

Minimally Invasive Pedicle Screw Placement in A Case of L4 Fracture: Case Report with Review of Literature

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Introduction: Pedicle screw instrumentation provides a rigid construct to promote fusion in cases of spinal trauma and degenerative diseases. Minimally invasive percutaneous technique in lumbar spine is a safe and reliable procedure as compared to the well established Magerl technique. It is a straight forward alternative to open approaches or minimally invasive ones and the accuracy of screw placement is also similar to that reported for other techniques.

Case Report: A 16 year old high school boy presented to us with accidental fall from third floor. He was suffering from common cold with resulting high fever. He developed low back ache with bilateral radiculopathy and weakness of dorsiflexors. Neuro-imaging revealed a burst fracture of L4 vertebral body (type A 3.3 according to Magerl/AO spine classification), with bone fragments compromising the spinal canal. Delayed surgery was planned in view of anticipated excessive bleeding from the wound site in addition to poor general condition. Using a bone impactor, the bony fragments were impacted back into the original vertebral body space. Sextant (Medtronic Sofamor Danek, Tennessee, USA) percutaneous pedicle screw and rod fixation device was then used as a rigid construct to stabilize the lumbar spine. Post-operative CT scan and MRI revealed accurate pedicle screw fixation with adequately decompressed spinal canal.

Conclusion: Short segment fusion with minimally invasive pedicle screwing following decompression of cauda equina was considered to be a minimally invasive approach for this case.

Keywords: Percutaneous pedicle screw, burst fracture, lumbar spine

Introduction

The use of pedicle screw fixation is gaining popularity for spinal stabilization procedures. Standard techniques for lumbar pedicle screw fixation involve exposure and excessive muscle dissection, which is associated with greater blood loss, muscle denervation, pain and atrophy. Minimally invasive pedicle screw fixation can also be done under fluoroscopy using standard instruments designed for open approaches¹⁻⁴. The feasibility and safety of percutaneous pedicle screw fixation devices in the treatment of instabilities of lumbar spine resulting from various disorders is well documented⁴⁻⁹. The procedure is completed

within minutes and the operative time, blood loss and hospital stay are also significantly shortened.

Since the first documented case by Foley et al¹⁰ in 2002, several clinical case series have been published^{3,7,9,11-17} using this system in traumatic fractures or degenerative diseases, without the immediate need for canal decompression. We report a case where this system was used after the bony fragments, which were causing canal compression, were impacted back in the body of vertebrae.

Case Report

A 16-year-old high school boy presented to

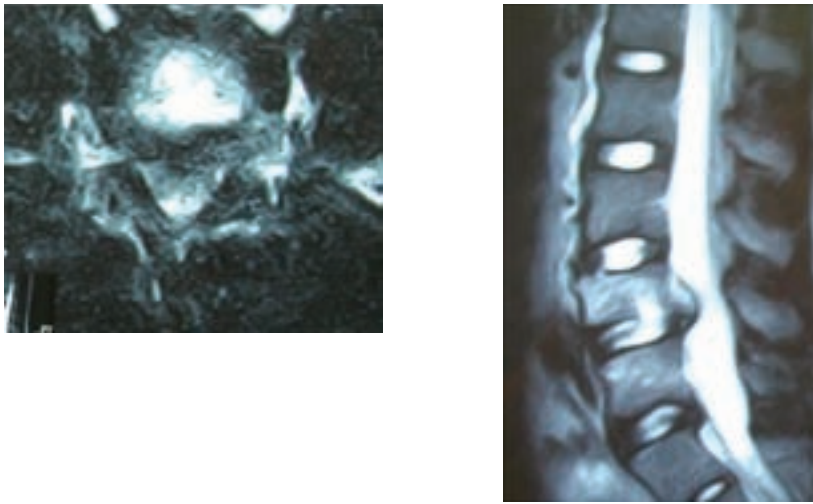


Figure 1. Axial T1-weighted and mid-sagittal and T2-weighted magnetic resonance images of the lumbar spine showing traumatic burst fracture of L4 vertebral body with bony fragments impinging on the spinal canal causing cord compression

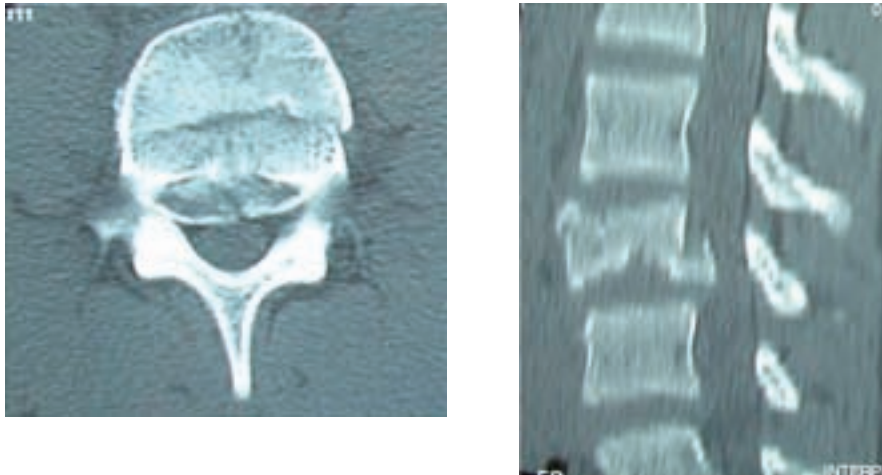


Figure 2. Sagittal and axial computed tomography scans show fracture of posterior and inferior endplate of L4 vertebrae body compromising the spinal canal

