Journal of Spine
ISSN: 2165-7939

Kuroki et al., J Spine 2013, S5
DOI: 10.4172/2165-7939.S5-002

Research Article Open Access

Long Thoracic and Lumbar Spinal Stabilization with a Minimally Invasive Spine Surgery Technique

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Abstract

Objectives: The purpose of the current case presentation was to indicate the usefulness of long thoracic and lumbar (TL) spinal stabilization by percutaneous minimally invasive instrumentation.

Materials and methods: From August 2012 to May 2013, we performed long TL spinal stabilization with VIPER 2 system (Depuy Spine, Inc., MA, US) by using a minimally invasive surgery (MIS) posterior approach in 4 patients. The first case was a 54 year old male who suffered from burst fracture of T12 (Frankel A) with brain contusion by a fall. The second case was a 68 year old male who developed incomplete paraplegia by metastatic renal cell carcinoma of T11 (Frankel C). The third case was a 79 year old male who affected Chance fracture of T12 (Frankel E) with an ankylosing spinal hyperostosis. And the fourth case was a 75 year old male who sustained pathological fracture of T8 (Frankel A) due to metastasis of prostatic carcinoma accompanied by an ankylosing spinal hyperostosis. The assessment included the clinical outcome of the patients and implant imaging evaluation.

Results: Physical function was improved in all cases with quick pain relief. Mean operative time was 204 minutes. Mean estimated blood loss was 62.5 ml. In radiographic evaluation, spinal alignment was successfully maintained. One pedicle screw in case 3 cut out laterally in a pedicle-rib unit, but other pedicle screws in all cases were correctly inserted. No implant related complication was observed. And there were no conversions to open surgery.

Discussion: In comparison with conventional open surgery, intraoperative blood loss, operative time, and postoperative pain were remarkably decreased in a MIS technique. Long TL spinal stabilization with a MIS technique is useful method for the patients who are desirable to avoid major surgical procedure.

Keywords: Minimally invasive spine surgery; Percutaneous minimally invasive instrumentation; Percutaneous pedicle screw placement; Long spinal stabilization; Spinal trauma; Spinal tumor; Spinal infection

Introduction

Recently, minimally invasive surgery (MIS) has been broadly employed in the spine field to decrease approach-related morbidity associated with conventional open surgery. This might minimize damage of paraspinal muscles, blood loss, risk of infection, postoperative pain, functional disturbance, and prolonged hospitalization [1]. Hence, application of a MIS technique can be beneficial for the various spinal pathologies, especially in elderly or debilitated patients desired long spinal constructs. The purpose of the current case presentation was to indicate the usefulness of long thoracic and lumbar (TL) spinal stabilization by percutaneous minimally invasive instrumentation (PMII).

Materials and Methods

From August 2012 to May 2013, we performed long TL spinal stabilization with VIPER 2 system (Depuy Spine, Inc., MA, US) by using a MIS posterior approach in 4 patients. Causative disorders were trauma in 2 cases and metastatic spinal tumor in 2 cases. All cases were male with a mean age of 69 years old, ranged from 54 to 79 years old. These 4 patients were desirable to be done spinal surgeries less invasively because they were advanced age or debilitated by complicating disorders acceptable to undergo stabilization without bone graft. The assessment included the clinical outcome of the patients and implant imaging evaluation (Table 1).

Surgical procedure

The patients were placed in the prone position under general endotracheal anesthesia, and were carefully positioned on the surgical table in order to obtain the best pre-operative spinal alignment. Under fluoroscopic guidance, a stab wound approximately 2-3cm long was marked for every single pedicle that needed to be cannulated [2]. After making an incision through the skin and the muscle fascia, a muscular canal that linked all the stab wounds was created with digital dissection by splitting the muscle fibers apart. Pedicle screws were then inserted following the standard percutaneous technique. The rods were then contoured and cut as needed to adapt them to the desired curve of the spine. The rods were threaded through the uppermost extender sleeves and advanced through the muscular canal, taking care to pass through all extender sleeves. Once the rod was advanced, it was rotated to end up in the final position.

