

Case Report



Novel Combination of Harrington and Pedicular Screw Fixation in Traumatic Fracture-dislocation of Thoracic Spine: A Case Report and Literature Review

Mohammad-Reza Ehsaie¹, Amir-Hossein Haghir¹, Saman Mohazzab-Torabi¹, Bahador Maleki-Pour², Mohammad Ali Abouei-Mehrizi^{1*}

1. Department of Neurosurgery, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

2. Functional Neurosurgery Research Center, Shohada Tajrish Comprehensive Neurosurgical Center of Excellence, Shahid Beheshti University of Medical Sciences, Tehran, Iran



Citation: Ehsaie MR, Haghir AH, Mohazzab-Torabi S, Maleki-Pour B, Abouei-Mehrizi MA. Novel Combination of Harrington and Pedicular Screw Fixation in Traumatic Fracture-dislocation of Thoracic Spine: A Case Report and Literature Review. *Iran J Neurosurg.* 2022; 8:E21. <http://dx.doi.org/10.32598/irjns.8.21>

doi: <http://dx.doi.org/10.32598/irjns.8.21>



Article info:

Received: 10 Sep 2022

Accepted: 28 Oct 2022

Available Online: 30 Dec 2022

Keywords:

Complete fracture-dislocation, Decompression, Neurological deficit, Harrington spinal fixation

ABSTRACT

Background and Importance: Fracture-dislocation of the thoracic or lumbar spine (traumatic spondyloptosis) occurs in less than 5% of all spinal injuries mainly affecting the ventral direction.

Case Presentation: A paraplegic young man was admitted to Shahid Kamyab Hospital in Mashhad City, Iran due to a motor vehicle accident. Computerized tomography (CT) showed a complete posterior dislocation of the T10 vertebral body on T9, with the superior articular processes of T9 bilaterally locked in the inferior endplate of T10 and complete fractures of the posterior elements.

Conclusion: The spinal dislocation was re-aligned by a combination of Harrington fixation and pedicular screws leading to spinal fusion. Six months after surgery, the patient was still paraplegic but the sensory symptoms in the lower extremities and clean intermittent catheterization improved.

* Corresponding Author:

Mohammad Ali Abouei-Mehrizi, MD

Address: Department of Neurosurgery, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

Tel: +98 (915) 5061277

E-mail: drabouei@yahoo.com



Highlights

- Complete fracture-dislocation of the thoracic and lumbar spine is one of the most severe spinal injuries in traumatic patients.
- Harrington instrumentation and pedicular screw were used for spinal fixation.
- Precise observation and management should be obtained for catastrophic spinal fracture dislocation.

Plain Language Summary

Traumatic spinal fracture dislocation, known as a complete gross posterior translation of vertebrae in the sagittal plane, is one of the most severe forms of spinal injury associated with severe neurological deficits. Complete dislocation, usually defined as spondyloptosis, is always related to the disability of three spinal columns. Most patients have complete paraplegia and long-life disability. Despite the catastrophic consequences of spinal dislocation, we aimed to reduce deformity, and improve long-term neurological function and painless condition.

1. Background and Importance

Fracture-dislocation of the thoracic and lumbar spine (traumatic spondyloptosis) occurs in 3% of all spinal injuries mainly affecting the ventral direction and rarely in the dorsal direction [1]. This catastrophic event is responsible for spinal instability with severe and long-term neurological deficits and disability in patients [2]. We report a severe case of traumatic spondyloptosis of the lower dorsal leading to paraplegia that was realigned by using old-fashioned Harrington spinal traction and pedicular screw spinal fixation.

Case Presentation

A 27-year-old male was admitted to Shahid Kamyab Hospital in Mashhad City, Iran, after a car overturned at high speed and was thrown directly to the roadside guard rail. In the primary survey, his vital signs were as follows: heart rate: 87 per minute, respiratory rate: 12 per minute, Spo₂: 95%, and blood pressure: 123/70/mmHg. He was fully conscious and in good general condition. After primary evaluation, neurological examination showed a complete spinal cord injury (American spinal injury association (ASIA) impairment grade A) with paraplegia and T10 sensory level.

