CASE REPORT

Percutaneous pedicle screw fixation for an unstable thoracic spine fracture after a traumatic degloving injury

Emma Christine Celano,¹ Griffin R Baum,² Rondi B Gelbard,³ Faiz U Ahmad²

¹Emory School of Medicine, Atlanta, Georgia, USA

²Department of Neurosurgery, Emory School of Medicine, Atlanta, Georgia, USA

³Department of Surgery, Emory School of Medicine, Atlanta, Georgia, USA

Correspondence to

Dr Faiz U Ahmad,
faiz.ahmad@emory.edu

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SUMMARY

Unstable spinal fractures require urgent surgical intervention to relieve compression of the spinal cord, correct spinal deformity, stabilise the spine and prevent further neurological injury. We report the case of a young man with a thoracic chance fracture in the setting of a devastating degloving injury, whose fracture was stabilised using minimally invasive, percutaneous pedicle screw fixation. We discuss the advantages of using a minimally invasive technique for spinal fixation and its role in the treatment of complicated, multisystem trauma patients.

BACKGROUND

Traumatic spinal injuries are, regrettably, common, with 160 000 cases per year in the USA. Up to 30% of these injuries are associated with a concomitant injury to the spinal cord.¹ When vertebral fractures require surgical decompression or stabilisation, planning is often complicated by co-existing injuries. This is particularly true in patients with fractures of the thoracic spine. The thoracic vertebrae are stabilised by the relatively immobile intervertebral facet joints and further reinforced by the rib cage. Consequently, fractures of this region result from high-energy injury mechanisms. Over 80% of patients have coexisting injuries, most commonly, traumatic brain injuries, chest trauma (eg, pulmonary contusion, rib fractures, pneumothorax, cardiac contusions), long bone fractures^{2–3} and intra-abdominal injuries.⁴ Many of these patients require ventilatory support and prolonged intensive care unit (ICU) care,⁵ and surgical management of their spinal fractures must be planned with consideration to the significant comorbidities that are present in such patients.

As with traumatic brain injuries, the severity of spinal cord injuries depends not only on the initial impact but also on secondary damage caused by tissue swelling and compression, ischaemia and local metabolic disturbance.⁶ Consequently, early decompression of the spinal cord is associated with improved functional outcomes. Unfortunately, due to the narrow spinal canal and lack of collateral blood supply in the thoracic region of the spinal cord, 90% of patients with thoracic vertebral fractures (excluding compression fractures) present with neurological deficits.¹ The majority of these patients (63%) will have a 'complete' spinal cord injury, with no residual function below the level of injury, and are unlikely to recover neurological

function after surgery.⁶ In such cases, management is focused on spinal stability and preventing worsening of the patient's overall condition. These scenarios commonly require the use of short-term non-surgical treatment and alternative surgical approaches while more life-threatening issues are addressed.

One of the strongest indications for surgical stabilisation of vertebral fractures is instability, which can result in progressive spinal deformity and delayed injury to the spinal cord.⁷ The degree of instability relates to the biomechanical forces causing the fracture, with flexion-distraction-type injuries being among the most unstable.^{7–8} Chance fractures, a variant of flexion-distraction injuries, involve disruption of all three columns of the spine; classically, there are fractures of the spinous process, lamina, pedicles and vertebral body, and, often, disruption of the intervertebral disc complex.⁸ Compared to bracing and immobilisation, surgical stabilisation of flexion-distraction fractures has been shown to have lower rates of spinal deformity and neurological deficits.^{9–10} Patients who receive surgery earlier have the additional benefits of shorter hospital stays and less time on ventilator support.¹¹ In a multisystem trauma patient, however, the traditional open approach for pedicle screw fixation may need to be modified or delayed based on the patient's condition. We present a case of a young man with a thoracic chance fracture after a motor vehicle accident. In addition to his fracture, he suffered a severe degloving injury, anorectal dissociation and exposed muscles of the thorax and gluteus, which precluded a traditional, open surgical approach. This case illustrates the utility of minimally invasive surgery in multisystem trauma patients with spinal fractures.

