or locked should be osteotomized.

As late/neglected cervical spine subluxation or dislocation is rare, definitive treatment recommendations are not fully established, but several have been tried. There is a multiple-staged approach to deal with this particular injury. First, posterior-anterior-posterior approach can be performed with a posterior approach to perform a complete facetectomy, anterior discectomy with reduction and anterior fixation, then posterior fixation[9]. Secondly, an anterior-posterior-anterior approach was performed with anterior release, then repositioned-reduced-fixed during the posterior approach, and finally anterior fixation was performed[10].

However, there is a two-staged approach, consisting of a posterior-anterior approach by posterior procedure to perform soft tissue release, facetectomy, and interspinous wiring or lateral mass screw, followed by the anterior procedure for soft-tissue release, discectomy, reduction and plating[11-13]. Another approach used skull traction to reduce the old dislocation before surgery[14-16]. If reduction was successful, the authors then used an anterior approach to perform discectomy and fusion. But if closed reduction failed, a posterior procedure was used to perform facetectomy and fusion combined with anterior discectomy and fusion. These approaches may reduce the risk of iatrogenic neurological injury, operating time and blood loss, resulting in a shorter hospital stay[12].

In our practice, the authors treated patients with subluxation and dislocation differently. For dislocation, we use skull traction in order to realign the dislocated level, without attempting full reduction. Kahn's method for closed reduction for dislocation in patients presenting after 72 hours was successful in approximately 20%, compared with 64% in fresh dislocations[17]. Successful reduction was achieved after traction in only 2 of 12 patients more than 1.5 months after a dislocation injury[14].

In our work, after traction only one patient of six dislocated patients improved in alignment, so we chose anterior corpectomy and fusion alone. However, 4 patients with dislocations had not improved, so the posterior-anterior approach was performed. One patient with a dislocation did not want to have a salvage procedure, so he underwent only a posterior for aminotomy to treat arm pain and accepted residual deformity.

Among 4 subluxated patients, the authors avoided using pre-operative cervical traction. The authors carried out anterior decompression procedures and plate fixation to realign and stabilize. Three patients underwent only anterior cervical discectomy and fusion with plating. One subluxation patient required

combined surgeries because anterior-only fixation was inadequate.

In present study, we found improved spinal alignment after treatment compared to pre-operation status. Patients experienced clinical relief without neurological deterioration. Bony fusion was achieved at follow-up in all patients.

Conclusion

Most patients with late/neglected subaxial cervical spine subluxation or dislocation have posterior element fractures without evidence of disc herniation. Spinal malalignment appears to be the main cause of neurological impairment. The present study found that the posterior-anterior approach is preferable for late/neglected dislocation. For subluxation, the anterior approach is preferred. However, treatment of late/neglected injuries remains diverse, complex and controversial, depending on patient condition, the professional opinion of the physician and their facilities.

What is already known on this topic?

Five to twenty percent of patients with acute traumatic subaxial cervical facet subluxation or dislocation resulting from distractive-flexion injury might have been diagnosed and treated delay. Concomitant disc herniation, if missed, might cause further neurologic deficit during facet reduction and also influenced the surgical approach. Multiple-staged approach was recommended by many authors to deal with these old, complex injuries. However, the more surgical procedures were performed, the more hazardous occurred to the patients.

What this study adds?

Patients with old distractive-flexion injury of subaxial cervical spine almost always have fractures of the posterior neural arch. These may result in expansion of the spinal canal, causing neurologically intact during initial injury. Posterior cervical decompression and fixation in old injuries must be planned properly, as the posterior elements are usually destroyed. In contrast to acute injury, concomitant disc herniation is hardly found in old injury. Malalignment of the cervical spinal column is the major cause of neck pain, radiculopathy and myelopathy in old case. The current study finally demonstrates that combined posterior-anterior approach is beneficial for old facet dislocation and single anterior approach is optimal for old facet subluxation.

Acknowledgement

The authors wish to acknowledge Bruce G Weniger MPH for his effort to review this manuscript in preparation for submission. The authors also thank our research assistants for correcting the manuscript format, Sirichai Luevitoonvechkij MD for his helpful suggestions, and to G Lamar Robert PhD for reviewing the manuscript.

Potential conflicts of interest

None.

References

1. Sengupta DK. Neglected spinal injuries. Clin Orthop Relat Res 2005; 93-103.
2. Reid DC, Henderson R, Saboe L, Miller JD. Etiology and clinical course of missed spine fractures. J Trauma 1987; 27: 980-6.
3. Gerrelts BD, Petersen EU, Mabry J, Petersen SR. Delayed diagnosis of cervical spine injuries. J Trauma 1991; 31: 1622-6.
4. Davis JW, Phreaner DL, Hoyt DB, Mackersie RC. The etiology of missed cervical spine injuries. J Trauma 1993; 34: 342-6.
5. Platzer P, Hauswirth N, Jaindl M, Chatwani S, Vecsei V, Gaebler C. Delayed or missed diagnosis of cervical spine injuries. J Trauma 2006; 61: 150-5.
6. Rorabeck CH, Rock MG, Hawkins RJ, Bourne RB. Unilateral facet dislocation of the cervical spine. An analysis of the results of treatment in 26 patients. Spine (Phila Pa 1976) 1987; 12: 23-7.
7. Vaccaro AR, Falatyn SP, Flanders AE, Balderston RA, Northrup BE, Cotler JM. Magnetic resonance evaluation of the intervertebral disc, spinal ligaments, and spinal cord before and after closed traction reduction of cervical spine dislocations. Spine (Phila Pa 1976) 1999; 24: 1210-7.
8. Vaccaro AR, Madigan L, Schweitzer ME, Flanders AE, Hilibrand AS, Albert TJ. Magnetic resonance imaging analysis of soft tissue disruption after flexion-distraction injuries of the subaxial cervical spine. Spine (Phila Pa 1976) 2001; 26: 1866-72.
9. Bartels RH, Donk R. Delayed management of traumatic bilateral cervical facet dislocation: surgical strategy. Report of three cases. J Neurosurg 2002; 97: 362-5.
10. Payer M, Tessitore E. Delayed surgical management of a traumatic bilateral cervical facet dislocation by an anterior-posterior-anterior approach. J Clin Neurosci 2007; 14: 782-6.