Computerized tomography (CT) showed a complete posterior dislocation of the T10 vertebral body on T9 “telescopic view”, with the superior articular processes of T9 bilaterally locked into the inferior endplate of T10 and complete fractures of the posterior elements (Figure 1). A

thoracoabdominal CT scan with and without contrast was performed by a general surgeon to rule out any thoracic and abdominal vascular injuries. Unfortunately, hemothorax was seen in the right lung and the general surgeon inserted a chest tube to prevent further respiratory condition. Then, the patient was transferred emergently to the operating room. After general anesthesia, the patient was placed in the prone position and head was held fixed using a head rest. A midline spinal incision was made at the level of the palpable vertebrae dislocation. After stripping the fascia and muscles, the spinal process and transverse process were shaved up. Auto-laminectomy at the dislocated level was seen and further complete level laminectomy was done to release the spinal cord.

Harrington hooks were inserted behind the left T7 and T12 transverse processes and then the surgeon under precise monitoring gradually increased the Harrington rods level to facilitate distraction and unlocking (Figure 2). After complete reduction, a temporary Harrington rod was fixed on the left side under fluoroscopic control and pedicular screws, 5.5 mm in diameter and ranging from 30 to 40 mm in length, were inserted in the right side from T7–T9 cranially and T11–L1 caudally (dislocated level was skipped) and the right final rod was secured (Figure 3). After right side fixation, Harrington’s temporary rod was removed and pedicular screws were inserted in the left side as the right side. Finally, the reduction was maintained by securing two lateral longitudinal rod, contoured to preserve the natural anatomy of the lower dorsal of spine, into the screw heads (Figure 4). Operation time and intra-operative bleeding were 125 minutes and 385 cc, respectively.



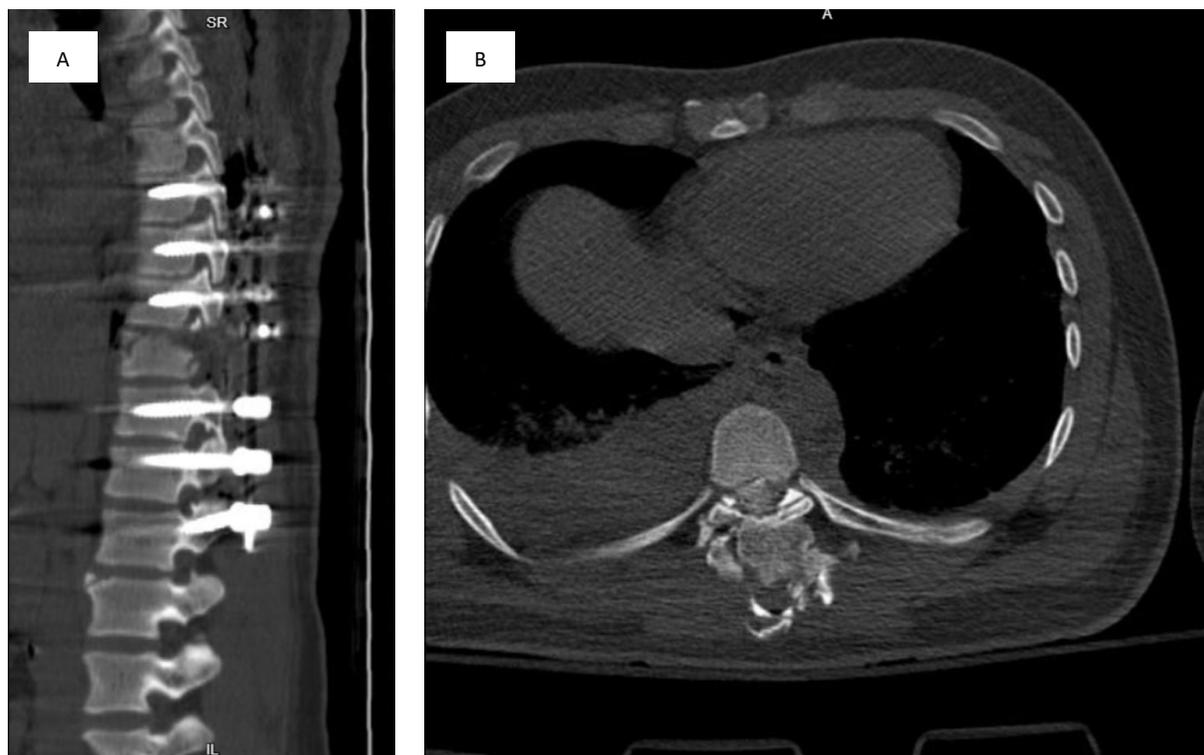


Figure 1. Sagittal (A) and axial (B) bone window of spine

Complete T9-T10 dislocation is seen.



