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Migration of Rod: A Case Report of Rare Complication of Minimal Invasive Surgery in Spinal Trauma with Narrative Review of Literature

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Learning Point of the Article:

Mechanical complications associated with implants should be always kept in mind while planning Minimal invasive surgery in spine trauma.

Abstract

Introduction: Traumatic spine injury is one of the leading causes of morbidity and mortality in trauma patients. Open surgical procedure is associated with increased blood loss, surgical trauma, and increased recovery period. The goal of minimally invasive surgery (MIS) is to minimize iatrogenic trauma caused by open surgery.

Case Report: A 39-year-old female patient presented to us with complaints of severe pain in back following a fall from ten feet height 1-day back. She was diagnosed with L1 burst fracture and was managed by indirect fracture reduction and posterior instrumented stabilization from D12 to L2 by MIS. She presented to us with complaints of pain over back after 3 months of index surgery. Neurology was intact, and ESR and quantitative CRPH were normal. X-ray showed downward and outward displacement of left connecting rod with pedicle screws in situ.

Conclusion: Minimal invasive surgery in spine is associated with steep-learning curve and technical challenges. Mechanical complications associated with implants should be always kept in mind while planning the surgery.

Keywords: Minimal invasive surgery, spine trauma, burst fracture, rod migration, implant complications.

Introduction

Traumatic spine injury (TSI) is one of the leading causes of morbidity and mortality in trauma patients. Global incidence for TSI was 10.5 cases per 100,000 persons (95% CI 8.6–12.84 cases/100,000) that resulted in an estimated 768,473–790,695 cases of TSI worldwide each year as reported by Kumar et al. [1]. Spinal trauma is traditionally managed by decompression and fixation by instrumentation. Open surgical procedure is usually associated with increased blood loss, surgical trauma, and increased recovery period [2]. Significant devascularization and denervation of spinal musculature cause chronic pain after open surgery. The goal of minimally invasive surgery (MIS) is to minimize iatrogenic trauma caused by open surgery. MIS causes decreased denervation and muscle atrophy [3].

Wiltse et al. reported muscle-splitting approach in 1968, with same exposure to perform far-lateral discectomy, insertion of pedicle screws, and ipsi-contralateral decompression in lumbar spine, which formed the basic philosophy of minimal invasive surgery in spine [4]. MIS for spinal trauma was initially reported as endoscopic guided anterior approach in 2005 by Beisse et al. [5].

Assaker et al. presented the use of minimal access spinal techniques for the management of thoracolumbar trauma at Eurospine, Barcelona, Spain, 2005. He has described posterior approach as a stand-alone technique or in combination with an anterior endoscopic approach [6]. First report of a percutaneous transforaminal endoscopic approach combined with percutaneous pedicle screw fixation for the correction of altered sagittal plane alignment in thoracolumbar burst

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Author's Photo Gallery

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Figure 1: Pre-operative X-ray showing L1 burst fracture.

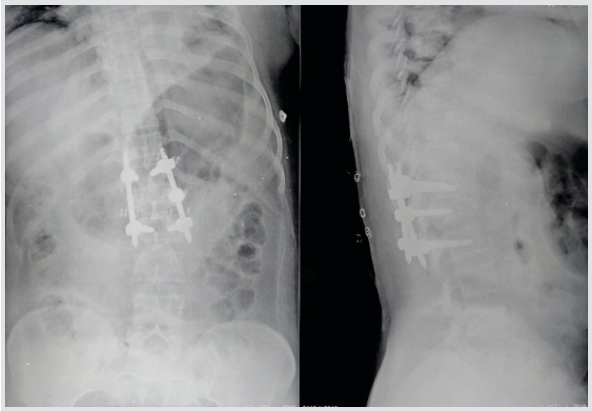

Figure 2: Immediate post-operative X-ray showing pedicle screws and connecting rod in position.

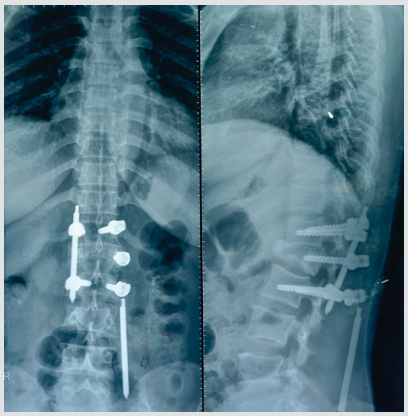

Figure 3: X-ray showing connecting rod migration, pedicle screws were in situ.

fractures was published in 2014 by Wang et al. [7].

Due to decreased morbidity and postoperative hospital stay compared to open surgeries, which involve extensive sub-periosteal stripping and prolonged retraction of soft-tissues resulting in significant ischemic necrosis of the paraspinal muscles and chronic back pain [8], MIS is gaining popularity over past two decades. Nonetheless, application of MIS principles in spine trauma still remains to be explored and, as per current evidence, has been reported to have a number of hardware-related complications [9].

