Surgical technique

Technical notes on reduction of thoracic spine fracture dislocation

Abdulrazzaq Alobaid, MD,* Vincent Arlet, MD;† Jean Ouellet, MD;* Rudolph Reindl, MD*

Fracture dislocation of the thoracic spine is a rare spinal injury often resulting from high-energy trauma. Associated soft-tissue thoracic injuries are common and are compounded by the often-associated paraplegia. Exceptionally, there are some cases of thoracic spine dislocations without neurological injuries.

A major challenge in the surgical management of such spinal fractures is achieving reduction and then maintaining it after stabilization. The goals of surgical management of these unstable spine fractures are 4-fold: (1) achieving reduction; (2) immediate stabilization and maintenance of reduction, coupled with spine fusion; (3) decompression of the neurological elements (if indicated); and (4) early mobilization.

Classic posterior spinal instrumentation, such as screw-plate, hook-rod and screw-rod systems, has been used successfully. It has been shown that most of these unstable injuries can be managed using these techniques without the need for additional combined or staged anterior spinal surgery. However, recent concerns have been raised that maintenance of reduction, restored height and sagittal balance has not occurred in long-term follow-up using such systems. As for thoracolumbar, unstable burst fractures, some have advocated that anterior decompression and anterior column reconstructions must be done to avoid delayed loss of coronal and sagittal balance, but for fracture dislocations most of the literature has described a posterior approach.

It has been our experience that the use of side-opening pedicle screws facilitates reduction to help achieve the surgical goals previously enumerated.

Technique

The patient is positioned in the standard prone fashion with appropriate bolsters. Care must be taken when rolling the patient. If the surgeon does not have access to a Jackson table, then axial traction (head to feet) should be applied to the patient when log rolling to minimize translations of the spine. A standard midline approach with elevation of paraspinal musculature is taken, exposing the spine out to the transverse processes. Cautious dissection is warranted across the fracture dislocation, so as not to inadvertently injure the possibly exposed dural elements. Dissection is done 2 levels above and 2 below the fractured/dislocated segment. Once standard bony landmarks have been identified, we then insert 2 pairs of pedicle screws above and 2 below the dislocation.

Anatomical barriers

Classically with such fracture dislocation of the thoracic spine, the facet(s) can be jumped, perched or impacted. Manual reduction of such pathology is often warranted. The facet joint can be reduced manually by introducing a large Penfield instrument underneath the inferior facet. Ideally one would prefer to leave the facet in place; however, if the reduction fails, then undertaking superior and/or inferior resection of one or both facet joints may be justified. Despite this, in some rare cases (particularly delayed cases) one may still not be able to reduce the spine.

To facilitate the reduction, we place the implants in a special configuration to generate greater reduction force, thus facilitating reduction of the spine to the pre-contoured rod with appropriate sagittal and coronal alignment. The complex reduction clamp, the “Persuader” from the AO Universal Spine System (USS; Synthes, Paoli, Pa.), also facilitates the reduction manoeuvre, because it is able to bring the spine to the rod simultaneously in 2 different planes (Fig. 1).

Sagittal reduction

To facilitate our spinal reduction in the sagittal plane, we purposely leave the screws slightly proud (from 5 mm to 10 mm according to the amount of dislocation/displacement and the anticipated difficulty in reduction) on the segment that is posteriorly translated (usually distal). On the other hand, we insert the screws flush to the spinal elements in the segment that is anteriorly translated (usually proximal). We purposely create an exaggerated offset of the pedicle screw height of 5–10 mm. By doing so, we
achieve greater translational forces across the fracture dislocation when the spine is being reduced to the rods with the help of the complex reduction forceps. As this is a side-opening system, once the spine is reduced and both rods are in place, one can individually remove the locking cap and advance each screw one by one, to a normal depth as needed (Fig. 1A).

### Coronal reduction

To create maximal coronal translational forces, we purposely offset the opening of the screws on the opposite side of the fracture dislocation. The side opening is directed in such a way that it faces the direction of the dislocation in the coronal plane (Fig. 1B). By doing so, one lever the translated segments across in a coronal plane with the rod as it is being fixed in the bottom 2 screws.

### Axial reduction

If there is an associated locked facet, one can use the screws to apply distraction to the side where the facets may be locked.

### Step-by-step reduction

The screws are inserted proud in the posteriorly (distal) translated segment, while flush in the anteriorly (proximal) translated segment. Care is taken to leave the side opening facing toward the side where the spine is coronally translated (Fig. 1), that is, if the proximal segment is translated to left, then the 4 screws proximal to the dislocation will be open to the left, while the distal 4 screws will be open to the right. The rod is cut and bent to the appropriate anatomical sagittal profile. The 2 rods are then fixed to the distal pedicle screws and cross-linked distally. Using 1 or 2 complex reduction forceps, the proximal part of the spine is reduced to the 2 rods both in the sagittal and coronal plane by pulling the proximal spine posteriorly and medially. Because of the flexibility of the metal and the elasticity of the bone, no overreduction is achieved during these correction manoeuvres. Both the coronal and sagittal offset of the screws offer strong axial, sagittal and coronal forces that enable the spine to be reduced. If there are associated locked facets, then distraction can be

---

**FIG. 1.** Schematic representation of the screw positioning for reduction: (A) sagittal view, (B) coronal view. Steps of reduction: the screws are inserted first proud distally (↔), then flush with the lamina proximally (Ø). The side openings of the screws have to face the side of the dislocation proximally, facing opposite the direction where the spine should go, and facing the opposite side distally. Screws are inserted 2 levels above and 2 below. After achieving reduction, the distal screws may be inserted deeper to the appropriate depth. This is done after disconnecting the screws from the rods one by one and inserting them deeper. Because fracture dislocations of the thoracic spine are considered rotationally unstable, a cross-link should be applied.