2. Results

Postoperatively, CT showed a complete reduction of dislocation and acceptable instrument insertion (Figure 3). The patient was paraplegic but attained remarkable truncal control (ASIA score B). After 6-month follow-up, he could perform most personal activities independently, including self-catheterization, but needed medical treatment and digital stimulation to achieve bowel movements.

3. Discussion

Fracture-dislocation of the thoracic or lumbar spine, characterized by complete gross posterior listhesis of vertebrae in the sagittal plane, is one of the most severe forms of spinal injury associated with severe neurological deficit. Complete dislocation (spondyloptosis) is always associated with three-column failure and dural tearing. Nearly 80% of patients develop total paraplegia and long-term disability [3]. Despite the catastrophic consequences of this type of thoracolumbar dislocation, our goals were to reduce deformity, improve long-term neural function, and provide painless conditions which received little attention in the literature.

Various technical management strategies have been proposed in the literature regarding deformity and neurological deficit, however complete realignment can be achieved only in about 25% of the cases [4]. Using the best of our knowledge and after reviewing previous studies, we used a combination of Harrington and pedicular screws for the reduction of T9-T10 dislocation for the first time. The key point of our operation was the temporary reduction of the dislocated level using Harrington and then final fixation with pedicular screws and horizontal bilateral rods. Harrington was an old-fashioned technique that was routinely used in the 80s and early 90s for spinal fracture fixation with long-term complications, such as lack of complete lordosis or kyphosis correction and only capability to posterior column fixation. In 2013, Barcelos et al implemented the vertebrectomy technique and further spinal shortening to stabilize upper dorsal dislocation and reduction in a major traumatic center in Brazil [5]. In 1993, Korovesis et al reported T5-T6 fracture dislocation which was realigned by Harrington rods without fusion and discharged with a Milwaukee brace with partial reduction of lateral displacement in Greece [6]. In 1992, Denis et al. implanted Harrington rods to dislocate thoracic and lumbar dislocation with post-operative kyphosis, pseudoarthrosis, and hooks dislocation needed re-operation