Results

Physical function was improved in all cases with quick pain relief. Mean operative time was 204 minutes (range, 131-301 min). Mean estimated blood loss was 62.5 ml (range, 40-90 ml) (Table 1). In radiographic evaluation, spinal alignment was successfully maintained. One pedicle screw in case 3 cut out laterally in a pedicle-rib unit, but other pedicle screws in all cases were correctly inserted. No implant related complication was observed. And there were no conversions to open surgery.

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Received May 06, 2013; **Accepted** June 21, 2013; **Published** June 23, 2013

Citation: Kuroki H, Inomata N, Hamanaka H, Chosa E (2013) Long Thoracic and Lumbar Spinal Stabilization with a Minimally Invasive Spine Surgery Technique. J Spine S5: 002. doi:10.4172/2165-7939.S5-002

Case No.	Age	Sex	Diagnosis	Level Of Lesion	Cause	Co-Mobidity	Instrumented Levels	EBL**	OT***	Physical function	
										preop.	postop.
1	54	male	burst fracture (A3.3.3*)	T12	fall	brain contusion	T10-L2	50	184	bedridden	sitting
2	68	male	metastatic tumor	T11	renal cancer	-	T9-L1	70	310	bedridden	sitting
3	79	male	Chance fracture	T12	fall	ankylosing spinal hyperostosis	T9-L2	40	191	bedridden	walking
4	75	male	metastatic tumor (pathological fracture)	T8	prostatic cancer	ankylosing spinal hyperostosis	T5-T11	90	131	bedridden	sitting

* Magerl classification **estimated blood loss (ml) ***operative time (min)

Table 1: Summary of cases.

Case Presentation

Case 1

A 54 year old male suffered from traumatic burst fracture of T12 (Frankel A) with impaired consciousness due to brain contusion by a fall. The type of fracture classified by Magerl [3] was A3.3.3. Fortunately, consciousness level was recovered after cranial decompressive procedure. Then, we performed long TL spinal stabilization with a MIS technique to facilitate rehabilitation for his independence. Patient-based evaluation about pain was not possible for residual impaired consciousness, however preoperative continuous dosing of opioid analgesia could be discontinued at 4 days postoperatively. Independent activity in a wheel chair was obtained at 4 months after surgery and alignment of the spine had maintained with consolidation of T12 at 6 months after surgery (Figure 1).

Case 2

A 68 year old male developed incomplete paraplegia with severe back pain by metastatic renal cell carcinoma of T11 (Frankel C) (Figure 2). We performed long TL spinal stabilization with a MIS technique and partial tumor resection through another small incision to aim quick pain relief and recovery of paralysis. Two cross-links could be installed via this extra wound (Figure 3). Soon after surgery, his intolerable pain was diminished and paralysis was also partly improved (Figure 4). Although he could not sit by himself preoperatively, independent sitting in a wheel chair was obtained at 4 days after surgery. Not only opioid administration prior to surgery but also a MIS technique seemed to quite reduce surgical site pain.

Case 3

A 79 year old male affected Chance fracture of T12 (Frankel E) (Figure 5). We selected long TL spinal stabilization with a MIS technique because he also had an ankylosing spinal hyperostosis that arise severe instability at the fracture lesion (Figure 6). Patient-based evaluation about pain was impossible for mild dementia, however he could walk by himself at 2 days after surgery. Bone union was confirmed at 4 months postoperatively and his activity of daily living was completely returned to pre-traumatic level.

Case 4

A 75 year old male affected pathological fracture of T8 (Frankel A) and became bedridden due to an unbearable motion pain in the back (Figure 7). We selected long TL spinal stabilization with a MIS technique because he had significant unstable spine derived from not only metastatic prostatic carcinoma between T7 and T9 levels but also an ankylosing spinal hyperostosis in the whole spine (Figure 8). Soon after surgery, his intolerable back pain was markedly decreased and he could sit by himself with half dosage of preoperative opioid analgesia.

