

# Evaluation of Stabilization Failure for Thoracolumbar and Lumbosacral Spine Instabilities Treated by Transepipedicular Screws and Rods

Alam MS<sup>1</sup>, Khan AM<sup>2</sup>, Amin MR<sup>3</sup>, Islam FA<sup>4</sup>, Asfia KN<sup>5</sup>, Hossain M<sup>6</sup>, Sultana R<sup>7</sup>

### Abstract

**Background :** The stabilization of the thoracolumbar spine was done due to trauma, tuberculosis, spondylolisthesis, osteoporotic fracture and secondaries in the vertebral body. Failure of stabilization in these groups of patients happened in several cases. This study observed those cases to find out the probable causes and future prevention.

**Objective:** The objective of the study was to observe the efficacy of pedicle screw stabilization with its failure rate to understand the probable cause of failure with further understanding to reduce failure rates in such cases.

**Methodology:** Retrospectively, 127 patients with various disorders leading to instability of the thoracolumbar spine were observed. The cases were treated via a posterior surgical approach with pedicle screw and rod fixation. The accuracy of screw placement was assessed on intraoperative, immediate postoperative, and follow-up radiographs.

**Result:** Among 127 cases 9 cases had stabilization failure and others improved in due courses with time. In 9 cases, 7 were male and 4 were female. Among them breakage of screw was in 5 cases, breakage of rod was in 2 cases and loosening of screw was in 2 cases.

**Conclusion:** Stabilization of thoracolumbar vertebra is an effective procedure in the management of thoracolumbar instabilities and failure can be prevented meticulously.

**Keywords:** Thoracolumbar stabilization, pedicle screw, stabilization failure.

Bang. J Neurosurgery 2015; 5(1): 3-7

### Introduction :

The management of instability of the thoracolumbar spine remains controversial. A large number of publications describe various surgical techniques for the reduction and fixation of spinal fractures without a consensus on the optimal treatment. In general, surgical treatment of thoracolumbar fractures is deemed necessary if the biomechanical stability of

the spine is severely compromised or if a neurologic deficit is imminent or already present. Segmental fixation systems decrease the need for postoperative immobilization, bracing and facilitate early rehabilitation and ambulation.<sup>8,13,16,19</sup>

Short-segment pedicle screw instrumentation is a well-described technique to reduce and stabilize thoracolumbar fractures. It has been increasingly used over the past decade, with numerous reports of good clinical results. It is a relatively easy procedure but can indirectly reduce a fractured vertebral body, and the means of augmenting the anterior column are limited.<sup>6,7,11</sup>

And also because pedicle screw systems generally require fewer instrumented segments, they are advantageous in preserving motion segments, which is particularly important in the mobile lumbar spine and is shown to increase fusion rates. These advantages have made transpedicular fixation a mainstay of treatment for thoracolumbar fixation procedures. Despite these advantages, transpedicular fixation is associated with risks of screw breakage; screw/rod disconnection; pseudoarthrosis; and nerve root injury, dural laceration and pedicle fracture during screw insertion.<sup>5,14,15,18,21</sup>

1. Dr. Md. Shafiul Alam, Associate Professor, Department of Gamma Knife Neurosurgery, National Institute of Neurosciences, Dhaka, Bangladesh.
2. Amir Mohammad Khan, Assistant Professor, Department of Neurosurgery, National Institute of Neurosciences, Dhaka, Bangladesh.
3. Dr. Md. Rezaul Amin, Assistant Professor, Dept. of Neurosurgery, BSM Medical University, Dhaka.
4. Dr. Ferdous Ara Islam, Medical Officer, Department of Neurosurgery, National Institute of Neurosciences, Bangladesh.
5. Dr. Kazi Nur Asfia, Assistant Professor, Department of Anaesthesiology, National Institute of Neurosciences, Dhaka, Bangladesh.
6. Mohammad Hossain, Associate Professor, Dept. of Neurosurgery, BSM Medical University, Dhaka.
7. Rokeya Sultana, Resident Surgeon, Oncology, Dhaka Medical College Hospital.