**FIG. 2.** (Left) preoperative radiographs obtained 4 weeks after injury show the lateral translation and the kyphosis. (Right) axial computed tomographic image shows the dislocation.
applied using the instrumentation setting. In the case of an old fracture dislocation, reduction manoeuvres are applied to both rods simultaneously with 2 complex reduction forceps to minimize the stresses.

After achieving reduction in both planes, the distal screws may be inserted deeper to the appropriate depth. This is one of the advantages of side-loading screws that can be removed or modified even after the rods have been in place. Because this type of injury is rotationally unstable, a second cross-link is applied proximally. Finally, bone grafting and fusion are performed.

**Case example**

A 40-year-old man who was seen initially at another hospital with back pain following a fall from a height was treated with a brace. He presented to us 5 weeks after his injury with severe back pain and progressive kyphotic deformity. Examination ruled out any neurological compromise. His radiograph and computed tomographic scan (Fig. 2) showed T8–T9 fracture dislocation. The patient was brought to the operating room to have his spine stabilized and realigned. As the dislocation was old, the reduction could only be achieved in a stepwise fashion as described above. The patient was instrumented posteriorly from T6 to T11 with posterior pedicle screws (Fig. 3). The T8 and T9 levels were not instrumented because of pedicle fractures at these levels. At the last follow-up (24 mo), the alignment was maintained with apparently good fusion.

**Discussion**

Management of fracture dislocation of the thoracic spine remains challenging. Compared with thoracolumbar fracture, thoracic fracture dislocations of the spine are less common and are usually associated with neurological injuries, although there have been some case reports of thoracic spine dislocations without neurological injuries.1

Spine fractures that produce ligamentous and bony instability are the most unstable injuries. The classic treatment has been to use a combination of distraction–compression-type hooks in the thoracic spine with lumbar pedicle screws.12 Recently, the use of pedicle screws in the thoracic spine has gained popularity, and they appear in experienced hands to be a safe and reliable strategy in the surgical treatment of unstable thoracic spine fractures.6,13 For fracture dislocation of the thoracic spine, we believe they are essential in facilitating and maintaining the spinal reduction. One might ask why we are not using Schanz screws in the thoracic spine. If we use them routinely for the thoracolumbar junction, it is our experience that Schanz screws in the middle of the thoracic spine are too high-profile leading to possible skin irritation, and we therefore prefer the use of USS side-opening screws in the described configuration. Naturally such a configuration can be achieved with any side-opening system and is not specific to the AO USS. Possible complications of such technique are mostly related to screw malpositioning, and anteroposterior and lateral fluoroscopy are mandatory to avoid such complications. None of our treated patients has experienced any loss of correction, and we have postulated that all our fusions had to be solid.

**Conclusion**

The use of thoracic pedicle screws with the configuration and surgical technique described here facilitates intraoperative reduction and restoration of spinal alignment in the management of unstable thoracic spinal fracture dislocation.

**Competing interests:** None declared for Drs. Alobaid, Ouellet and Reindl. Dr. Arlet has received an educational grant from Synthes USA and holds stock in Synthes, J&J and Medtronic Sofamor Danek.

**References**


---

### How you can get involved in the CMA!

The CMA is committed to providing leadership for physicians and promoting the highest standard of health and health care for Canadians. To strengthen the Association and be truly representative of all Canadian physicians, the CMA needs to hear from members interested in serving in elected positions and on appointed committees and advisory groups.

The CMA structure comprises both governing bodies and advisory bodies either elected by General Council or appointed by the CMA Board of Directors. The Board of Directors — elected by General Council — has divisional, affiliate, resident and student representation, is responsible for the overall operation of the CMA and reports to General Council on issues of governance. CMA councils and committees advise the Board of Directors and make recommendations on specific issues of concern to physicians and the public. Five core councils and committees consist of either divisional or regional representation, while other statutory and special committees, and task forces consist of individuals with interest and expertise in subject-specific fields. Positions on one or more of these committees may become available in the coming year.

For further information on how you can get involved, please contact:

**Paula Wilson**  
**Corporate Affairs**  
**Canadian Medical Association**  
1867 Alta Vista Drive  
Ottawa ON K1G 3Y6  
Fax 613 526-7570  
Tel 800 663-7336 x2047  
involved@ema.ca

By getting involved, you will have an opportunity to make a difference.  
We hope to hear from you!