Discussion

Conventional open procedures have been widely used in the treatment of thoracic or lumbar spinal diseases over the years. However, they can be associated with significant approach-related morbidity [4]. Anterior approaches have been related to considerable postoperative pain, shoulder girdle dysfunction, and compromised ventilation. The standard posterior midline approach has been associated with significant muscle morbidity, including muscle denervation, increased intramuscular pressures, ischemia, and revascularization injury. Whereat, minimally invasive spine surgery (MISS) was developed to decrease the rate of approach-related morbidity associated with conventional open spine surgery in an effort to improve clinical outcomes [5].

The most important advantages of MISS are the prompt recovery of the patient and the decrease in the complications by minimizing iatrogenic tissue injury typical of that encountered following open surgery [6]. Some experimental studies have proven that MIS techniques are obviously less invasive than standard open procedures for the multifidus muscles [7,8]. Consequently, intraoperative blood loss, operative time, and postoperative pain were remarkably decreased in MISS in comparison with conventional open surgery.

In 1977, the technique of PMII with percutaneous pedicle screw placement was described by Magerl [9]. It was used subsequently only for temporary external stabilization, and the idea recently has been taken further to percutaneous internal stabilization [10]. At the beginning, this technique made use of single level stabilization. After that, multi-segmental stabilization has been popularly utilized by developing new devices that enable the long spinal stabilization. The spinal stabilization with PMII utilizing muscle-dilating approaches is a desirable advancement to minimize surgical incision length, surgical cavity size, and the amount of iatrogenic soft-tissue injury associated with surgical spinal exposure [11]. In contrast, a potential disadvantage of the spinal stabilization with PMII feared by spine surgeons is the inability to perform adequate arthrodesis and achieve long-term osseous fusion [5]. And further, this technique does not allow the cross-link placement [1]. Although Roldan et al. [2] introduce the surgical procedures to perform facet fusion and apply a cross-link with minimally invasive technique, they need additional incisions.

Considering these drawbacks of the spinal stabilization with PMII, we performed long TL spinal stabilization with this technique for the patients with spinal trauma and malignant spinal tumor that do not always need bone graft. In consequence, all 4 patients obtained quick pain relief by the spinal stabilization and recovery due to less soft tissue damage. In case 2, we could additionally put two cross-links through another small incision for tumor resection.

At present, the spinal stabilization with PMII is supposed to be

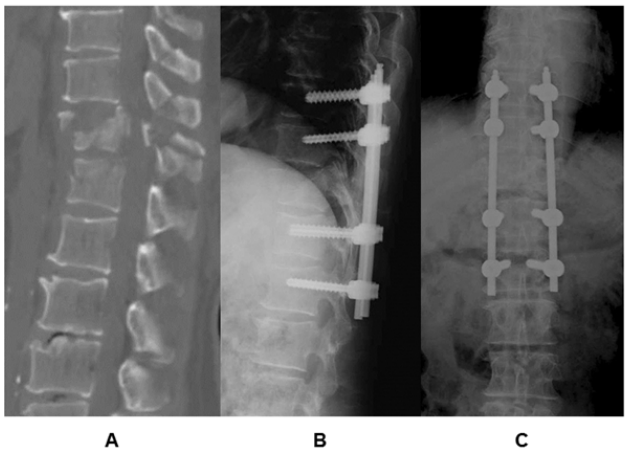

Figure 1: Case 1 Preoperative CT and postoperative x-rays at 6 months after surgery.

A. Preoperative CT Type A3.3.3 burst fracture of T12 was indicated.
B, C. Postoperative x-rays at 6 months after surgery
Alignment of the spine had successfully improved and maintained.