11. Liu P, Zhao J, Liu F, Liu M, Fan W. A novel operative approach for the treatment of old distractive flexion injuries of subaxial cervical spine. Spine (Phila Pa 1976) 2008; 33: 1459-64.
12. Jain AK, Dhammi IK, Singh AP, Mishra P. Neglected traumatic dislocation of the subaxial cervical spine. J Bone Joint Surg Br 2010; 92: 246-9.
13. Shimada T, Ohtori S, Inoue G, Nakamura J, Nakada I, Saiki H, et al. Delayed surgical treatment for a traumatic bilateral cervical facet joint dislocation using a posterior-anterior approach: a case report. J Med Case Rep 2013; 7: 9.
14. Hassan MG. Treatment of old dislocations of the lower cervical spine. Int Orthop 2002; 26: 263-7.
15. Basu S, Malik FH, Ghosh JD, Tikoo A. Delayed presentation of cervical facet dislocations. J Orthop Surg (Hong Kong) 2011; 19: 331-5.
16. Jeon TS, Chang H, Kim YB, Oh BH, Kim SB, Nam TS, et al. Delayed diagnosed stage 1, 2 distractive flexion injury of the cervical spine. Asian Spine J 2011; 5: 35-42.
17. Kahn A, Leggon R, Lindsey RW. Cervical facet dislocation: management following delayed diagnosis. Orthopedics 1998; 21: 1089-91.
18. Shapiro SA. Management of unilateral locked facet of the cervical spine. Neurosurgery 1993; 33: 832-7.

การศึกษาผลการรักษาข้อฟาเซตกระดูกสันหลังส่วนคอเคลื่อน-หลุดที่ได้รับการวินิจฉัยและการรักษาล่าช้า: รายงานผู้ป่วย 10 ราย

ต่อพงษ์ บุญมาประเสริฐ, เปรมชัย ติรางกูร

ภูมิหลัง: *กลไกการบาดเจ็บต่อกระดูกสันหลังส่วนคอชนิดดึงแยก-ก้ม ทำให้เกิดการบาดเจ็บเฉียบพลันต่อข้อฟาเซต เมื่อการบาดเจ็บได้รับการวินิจฉัยล่าช้าทำให้เกิดอาการปวดคอ ความผิดรูป และความผิดปกติต่อระบบประสาท*

วัตถุประสงค์: *ศึกษาพยาธิสภาพ การวินิจฉัย การรักษาผู้ป่วยข้อฟาเซตกระดูกคอระดับ C3-C7 เคลื่อน (subluxation) - หลุด (dislocation) ที่วินิจฉัย และรักษาล่าช้า*

วัสดุและวิธีการ: *การศึกษาย้อนหลังในผู้ป่วย 10 ราย กระทำที่คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ ระหว่าง พ.ศ. 2551-2554 ทำการบันทึกอาการ ภาพรังสี ผลการผ่าตัด และการติดตามผลการรักษาในผู้ป่วยข้อฟาเซตกระดูกคอเคลื่อนข้างเดียว 2 ราย เคลื่อนสองข้าง 2 ราย หลุดข้างเดียว 1 ราย และหลุดสองข้าง 5 ราย*

ผลการศึกษา: *ระยะเวลาตั้งแต่อุบัติเหตุจนได้รับการผ่าตัดเฉลี่ย 52 วัน พบอาการปวดคอร้าวลงแขน 5 ราย กดไขสันหลัง 5 ราย ภาพรังสี 9 ราย พบการแตกหักของโครงสร้างส่วนหลัง โดยไม่พบหมอนรองกระดูกเคลื่อน อาการปวด แนวกระดูกสันหลัง ความผิดปกติของระบบประสาทดีขึ้น และผลการเชื่อมข้อต่อพบว่าเชื่อมติดทุกรายหลังการผ่าตัด*

สรุป: *ข้อฟาเซตกระดูกสันหลังส่วนคอเคลื่อน-หลุดที่ได้รับการวินิจฉัยและการรักษาล่าช้า จะพบการแตกหักของโครงสร้างส่วนหลังเสมอแนวกระดูกคอที่ผิดปกติเป็นสาเหตุของความผิดปกติของระบบประสาท มิใช่เป็นสาเหตุจากจากหมอนรองกระดูกคอเคลื่อน ผู้ป่วยข้อฟาเซตคอหลุดแนะนำการผ่าตัดหลัง-หน้า ผู้ป่วยข้อฟาเซตเคลื่อนแนะนำการผ่าตัดทางด้านหน้า*