We are reporting an unusual complication of migration of connecting rod that has been published only once in literature related to spine trauma [10], and in that process, we intend to present a narrative review of literature on failure of implants-related complications in MIS for thoracolumbar spinal injuries.

Case Presentation

A 39-year-old female patient presented to us with complaints of severe pain in back following a fall from ten feet height 1-day back. No history of back pain before trauma. Clinical examination did not reveal any neurologic deficit. Radiologic examination showed burst fracture of L1 (AO type A4) with 15 degrees of segmental kyphosis and thirty percent canal compromise (Fig. 1). She was managed with indirect fracture reduction and posterior instrumented stabilization from D12 to L2 by MIS (Fig. 2). Her further hospital stay was uneventful. She was mobilized full weight bearing with customized thoracic lumbar sacral orthotic (TLSO) brace on post-operative day 1 and was discharged on day 2. Her surgical site staples were removed on post-operative day 14 and there were no wound related complications.

She presented to us with complaints of pain over back after 3 months of index surgery. On examination mild tenderness was present over surgical site without any sign of infection or inflammation. Neurology was intact, and ESR and quantitative CRPH were normal. X-ray showed downward and outward displacement of left connecting rod with pedicle screws in situ (Fig. 3). Patient was planned for removal of implant.

Intraoperatively, pedicle screws were found to be loose, but the cap was found to be tight. No collection or bony changes was found intraoperatively. The displaced rod was traced and removed through a subcutaneous tunnel, without extending the incision, along-with ipsilateral pedicle screws and contralateral connecting rod and pedicle screws. There were no radiologic signs of instability intraoperatively after implant removal. Postoperatively patient started on full weight bearing mobilization with customized TLSO brace and was not having any neurological deficit. Three months after the second surgery, patient is pain-free with Oswestry Disability Index of 30 %.

Discussion

Due to limited work-space available in MISS, there is obvious difficulty in locating anatomical landmarks that can result in

Table 1: Complications in reviewed literature.

S. No	Complications	Percentage
1	Screw breakage	1.02–14.28 [10, 15]
2	Plug screw fall off	0.3 [10]
3	Connecting rod loosening	0.4 [10]
4	Misplaced screws	6.3–9.7 [12, 16]
5	Screw loosening	1.1–4.8 [17, 18]
6	Screw pull out	3.1–9.5 [19, 20]

Table 2: Representative publications on implant related complications in MIS in traumatic spine injuries

S. No.	Article	Year	Type of study	No of cases	Outcome	Inferences
1	Shao *et al*. [21]	2020	Prospective analysis	22 patients with single segment thoracolumbar burst fracture	Pedicle screw misplacement – ten out of 123 screws (8.1%)	MIS spine surgery is reliable and safe with lower rate of complications
					Screw loosening – 1	
2	Afolabi *et al*. [22]	2019	Retrospective analysis	Comparison of 100 MISS patients and 155 open surgery patients for thoracolumbar fractures	Two patients had reduction failure due to hardware loosening and ten patients had pain due to hardware prominence in MISS group. Two failure patients had revision and other ten patients had elective implant removal	Percutaneous MISS technique is a reasonable option for stabilizing the thoracolumbar spine compared to the standard open approach
3	Zhao *et al*. [10]	2018	Retrospective analysis	781 patients who had undergone MIS for thoracolumbar spine fractures	Eight patients had screw breakage, two patients had plug screw falloff, three patients had connecting rod loosening	Revision procedure done for some patients and removal after healing done for some patients
4	Tinelli *et al.* [16]	2018	Retrospective analysis	127 patients with thoracolumbar and lumbar burst fractures treated with MIS	34 (6.3%) screws of 22 patients (17.3%) were misplaced out of 542 screws	MIS in spine trauma have less complications and very useful in elderly patients
5	Choi *et al*. [23]	2016	Retrospective analysis	Seven cases who underwent MIS for thoracic and lumbar spine burst fractures	One patient had screw fracture and revision surgery was done	Percutaneous pedicle screw fixation may be a viable strategy for spine trauma that requires further investigation to evaluate long-term outcomes and adverse effects in large cohorts
6	Lyu *et al*. [17]	2016	Randomized controlled trial	90 patients with type A thoracolumbar fractures were randomly assigned into three groups of 30 who were treated with three-level percutaneous fixation, two-level percutaneous fixation, and three-level open fixation, respectively	One case of screw loosening in percutaneous two level fixations who was managed with decreased ambulation and with brace	The efficacy of three-level percutaneous fixation and two-level percutaneous fixation in the treatment of thoracolumbar fractures is not significantly different
7	Proietti *et al*. [24]	2014	Retrospective analysis	63 patients who have undergone short segment percutaneous instrumentation for thoracolumbar fractures	One patient had both cranial and caudal screw breakage after 5 years of surgery	Percutaneous spinal fixation do not replace the other open technique but add to treatment options
8	Lee *et al*. [19]	2013	Retrospective comparative study	59 patients, who underwent either percutaneous (n=32) or open (n=27) short-segment pedicle screw fixation for stabilization of thoracolumbar burst fractures	One case of screw pull out was observed and was managed conservatively and observed closely with serial radiologic exams and clinical status	PPSF is recommended for the treatment of thoracolumbar burst fractures. For the future, study about the changes of spinal motion and alignment after screw removal in MISS group will be required
9	Takami *et al*. [18]	2013	Prospective analysis	21 patients with thoracolumbar burst fractures treated by MIS	Screw loosening - 1	Patient managed conservatively. MIS promotes early rehabilitation
10	Raley and Mobbs [12]	2012	Retrospective analysis	88 patients who had undergone MIS for thoracolumbar spine fractures	Out of 424 screws used 41 screws were found misplaced (9.7%)	MIS is an acceptable technique with a low complication rate in experienced hands
11	Le *et al*. [15]	2012	Retrospective study	101 patients who have underwent minimally invasive lateral interbody fusion for trauma and other degenerative conditions	Dislodged lateral plate was found in three cases. Vertebral body fracture in one case, vertebral body fracture with kyphotic deformity in one case and coronal fracture with lateral listhesis in one case. Incidence of hardware related complications is 5.9 percentage	Meticulous attention at each stage of surgery is required to avoid hardware related complications.
12	Yang *et al*. [20]	2012	Retrospective study	21 patients with thoracolumbar burst fractures treated by MIS	Screw pull out – three screws in two patients	MIS for spine trauma is a suitable technique that yields a satisfactory outcome
13	Ni *et al*. [25]	2010	Prospective analysis	36 patients who have undergone percutaneous pedicle screw fixation for neurologic intact thoracolumbar burst fractures AO type A3	One patient developed loosening of screw	MISS can be an alternative procedure for the treatment of thoracolumbar AO type A3 fractures
14	Palmisani *et al*. [26]	2009	Prospective analysis	51 patients with 64 fractures of the thoracolumbar and lumbar spine undergoing the surgical treatment by percutaneous trans-pedicular fixation and stabilization with minimally invasive technique	Two times the instrumented construct showed mechanical failure (3.9%). One fracture did not heal and an anterior arthrodesis through minimally invasive technique has been needed. The instrumentation has been removed in ten patients (19%)	Implants need to be removed in case of complications or symptoms referred by the patient. Otherwise system hardware removal is mandatory only when fixation involves L2 or lower segments