us in the emergency department with history of fall on the ground from the third floor accidentally. On examination, he was conscious and had high fever due to common cold. He complained of low backache radiating to both lower limbs. He had hypoesthesia at L5 dermatome and bilateral weak dorsiflexors (Grade IV/V), without any bladder or bowel involvement. MRI and 3D-CT scan of the lumbo-sacral spine revealed a burst fracture (type A 3.3 according to Magerl/AO spine

classification) of L4 vertebrae with bony fragments impinging on the dura causing spinal canal compression (Fig.1, 2). Surgical planning was done, and a decision for delayed surgery was taken as the anticipated risk of intra-operative bleeding was significant in addition to his poor general condition. He was put on a hard corset and was advised bed rest for a week prior to the planned surgery. Sextant (Medtronic Sofamor Danek, Tennessee, USA) percutaneous pedicle screw fixation was

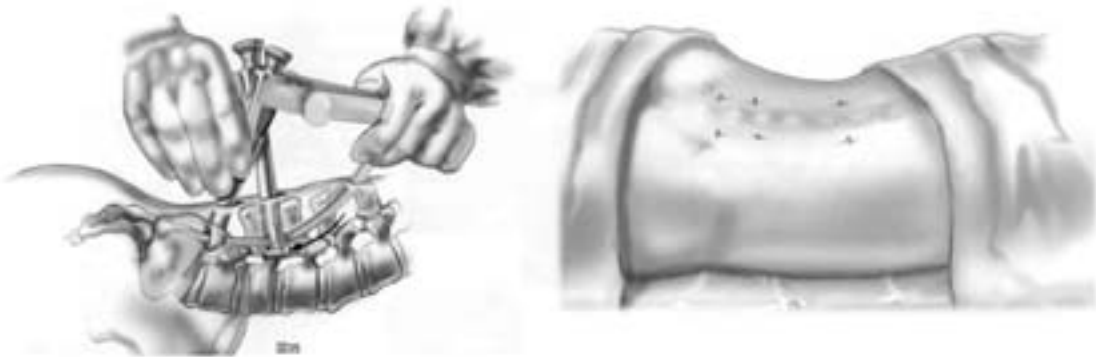


Figure 3. Sextant device being used to demonstrate percutaneous pedicle screw and rod fixation in the lumbar spine , using multiple small skin incisions

performed under general anesthesia using the posterior midline approach. Five cms linear skin incision was given in the midline and subsequent L4 and L5 laminectomy was performed. Without removing the midline ligamentum flavum, the dural sac and bilateral L5 nerve roots were exposed. Bone fragments in the canal were impacted back into the vertebral body using an impactor. Thereafter, bilateral L3 and L5 pedicles were localized, cannulated, drilled and tapped. Screws were then placed percutaneously using the Sextant system for fixation (Fig.3). An extension sleeve was used which allowed remote manipulation of polyaxial screw heads and engagement of screw locking system. The Sextant rods are pre-contoured into a curvilinear shape that precisely matches the

contour of the rod inserter. The rods were then placed in a standard submuscular position with minimal manipulation and no muscle dissection. The consumed time for pedicle screws and rod placement was approximately 90 minutes.

Postoperatively thin sections of CT scan were obtained to determine the accuracy of screw placement. Scans revealed accurate placement of all pedicle screws along with adequately decompressed spinal canal (Fig.4, 5, 6). He experienced an immediate improvement in backache postoperatively. The patient was mobilized 1-2 days post-operatively and was put on external brace for a short period. He started his daily routine activities gradually and presently he is asymptomatic without any residual neurological deficits. At 6 months follow

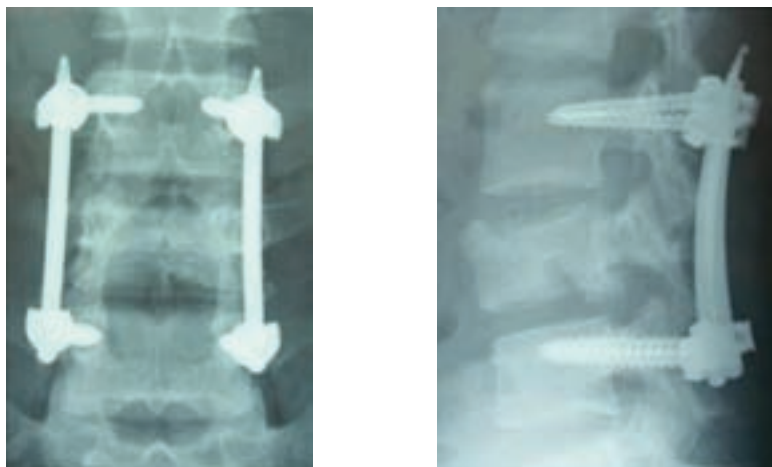


Figure 4. Post-operative postero-anterior radiograph of the lumbar spine showing pedicle screws and rods in L3 and L5 pedicles



Figure 5. Post-operative T2-weighted axial and mid-sagittal magnetic resonance images of the lumbar spine demonstrating adequate decompression of the spinal canal.