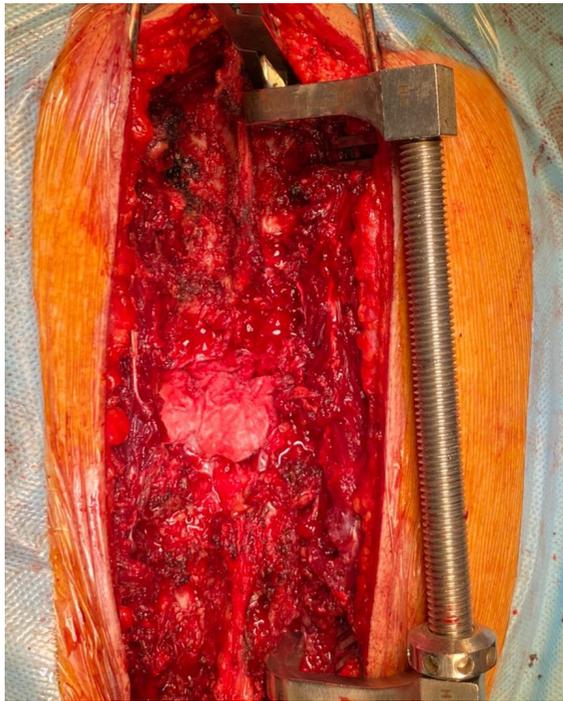


Figure 2. Fixed Harrington rod after dislocated level reduction



Figure 3. Final alignment with bilateral pedicular screws implantation

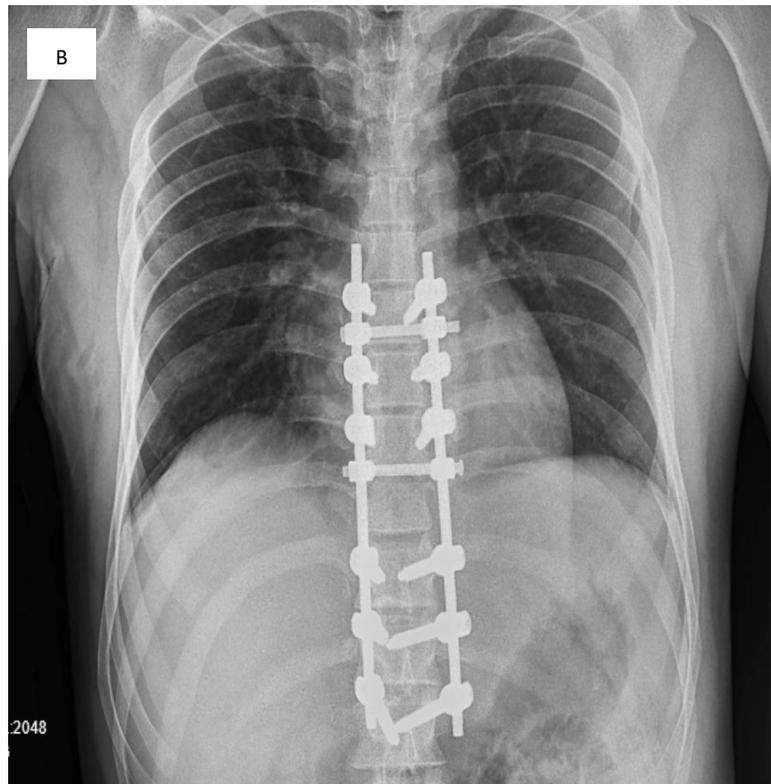


Figure 4. Postoperative lateral and posteroanterior radiographs of thoracolumbar spine revealing the normal alignment after the insertion of instrument

in Minnesota, USA [7]. Total vertebrectomy is considered successful management for many non-traumatic spinal deformities. Many studies have reported uneventful complications, such as hemothorax, infection, intra-operative, and post-operative hematoma [4, 8].

Operative techniques have usually performed cephalic and caudal spinal pulling stimulations in the sagittal plane and then screw insertion with final rod fixation. [9] In one study, screws were implemented in vertebrae on each side of dislocation with dominoes longitudinally oriented rod and anteriorly dislocated vertebrae back into normal alignment by applying reducer to screws head as well as intradiscal distraction [10]. Some studies performed manual abdominal pressure maneuvers or thoracic pad and even transpedicular or thoracotomy corpectomy [5]. Lee et al applied the head of screws inserted in each level of fracture as a distraction point and lever action [11].

As we achieved final complete spinal realignment, the temporary Harrington fixation with permanent pedicular screw insertion has not been previously reported. The aim of our operating strategy was spinal stability, reduced long-term pain, and an effective sitting position that improves daily minimum work. We evaluated the visual assessment scale (VAS) for pain in our patient before surgery, on the day of discharge, and 3 months later which were 9, 4, and 1, respectively. Critical beneficial outcomes of novel Harrington and final pedicular screw insertion were observed. Firstly, based on our experiences, especially in long-term admitted patients, fibri-naiton and adhesion of the aorta to anterior elements were often seen during spinal reduction operations. Similar to the vertebrectomy technique [5]. Harrington's progressive elevation helps us directly observe the spinal cord and anterior vascular arteries, leading to minimum risk of the transaction and aortic dissection despite stimulation of the cephalon-caudal manipulation. We suggest evaluating thoracoabdominal vascular integrity before any reduction surgery to ensure intra-operative vascular rupture. In addition, our strategy permits the neurosurgeon to correct approximate lordosis at the thoracolumbar junction. Furthermore, our operation time was 130 minutes which was shorter than vertebrectomy (360 minutes) and other techniques which reduced post-operative infection, pain, and bleeding [5]. Meanwhile, despite any clinical improvement in sensory or motor function, the visual assessment scale (VAS) pain scale reduced significantly, and post-operative imaging revealed appropriate realignment of T9-T10 dislocation.

