Introduction

The thoracic cage and sagittal orientation of the facet joints at the level of the thoracic spine create a relatively protected spine region. As a result of the solid stability provided by these anatomical factors, substantial force is required to produce a significant injury. Traumatic impact causes either a flexion-rotation stress or a shearing force that fractures the facets and ruptures ligaments, resulting in spinal disarticulation. The thoracic spondyloptosis is a severe form of spondylolisthesis and caused by strikingly great injury force.

We report a case of thoracic spondyloptosis caused by a motorcycle accident in a healthy adult. The dislocation was reduced by posterior technique with pedicle screw fixation. The traumatic spondyloptosis and the posterior reduction and fixation in the thoracic spine as a reliable surgical procedure is discussed with review of the pertinent literatures.

Case Report

A thirty-two-year-old man was involved in a motor vehicle accident. He was driving a motorcycle and struck by a truck from behind. At the time of accident, he was hit across his back against the loaded pack and was blown up and fell down. Notable findings on physical examination included deep facial abrasions and respiratory difficulties. The vital signs were very unstable including systolic blood pressure of 60mmHg. The patient presented with paraplegia and anaesthesia of both lower extremities and complete loss of anal sphincter tone(Frankel grade A).

Plain radiographs and computed tomography of the chest
demonstrated multiple rib fractures and bilateral hemothoraces. At the level of the ninth and tenth rib, the costovertebral junctions were overlapped and the corresponding vertebral bodies were translated laterally (Fig. 1). A magnetic resonance imaging of the thoracic spine demonstrated the diffuse signal change of spinal cord and the complete anterior dislocation of T8 body on T9 body. A computed tomography showed bilateral facet fractures without pedicle injury of the anteriorly dislocated vertebra (Fig. 2).

He was taken intensive care unit and applied with ventilator and drainage of closed chest tube. Meanwhile, the patient's conditions such as vital signs, amounts of chest tube drainage, and the oxygen saturation were stabilized. However, the paraplegia was not improved.

At admission 9th day, he was undertaken reduction of the anterior spondyloptosis and posterior fixation. Under a general anesthesia, the patient was laid on prone position. We tried to reduce the dislocated segments in closed manner through manual traction between axilla and pelvis. Crepitation was audible, but the dislocated segment was not fully reduced under the C-arm fluoroscope. Through the operative procedure, bilateral facet fractures of T9 vertebra, and spinous process fractures from T6 to T9, and scalloping of two laminae were observed. After complete denudation of the facets and laminae of T8-T9, we tried to distract and elevate the dislocated segment by using the pedicle screws between the T7 and T9 vertebra. The heads of pedicle screws were used for the points of distraction and lever action. During reduction and distraction, the T8 lamina was eventually reduced back in line with the T9 lamina. There was no evidence of the leakage of cerebrospinal fluid. Reduction was maintained with lengthening placement of pedicle screws at the T5, T6, and T10 vertebrae (Fig. 3).

Postoperatively, the lung function and general condition were improved. He was instructed to wear a thoracic lumbar sacral orthosis (TLSO) for 3 months, which was well tolerated. At 1 year's follow-up, the spinal alignment with instrumentation was stable, but his paraplegia was not changed despite physiotherapies.

**Discussion**

The rigid configuration of the thoracic spine is mainly attributed to the ribs, anterior and posterior longitudinal ligaments, and a sagittal orientation of the facet joints that resists axial rotation and horizontal translation. Thus, a significant force is required to cause a fracture and dislocation in the thoracic spine. Spondyloptosis is another form of the spine dislocations or advanced spondylolisthesis, in which one spine is lodged in anterior or posterior space of the other.

In neurofibromatosis, spinal deformity is the most common orthopedic sequela, thus these deformity may facilitate spinal fractures and dislocation. Dural ectasia causes enlargement of the neural foramen and spinal canal and prevents severe spinal cord injury in patients of spondyloptosis with the neurofibromatosis. In thoracic spine of the healthy man, there is lack of the available space of spinal cord. Therefore, the chance to preserve the cord function in the spondyloptosis has the least possibility. However, in cases in which bilateral pedicle fractures occurred at the site of the dislocation, both preservation of the spinal canal and neurological function of spinal cord could rarely occur. In our case, the fractures were developed at the facet joints and the spinal canal was impinged and kinked by the dislocated spinal segment. Consequently, he presented unfortunately with paraplegia and showed no neurological improvement.

The injury mechanism of the patient would be comparable with the shear type of fracture dislocation according to the report of Denis. According to this report, all three columns were disrupted and most of the cases were developed by hit across the midback by falling trees. In our case, he was also hit across his back by the heavy load and fell down. The injured spinal segment was forced by the shearing energy of the postero-anterior direction. As a result, fractures of several spinous processes and superior facets of the lower vertebrae were occurred. And, axial compression during falling down may cause the downward displacement of anteriorly dislocated segment. The spondyloptosis in our case results from the concurrent mechanism of shearing and axial compression.
Fractures have been classified as stable or unstable according to the three-column concept. Stable fractures could be treated by bed rest or brace, but unstable fractures were generally treated with open reduction and stabilization with the rigid instrumentation. Occasionally, unstable fractures were managed with the same methods of the treatment of stable fracture because of the patient’s neurological status, age and vital sign. However, non-surgical treatment may cause future spinal deformity and back pain.

Although the current patient had severe chest injury, more aggressive managements were required as his lung condition was getting better. We decided to make the unstable spine to stable one by the reduction and rigid fixation. In the cases of thoracic spondyloptosis in neurofibromatosis, posterior fusion using rod constructs and then, anterior arthrodesis with bony autograft was performed. They did not try to reduce the dislocated segment completely because their patients presented with incomplete cord injury and further injury to the spinal cord could be happened. They advocated that the spine should be stabilized and arthrodesed in a bayonet apposition when anatomic reduction could not be achieved.

In our case, the patient exhibited complete paraplegia and sensory anesthesia and not improved in any degree for 9 days. Instead of neural decompression, solid fixation was needed in this situation. We decided to obtain a fixation of the dislocated spinal segment in short operation time and conserve lung function. Although segmental pedicle screw fixation in the thoracic spine requires scrupulous attention, it is considered as a safe and effective method for stabilizing the thoracic spine. And, the distraction between the segmental pedicle screws could provide a sufficient reduction force for the dislocated segments. By the posterior approach described above, we achieved satisfactory anatomic alignment and rigid fixation.

Conclusion

Traumatic thoracic spondyloptosis is very rare in healthy adults. It is also accompanied by severe chest injury and the worst neurologic deficits. For the aggressive management such as chest physiotherapy and ambulation, rigid fixation and stabilization is mandatory. The posterior reduction and fixation using pedicle screw in the thoracic spondyloptosis is sufficient to make good alignment and fixation.

References