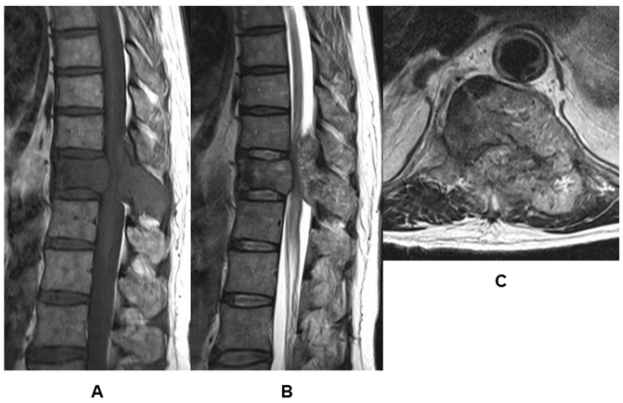

Figure 2: Case 2 Preoperative MRI.

A. T1WI sagittal
B. T2WI sagittal
C. T2WI axial
Preoperative MRI showed compression of the spinal cord by metastatic bone tumor.

favorable as the less invasive surgery that unneeded bone graft for spinal trauma with other musculoskeletal and visceral injuries or with significant medical comorbidities, the stabilization to preserve motion segments with vertebral fracture, for example in Chance fracture [12], the temporal stabilization for the segment in spinal infection, and the palliative surgery to spinal tumor for maintaining or improving the QOL. The need to remove the implant once the fracture heals may be a matter of discussion in the future [6].

The application of the spinal stabilization with PMII can be broadened to long spinal constructs to assess fractures, tumor, deformity, and infection more and more hereafter. This procedure seems especially adequate and proportionate to achieve temporal internal stabilization in elderly or debilitated patients, in which approach-related morbidity needs to be reduced to a minimum. However, problems related to this technique will be anticipated with the expansion of surgical indication. Unfortunately, due to the small number of cases and short follow-up period, it was difficult to derive issues in the current report. Therefore, prospective and long-term comparative clinical studies with the conventional open procedure are required to demonstrate the true clinical benefit of this technique and the real survival of minimally implanted long constructs [2]. But we believe that our case series will contribute to some development of the spinal stabilization with a MIS technique.

Conclusions

Long TL spinal stabilization with a MIS technique is useful method

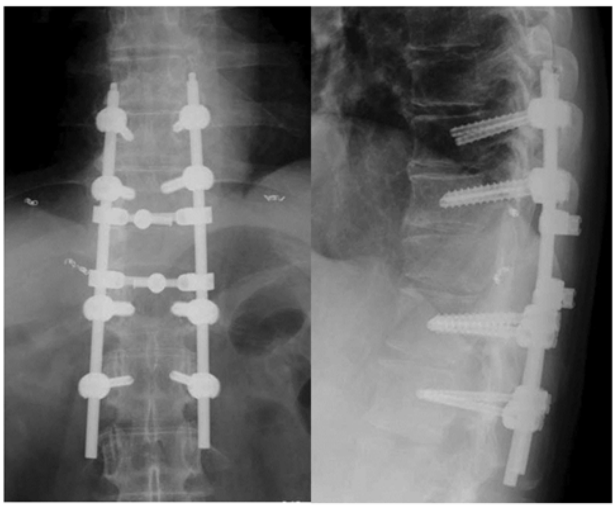

Figure 3: Case 2 Postoperative x-rays at 1 month after surgery.

Thoracic spine was stabilized with percutaneous minimally invasive instrumentation with two cross-links.