**Address of Correspondence:** Dr. Md. Shafiul Alam, Associate Professor, Department of Gamma Knife Neurosurgery, National Institute of Neurosciences, Bangladesh. Email: dr\_chapal@hotmail.com, Mobile no. 01711567358

**Material and methods:**

This is a retrospective analysis of the medical record of the Neurosurgery Department of Dhaka Medical College Hospital and some other private hospitals of Dhaka city for patients who underwent surgical treatment for thoracolumbar stabilization. Between January 2007 and December 2012 a total of 127 cases of stabilization were done, of which 9 (7%) cases failed.

**Demography:**

The inclusion criteria included all patients in whom short segmental instrumentation was done, one level above and below the injured vertebrae. The indications were traumatic fracture, osteoporotic fracture, primary bony lesion, secondaries of the spine, tuberculosis of the spine and spondylolisthesis.

Out of the 127 patients, there were 93 males and 34 females with a mean age of 37.6 years (range 16 - 60 years).

**Operative technique:**

The patients were treated with short-segmental instrumentation consisting of pedicle screws applied immediately above and below the fractured level. All patients were operated upon in prone position with a midline posterior incision. A marker was placed and a lateral x-ray was taken, AP view was not available in all the operative procedures either due to technical difficulties or unavailability of the C-arm machine. Spinal laminectomy opposite to the compromised neural canal was performed, when required for neural decompression or dural repair. No attempt was made to reduce the displaced or retro pulsed fragment of the broken vertebra. No neurophysiological monitoring was conducted during the placement of instrumentation. Different transpedicular screw systems were used in this series of patients. Both monoaxial and polyaxial pedicle screws had been used. The posterior or posterolateral bone grafting was used in most of our patients with a short segment transpedicular technique.

**Radiological assessment :**

Anteroposterior and lateral radiographs were performed in all patients. If one spinal fracture was detected, a total spine x-ray was taken because noncontiguous spine fractures occur in 10 - 30% of patients.<sup>16</sup>

Computed tomographic (CT) scan was done in selected patients as CT has enhanced the

understanding of mechanisms of neurologic injury and fracture morphology. The middle column and subtle posterior injuries can easily be diagnosed with CT. To allow accurate fracture classification and to help direct treatment, we recommended 3D CT examination.

Magnetic resonance imaging (MRI) was done to demonstrate spinal cord pathology and the presence of neural compression, other soft tissue injuries and the state of the intervertebral disc can be identified. Magnetic resonance imaging can predict neurologic recovery in some cases based on T2-weighted images. Magnetic resonance imaging was indicated in patients with progressive neurologic deterioration, incongruous neurologic, skeletal injury, and unexplained neurologic deficit. Also, MRI can be used to assess the status of the posterior ligamentous complex.

**Follow up :**

All patients were mobilized as soon as possible. Each patient wore an external orthosis (lumbosacral belt) for 6 - 8 weeks. Serial postoperative radiographs were obtained on follow-up; 6 months and one year. Of the 173 patients, 78 (45%) patients were available for follow-up until the end of the study and 90 patients were followed-up for 6 months postoperatively. Implant failure and radiological analysis done through plain x-rays. The postoperative plain radiological studies included the standard A/P and lateral views. Successful fusion was determined by evaluating the radiographs for the presence bridging bone between the fused segments. The radiographs were interpreted for manifestations of failure of fixation, the effect of implant failure, the point of implant failure, screw length and diameter, rod length and diameter and status of the bone graft. The most common complications were also observed in screw misplacement, breakage of screws, breakage of rods, loosening of screws and rods.

**Results:**

Nine patients with stabilization failure were identified in 127 consecutive patients in whom short-segment transpedicular instrumentation was placed. The probable causes of failure were the absence of bone graft, failure to bone fusion, poor surgical technique, use of less diameter screws, poor quality of implants, inadequate rest after surgery, trauma after surgery and short segment fixation.