4. Conclusion

Finally, although retro-thoracolumbar dislocation is a rare accident, it is often associated with catastrophic complications, such as spinal cord injury. The dislocation of the thoracic or lumbar spine always needs aggressive operating strategies such as pedicular screw insertion and internal or external realignment reduction techniques. We introduced a novel open reduction method by applying a horizontally temporary Harrington hook allowing gradual distraction in the vertical plane to spinal reduction and then pedicular screw insertion and rod fixation on each side. Our strategy achieved final complete realignment without vascular complication.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of [Mashhad University of Medical Sciences](#) (MUMS REC.1400.110). The legal guardians of the patients signed an informed consent form before beginning the study and after briefing the participant about the method and its potential risks and benefits. We obtained written informed consent from the patient to present his condition.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors' contributions

Data Collection: Saman Mohazzab-Torabi and Bahador Maleki-Pour; Drafting the article: Saman Mohazzab-Torabi and Mohammad Ali Abouei-Mehrzi; Critically revising the article: Mohammad-Reza Ehsaie; Reviewing submitted version of manuscript, Approving the final version of the manuscript: All authors.

Conflict of interest

The authors declared no conflict of interest.

References

- [1] Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine*. 1983; 8(8):817-31. [DOI:10.1097/00007632-198311000-00003] [PMID]
- [2] Rahimi-Movaghar V. Efficacy of surgical decompression in the setting of complete thoracic spinal cord injury. *The Journal of Spinal Cord Medicine*. 2005; 28(5):415-20. [DOI:10.1080/10790268.2005.11753841] [PMID] [PMCID]
- [3] Abdel-Fattah H, Rizk AH. Complete fracture-dislocation of the lower lumbar spine with spontaneous neurologic decompression. *Clinical Orthopaedics and Related Research*. 1990; (251):140-3. [DOI:10.1097/00003086-199002000-00022] [PMID]
- [4] Wang F, Zhu Y. Treatment of complete fracture-dislocation of thoracolumbar spine. *Clinical Spine Surgery*. 2013; 26(8):421-6. [DOI:10.1097/BSD.0b013e31824e1223] [PMID]
- [5] Barcelos AC, Botelho RV. Treatment of subacute thoracic spine fracture-dislocation by total vertebrectomy and spine shortening: Technical note. *Journal of Neurosurgery: Spine*. 2013; 18(2):194-200. [DOI:10.3171/2012.10.SPINE12582] [PMID]
- [6] Korovessis P, Sidiropoulos P, Dimas A. Complete fracture-dislocation of the thoracic spine without neurologic deficit: Case report. *The Journal of Trauma*. 1994; 36(1):122-4. [DOI:10.1097/00005373-199401000-00022] [PMID]
- [7] Denis F, Burkus JK. Shear fracture-dislocations of the thoracic and lumbar spine associated with forceful hyperextension (lumberjack paraplegia). *Spine*. 1992; 17(2):156-61. [DOI:10.1097/00007632-199202000-00007] [PMID]
- [8] Morel E, Ilharreborde B, Zadegan F, Dauzac C, Rillardon L, Guigui P. Thoracolumbar junction lateral spine dislocation. *Orthopaedics & Traumatology: Surgery & Research*. 2010; 96(4):476-9. [DOI:10.1016/j.otsr.2010.04.006] [PMID]
- [9] Zhang S, Yan TB. Severe fracture-dislocation of the thoracic spine without any neurological deficit. *World Journal of Surgical Oncology*. 2017; 15(1):3. [DOI:10.1186/s12957-016-1070-7] [PMID] [PMCID]
- [10] Sugiura K, Sakai T, Adachi K, Inoue K, Endo S, Tamaki Y, et al. Complete fracture-dislocation of the thoracolumbar spine with no critical neurological deficit: A case report. *The Journal of Medical Investigation*. 2016; 63(1.2):122-6. [DOI:10.2152/jmi.63.122] [PMID]
- [11] Lee CW, Hwang SC, Im SB, Kim BT, Shin WH. Traumatic thoracic spondyloptosis: A case report. *Journal of Korean Neurosurg Society*. 2004; 35(6):622-4. [Link]