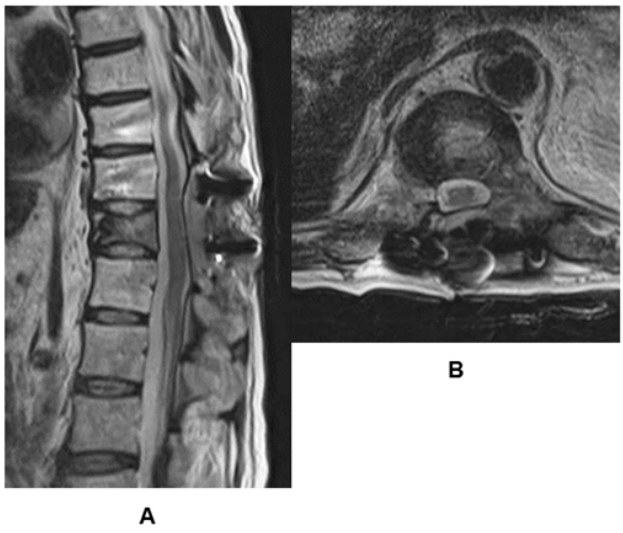

Figure 4: Case 2 Postoperative MRI at 4 months after surgery.

A. T2WI sagittal
B. T2WI axial
Spinal alignment had been maintained and spinal cord compression was improved.

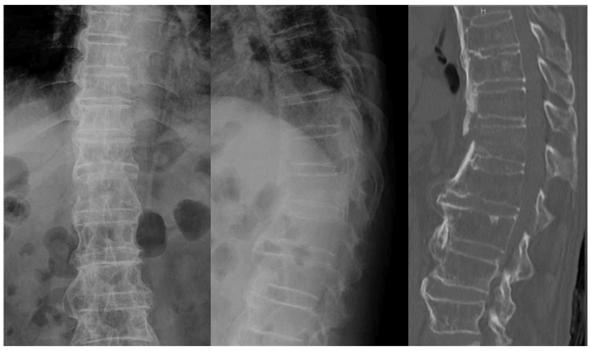

Figure 5: Case 3 Preoperative x-rays and CT.

A, B. Preoperative x-rays
C. Preoperative CT
These images showed Chance fracture of T12 without marked displacement. Most vertebrae were spontaneously fused with ossification of both the anterior longitudinal ligament and the supra-spinous ligament.

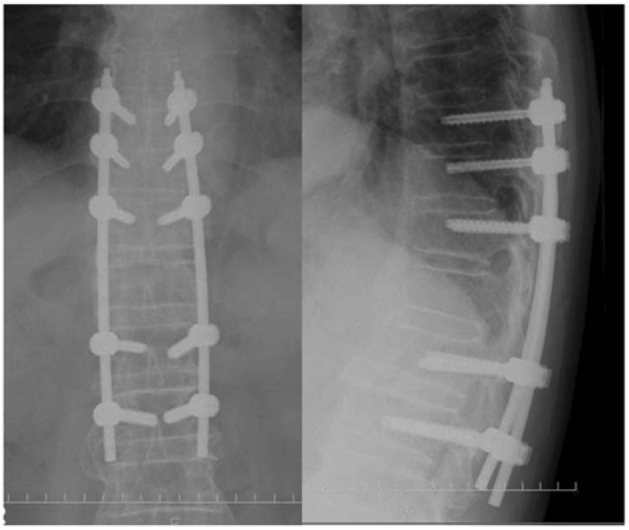

Figure 6: Case 3 Postoperative x-rays at 4 month after surgery.

Alignment of the thoracic spine had been maintained well. Radiolucent zone at the fracture area was diminished.

for the patients who are desirable to avoid major surgical procedure. Nevertheless, future prospective and long-term comparative clinical studies with the conventional open procedure are needed to demonstrate the true clinical benefits.

References

1. Krüger A, Rammler K, Ziring E, Zettl R, Ruchholtz S, et al. (2012) Percutaneous minimally invasive instrumentation for traumatic thoracic and lumbar fractures: a prospective analysis. Acta Orthop Belg 78: 376-381.
2. Roldan H, Perez-Orribo L, Spreafico M, Ginoves-Sierra M (2011) Long constructs in the thoracic and lumbar spine with a minimally invasive technique. Minim Invasive Neurosurg 54: 100-103.
3. Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S (1994) A comprehensive classification of thoracic and lumbar injuries. Eur Spine J 3: 184-201.
4. Smith JS, Ogden AT, Fessler RG (2008) Minimally invasive posterior thoracic fusion. Neurosurg Focus 25: E9.