**Table-I**  
*Patient profile of failed cases.*

Case No.	Age	Sex(Yrs)	Indication	Type of failure
1	F	46	Spondylolisthesis	Breakage of screws
2	M	52	Fall from height	Breakage of screws
3	F	43	Spondylolisthesis	Loosening of screws
4	M	35	Fall from height	Loosening of screws
5	M	25	RTA	Breakage of screws
6	F	52	Osteoporotic fracture	Breakage of screws
7	M	43	RTA	Breakage of rods
8	M	32	Fall from height	Breakage of rods
9	F	23	TB Spine	Breakage of screws



Case No. : 1



Case No. : 2



Case No. : 3



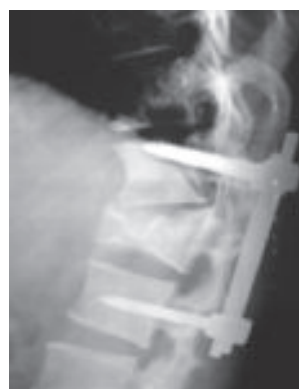
Case No. : 4



Case No. : 5



Case No. : 6



Case No. : 7



Case No. : 8



Case No. : 9

**Figure : Radiography of failed cases.**

All the patients with partial neurological deficits showed marked improvement postoperatively and ambulated independently without assistance.

### Discussion:

The technique of posterior instrumentation for thoracolumbar fractures had been studied extensively. Various methods have been described for identifying the pedicle and placing the pedicle screws. Basic steps include: cleaning the soft tissues, exposing the cancellous bone of the pedicle by decortications at the intersection of the base of the facet and the middle of the transverse process, probing the pedicle, tapping the pedicle and placing the screw. In the lower thoracic levels, screw placement with a straightforward direction may be safe. The incidence of pedicle wall violation was significantly reduced when screws were placed using the open-lamina technique through a partial laminectomy.<sup>3,4,9,14,20</sup>

Routine use of pedicle screw has not been free of complications.<sup>26</sup> The rate of screw misplacement has ranged from 10 - 25% and cortical violation up to 50% in some reports.<sup>3</sup> The frequency of screw breakage ranged from 2.6 - 9%. Screw pull out and screw connector disengagements have been reported both in vitro testing and in vivo. The variable angle screws are most useful in multilevel constructs in which several screw/rod connections are necessary. In this regard, there is a greater "margin of safety" in both the mediolateral and sagittal dimensions. The need for rod contouring is lessened and each screw may be placed on an axis parallel to the superior endplate, reducing the chance of construct failures.<sup>3,5,12</sup>

In a clinical trial with 20 patients suffering from traumatic thoracolumbar burst fractures, the balloon vertebroplasty procedure (additional to a pedicle screw construct) proved to be a feasible and safe technique.<sup>1,4,10</sup>

In our series, 9 patients had implant failure. Among them the breakage of screws was in 5 cases, breakage of rods was in 2 cases and loosening of screws was in 2 cases.

Edwards et al, found excellent maintenance of alignment in terms of kyphosis, vertebral body height and translation in their review of 122 patients.<sup>9</sup> The spinal canal area was improved by 32% (from 55% patency to 87%) if the rod sleeve construct was inserted within 2 days of injury. Between 3 and 14 days, they found a 23% improvement in canal

deviance (range, 53 - 76%). Little improvement was found with surgery after 14 days. In our study, we advised early surgical correction of spinal instability. Short-segment fixation using Cotrel-Du-bousset (CD) instrumentation has had poor outcomes, as reported by McLain et al. They reviewed 19 patients and found vertebral collapse, vertebral translation or hardware failure in 10 patients.<sup>22</sup> The primary cause for failure was attributed to the fixation device. Good outcome studies used a hybrid system using pedicular screws, rods and laminar hooks.<sup>2,6,17,22</sup>

### Conclusion:

Short-segment pedicle screw fixation is a common and relatively simple method for treating thoracolumbar instabilities. The failure of implanted pedicle screws and rods are not unavoidable complications. Failure to provide adequate stabilization can necessitate additional surgical procedures to achieve spinal fusion. Therefore, great attention must be directed to maintain the coronal and sagittal balance of the fractured spine by the proper distraction of the implant, and early reconstruction of the comminuted anterior column. An understanding of fundamental biomechanical principles of the spine, fixation strategies and good surgical technique is essential to avoiding unnecessary subsequent failures.