injury to facet capsule, nerve root, dura, and cord. Such a complication may necessitate open or revision procedures. Although less morbid, minimal invasive surgery is reported to be associated with certain hardware related complications [10].

We can divide these broadly into two categories: Organ injuries from hardware and failure of implant. The list includes, though not exclusive of, intraoperative guidewire breakage, abdominal aorta injury, dura mater injury, pedicle screw misplacement, screw breakage, plug screw falling off, connecting rod loosening, and poor reduction [10]. Complication rates for MIS and open surgeries did not differ significantly [11].

A number of recent studies have compared outcomes of open versus MIS and complication rates in both modalities.

In a study of 424 percutaneous placed pedicle screws done by Raley and Mobbs, post-operative CT scans demonstrated 41 misplaced screws (9.7%). Lateral cortical breaches were more common (n = 30) than medial breaches (n = 11), and neurological injury as a result of these breaches occurred with two screws (0.5%) [12].

Kramer et al. reported hardware failure, in the form of loss of correction or progressive increase in kyphosis, in 4 of 11 thoracolumbar fractures treated with short-segment fixation performed through a standard open approach with posterolateral fusion within a 2-year follow-up [13].

Biomechanical investigation comparing construct bending stiffness, torsional stiffness, and cycles to failure were done between patients who have undergone MIS versus universal spine stabilization system (USS) by Kubosch et al. [14] shows that construct in MIS is showing significant loss of correction compared to USS.

Le et al. did a retrospective study on 101 patients who have underwent minimally invasive lateral interbody fusion for trauma and other degenerative conditions and found that hardware related complications were 5.9% [15].

In our patient, mechanical failure seems to be the reason for loosening of implants. Even though bony union was achieved, construct got weakened on cyclical load from activities of daily living over. The unique features of this case is that the dislodged connecting rod is asymptomatic and without neurological impairment. Even though the construct became weak, bony union was achieved. Patient did not need any revision procedure for stabilization. We removed the implants and postoperatively patient had no neurological deficit and was mobilized full weight bearing with brace.

Implant-related complications can be avoided with proper surgical technique and selecting appropriate implants. Timely identification of complications and revision surgeries helps in improving outcome. Percentage of various complications in the studies, we analyzed are compiles in Table 1. A compilation of most relevant latest studies on MIS in spinal trauma and the complications in those studies is shown in Table 2.

Conclusion

Minimal invasive surgery in spine is associated with long learning curve and technical challenges. Mechanical complications associated with implants should be always kept in mind while planning the surgery. Careful selection of patients and implants with proper technique of MIS in spine will be advantageous than open surgeries.

Clinical Message

Migration of connecting rod is an extremely rare and unusual complication in MIS spine surgery that has been published only once in literature related to spine trauma. We are adding another such case to the literature.

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