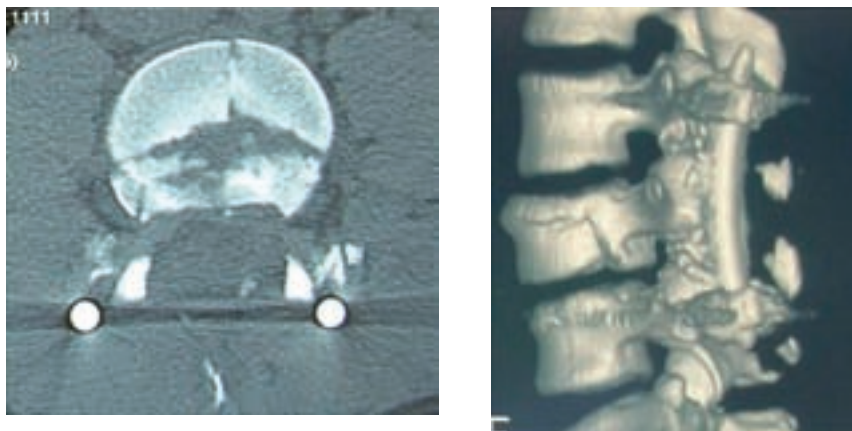


Figure 6. Post-operative axial computed tomography scan along with 3-D reconstruction shows rods and screws in place. The bony elements has been impacted back into the body of vertebrae

up there was no delayed loss of correction due to short segment spine fixation.

Discussion

Minimally invasive fixation of lumbar spine was first described by Magerl^{18,19}, and later Lowery et al²⁰ described a percutaneous lumbar pedicle screw fixation device using rods as longitudinal connectors. Pedicle screws engage all the three columns of spine thus providing better stability. Since the insertion device relies on the geometrical constraints of the rod

pathway through the screw heads, minimal manipulation is required to place the rods in a standard submuscular position and the need for direct visual feedback is avoided. The medial angulation is easily achieved, because extensive soft tissue and muscle retraction is avoided.

In the present case, there was an isolated burst fracture of L4 vertebral body compromising the spinal canal. After partial laminectomy and under C arm fluoroscope guidance, the bone impactor was used and the bone fragments which were causing canal compression were impacted back in the body of vertebrae. Finally

the spine was stabilized using the Sextant percutaneous pedicle screw fixation device. This minimally invasive surgery included short fusion and percutaneous fixation, which was possible in our case as the patient was young and active. It is a relatively safe procedure as the bone fragments were impacted back (and not removed) with the help of operating microscope. This technique radically alters both the intra-operative and postoperative course, minimizing the paraspinal tissue trauma without compromising the quality of fixation. One of the well known drawbacks of short segment fixation of spine is delayed loss of correction; hence long term follow up is mandatory in these patients.

The accuracy of screw placement is similar to that reported for other techniques and the disadvantages associated with standard open approaches are also reduced^{3,4,7-9,13}. Some of the advantages^{1,3,4,8,9,13} of this minimally invasive surgery include small skin incisions, minimal paraspinal muscle dissection, less intra-operative bleeding, superior post-operative muscle strength, less exposure to anesthetic drugs, quick recovery, early mobilization and shorter hospitalization stay. This device is safe even with conventional 2-D fluoroscopy alone and the use of navigation in conjunction with customized instruments and real time 3-D imaging is certainly beneficial. Several published studies^{3,4,8,9,13} have also suggested that lumbar percutaneous pedicle screw fixation is a safe and effective treatment for traumatic fractures and degenerative diseases.

Conclusion

The Sextant device allows a straight forward placement of lumbar pedicle screw and rod through minimally invasive stab wounds which are placed in anatomical position, similar to open surgical approach. The initial clinical results obtained using this system in traumatized lumbar spine have been promising. The present case is one of the few cases, where sextant percutaneous pedicle screw fixation device was used percutaneously to stabilize the lumbar spine in a case of burst fracture, after the compromised spinal canal was adequately decompressed by a bone impactor.

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Comment

This is an interesting article illustrating the usefulness of minimally invasive pedicle screw fixation in a case of L4 fracture. Currently more and more minimally invasive spine stabilizations are being performed all over the globe and hence this article is of interest and is recommend for publication.