### References:

1. Aebi M, Thalgott JS, Webb JK (eds): Modular stabilization system: The universal spine system. In: AO ASIF Principles in Spine Surgery. Berlin, Springer-Verlag 1998, pp 123-196.
2. Benzel EC: Short-segment compression instrumentation for selected thoracic and lumbar spine fractures: the short-rod/ two-claw technique. *J Neurosurg* 1993, 79(3): 335-340.
3. Castro WH, Halm H, Jerosch J, Malms J, Steinbeck J, Blasius S: Accuracy of pedicle screw placement in lumbar vertebra. *Spine* 1996, 21(11): 1320-1324.
4. Cresswell TR, Marshall PD, Smith RB: Mechanical stability of the AO internal spinal fixation system compared with that of the Hartshill rectangle and sublaminar wiring in the management of unstable burst fractures of the thoracic and lumbar spine. *Spine* 1998, 23(1): 111-115.
5. Davne SH, Myers DL: Complications of lumbar spinal fusion with transpedicular instrumentation. *Spine* 1992, 17(6 Suppl): S184-S189.
6. de Peretti F, Hovorka I, Cambas PM, et al: Short device fixation and early mobilization for burst fractures of the thoracolumbar junction. *Eur Spine J* 1996, 5(2): 112-120.
7. Dick W: The "fixateur interne" as a versatile implant for spine surgery. *Spine* 1987, 12(9): 882-900.

8. Dickman CA, Yahiro MA, Lu HT, Melkerson MN: Surgical treatment alternatives for fixation of unstable fractures of the thoracic and lumbar spine. A meta-analysis. *Spine* 1994, 19 (20 Suppl): 2266S-2273S.
9. Edwards CC, Levine AM: Early rod-sleeve stabilization of the injured thoracic and lumbar spine. *Orthop Clin North Am* 1986, 17(1): 121-145.
10. Arnold P M, Strang RD, Roussel D: Efficacy of variable-angle screws in transpedicular fixation. *Neurosurg Focus* 1999, 7 (6): E1.
11. Esses SI, Botsford DJ, Kostuik JP: Evaluation of surgical treatment for burst fractures. *Spine* 1990, 15(7): 667-673.
12. Esses SI, Sachs BL, Dreyzin V: Complications associated with the technique of pedicle screw fixation. A selected survey of ABS members. *Spine* 1993, 18(15): 2231-8; Discussion 2238-9.
13. Lesoin F, Bouasakao N, Cama A, et al: Posttraumatic fixation of the thoracolumbar spine using Roy-Camille plates. *Surg Neurol* 1982, 18(3): 167-173.
14. Gertzbein SD, Robbins SE: Accuracy of pedicular screw placement in vivo. *Spine* 1990, 15(1): 11-14.
15. Glassman SD, Dimar JR, Puno RM, et al: Salvage of instrumental lumbar fusions complicated by surgical wound infection. *Spine* 1996, 21(18): 2163-2169.
16. Hitchon PW, Torner JC, Haddad SF, Follett KA: Management options in thoracolumbar burst fractures. *Surg Neurol* 1998, 49(6): 619-26; Discussion 626-7.
17. Knop C, Blauth M, Bühren V, et al: Surgical treatment of injuries of the thoracolumbar transition—3: Follow-up examination. Results of a prospective multi-center study by the "Spinal" Study Group of the German Society of Trauma Surgery (in German). *Unfallchirurg* 2001, 104(7): 583-600.
18. Knop C, Bastian L, Lange U, et al: Complications in surgical treatment of thoracolumbar injuries. *Eur Spine J* 2002, 11(3): 214-26.
19. Kraemer WJ, Schemitsch EH, Lever J, et al: Functional outcome of thoracolumbar burst fractures without neurological deficit. *J Orthop Trauma* 1996, 10(8): 541-544.
20. Merloz P, Tonetti J, Eid A, et al: Computer assisted spine surgery. *Clin Orthop Relat Res* 1997, 337: 86-96.
21. Rechtine GR 2nd, Cahill D, Chrin AM: Treatment of thoracolumbar trauma: comparison of complications of operative versus nonoperative treatment. *J Spinal Disord* 1999, 12(5): 406-409.
22. Stancic MF, Gregorovic E, Nozica E, Penezic L: Anterior decompression and fixation versus posterior reposition and semirigid fixation in the treatment of unstable burst thoracolumbar fracture: prospective clinical trial. *Croat Med J* 2001, 42 (1): 49-53.