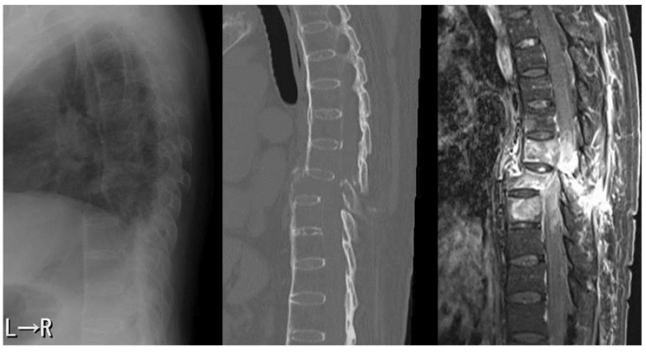

Figure 7: Case 4 Preoperative x-rays, CT, and MRI.

A. Preoperative x-rays B. Preoperative CT C. Preoperative MRI (T1Gd fat suppression)
These images showed pathological fracture of T8 with marked displacement. The whole spine was fused with the ossification of the anterior longitudinal ligament. Vertebrae between T7 and T9 were enhanced by gadolinium administration.

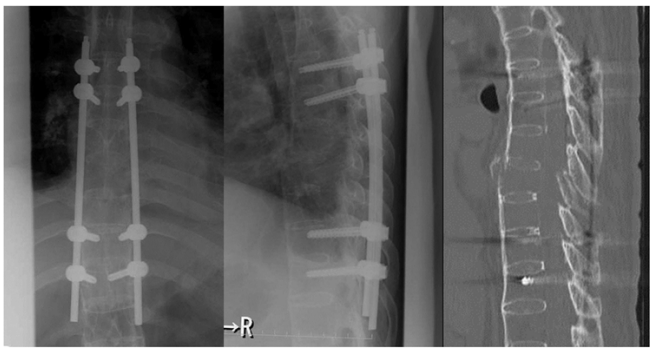

Figure 8: Case 4 Postoperative x-rays and CT at 1 week after surgery.

A, B. Postoperative x-rays C. Postoperative CT
Alignment of the spine had mostly improved.

5. Hsieh PC, Koski TR, Sciubba DM, Moller DJ, O'Shaughnessy BA, et al. (2008) Maximizing the potential of minimally invasive spine surgery in complex spinal disorders. Neurosurg Focus 25: E19.
6. Logroscino CA, Proietti L, Tamburrelli FC (2009) Minimally invasive spine stabilisation with long implants. Eur Spine J 18 Suppl 1: 75-81.
7. Kim DY, Lee SH, Chung SK, Lee HY (2005) Comparison of multifidus muscle atrophy and trunk extension muscle strength: percutaneous versus open pedicle screw fixation. Spine (Phila Pa 1976) 30: 123-129.
8. Stevens KJ, Spenciner DB, Griffiths KL, Kim KD, Zwienenberg-Lee M, et al. (2006) Comparison of minimally invasive and conventional open posterolateral lumbar fusion using magnetic resonance imaging and retraction pressure studies. J Spinal Disord Tech 19: 77-86.
9. Magerl F (1980) Injuries of the thoracic and lumbar spine. Langenbecks ArchC hir 352: 428-433 [in German].
10. Ringel F, Stoffel M, Stüer C, Meyer B (2006) Minimally invasive transmuscular pedicle screw fixation of the thoracic and lumbar spine. Neurosurgery 59: ONS361-366.
11. Mobbs RJ, Sivabalan P, Li J (2011) Technique, challenges and indications for percutaneous pedicle screw fixation. J Clin Neurosci 18: 741-749.
12. Schizas C, Kosmopoulos V (2007) Percutaneous surgical treatment of chance fractures using cannulated pedicle screws. Report of two cases. J Neurosurg Spine 7: 71-74.