CASE PRESENTATION

A 29-year-old man was brought to our level one trauma hospital after a motor vehicle accident, during which he was ejected from the vehicle during the crash. He lost consciousness on impact but was alert and oriented on arrival at the hospital, and was able to move all four extremities during the initial trauma assessment.

Multiple injuries were noted on presentation, including an extensive degloving injury with anorectal dissociation. The patient was taken for an emergent exploratory laparotomy shortly after admission and his abdomen was left open with a

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Figure 1 Sagittal CT scan demonstrating thoracic chance fracture after motor vehicle accident.

Figure 2 Photograph demonstrating extent of degloving injury with subsequent debridements for necrotising fasciitis.

temporary covering for 2 days due to abdominal compartment syndrome. Subsequent surgeries included bilateral chest-tube placement, end-sigmoid colostomy, anorectal reconstruction, closed reduction of a tibial fracture and tracheostomy.

On hospital day 3, the patient's neurological status deteriorated to a Glasgow Coma Scale of 3 T, with reactive pupils but no cough or gag reflex on examination. A head CT showed diffuse cerebral oedema due to a traumatic brain injury. On hospital day 7, he developed sepsis with renal failure and increased need for respiratory and blood pressure support. At that time, he was found to have necrotising fasciitis, and required multiple operative debridements of the devitalised skin and soft tissue.

INVESTIGATIONS

At the time of admission, CT imaging of the spine demonstrated an acute, oblique fracture through the body of the T4 and bilateral widening of the facet joints at T4/5, with posterior displacement of the fracture causing spinal cord compression ([figure 1](#)), consistent with an AO/Magerl Type B2.2.2 injury. Owing to the patient's other injuries and haemodynamic instability, no further imaging could be obtained to assess injury to the spinal cord and ligamentous structures.

On admission, sensation and motor function were intact in all four extremities, but after the patient's mental status declined secondary to traumatic brain injury, spinal cord function was difficult to monitor. When his condition improved, he had full strength in his upper extremities and was able to follow commands in his lower extremities. There was no loss of sensation detectable on examination. Spinal cord function appeared to be preserved although this was difficult to assess due to his other injuries.

TREATMENT

On hospital day 9, the patient's neurological status began to improve and he no longer required pressors for haemodynamic

Figure 3 Immediate postoperative photograph demonstrating incision sites for percutaneous pedicle screw fixation of a thoracic chance fracture.

stability. Over the next 3 weeks, he was frequently brought to the operating room for wound irrigation and debridements with revisions of his abdominal closure. During that time, his vital signs and renal function slowly improved and he was extubated on hospital day 25.

Owing to the patient's numerous injuries and haemodynamic instability, immediate management of the thoracic spine fracture consisted of a thoraco-lumbar-sacral orthosis (TLSO) brace, though the brace had to be frequently removed for wound care. One month into the hospitalisation, with his condition better stabilised, attention returned to the vertebral fracture and

options for management. The constellation of features found on CT was consistent with an unstable chance fracture, which required surgical stabilisation. Though the patient's condition was improving, he was not a good candidate for open surgery due to necrotising fasciitis, and extensive loss of skin and subcutaneous tissue. This resulted in a large area of exposed muscle over the lower thoracolumbar spine (figure 2). In light of this, surgical stabilisation was achieved using a minimally invasive approach, with percutaneous placement of pedicle screws from T2–T7 with bilateral titanium rods (figure 3). The pedicle screws were 5 mm by 40 mm in size and were made by DePuy-Synthes (Raynam, Massachusetts, USA). The decision to instrument down to the T7 level was due to difficulty in distinguishing the T4–6 levels on fluoroscopy after the T4 fracture was reduced, and the inability to cannulate and instrument the T4 pedicles. Therefore, we erred on the side of caution to provide an extra level of instrumentation and support. The patient tolerated the procedure well and postoperative imaging demonstrated accurate placement of hardware and effective reduction and fixation of the chance fracture (figure 4).

OUTCOME AND FOLLOW-UP

In the weeks following surgery, the patient continued to improve and received several skin grafts to the areas of exposed subcutaneous tissue. He was transferred from the intensive care unit to a regular floor, and was subsequently discharged to an acute rehabilitation facility. His total length of hospital stay was 12 weeks.

His motor strength and lower extremity function improved tremendously with extensive physical therapy, and at his most recent follow-up appointment (14 months) he was able to walk independently and perform all basic activities of daily life. Radiographs taken after surgery demonstrated accurate hardware placement and normal alignment of the thoracic spine (figure 4). Follow-up photographs (figure 5) demonstrated well-healed surgical incisions and well-incorporated skin grafts covering the previously exposed soft tissue over the thorax and gluteus.

DISCUSSION

Traumatic thoracic vertebral fractures are often associated with multiple systemic injuries. As a result, surgical management can

Figure 4 Postoperative anteroposterior radiograph (A), sagittal CT through the left pedicles (B), mid-sagittal CT (C), and sagittal CT through the right pedicles (D) demonstrating fracture reduction and successful placement of pedicle screw fixation for thoracic AO/Magerl Type B2.2.2 fracture.

Figure 5 Photograph demonstrating healed surgical incisions and incorporated skin grafts after extensive degloving injury from motor vehicle accident, taken 14 months after the initial injury.

be challenging, as it must address the patient's immediate needs as well as the long-term stability of the spine. In the setting of multisystem trauma, minimally invasive, percutaneous placement of pedicle screws can stabilise spinal instability and prevent future deformity while minimising the impact of a large, surgical exposure.

The limited operative view during minimally invasive spine surgery, combined with a steep learning curve and limited surface area for bony arthrodesis, has raised some concern about its feasibility in trauma patients. Several recent reports in patients with spinal trauma, however, have supported the use of minimally invasive techniques in the trauma population.^{12 13} Furthermore, when compared to open surgery, percutaneous pedicle screw fixation has been associated with significantly reduced intraoperative blood loss, decreased days on a ventilator, decreased ICU length of stay and shorter length of overall hospital stay.^{9 14}

The advantages of minimally invasive surgery are not at the expense of effective treatment. When compared to open pedicle screw placement, minimally invasive percutaneous fixation demonstrates similar outcomes, with no difference in the resulting degree of kyphosis, no new postoperative neurological deficits and no long-term functional status.^{9 14 15} For lumbar chance fractures, percutaneous pedicle screws have been used successfully, demonstrating that minimally invasive techniques can be effective even for highly unstable injuries.¹⁶

For a complicated patient with multiple, life-threatening injuries, management decisions concerning individual injuries must be prioritised in the interest of the patient's immediate condition. In selected patients with multisystem trauma and unstable spine fractures, minimally invasive techniques must be considered to address spinal instability while minimising the impact of a large, open surgical approach.

Learning points

- ▶ Traumatic thoracic vertebral fractures are often associated with multiple systemic injuries.
- ▶ In a multisystem trauma patient who is unable to tolerate open surgery, the traditional open, posterior approach for pedicle screw fixation may need to be modified or delayed based on the patient's condition.
- ▶ Pedicle screw fixation is the treatment of choice for stabilisation of flexion-distraction vertebral fractures to prevent progressive deformity and risks of delayed spinal cord injury.
- ▶ Percutaneous pedicle screw fixation of spinal fractures has been associated with significantly reduced intraoperative blood loss, decreased days on a ventilator, decreased intensive care unit length of stay and shorter length of overall hospital stay.
- ▶ In selected patients with multisystem trauma and unstable spine fractures, minimally invasive techniques must be considered to address spinal instability while minimising the impact of a large, open surgical approach.

Competing interests None declared.

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