

## Case Report

# Novel method for stepwise reduction of traumatic thoracic spondyloptosis

Danika Paulo, Alexa Semonche, Rachana Tyagi

Department of Neurosurgery, Rutgers Robert Wood Johnson Medical School, 1 Robert Wood Johnson Pl, New Brunswick, New Jersey, USA

E-mail: Danika Paulo - [dpaulo127@gmail.com](mailto:dpaulo127@gmail.com); \*Alexa Semonche - [ams757@rwjms.rutgers.edu](mailto:ams757@rwjms.rutgers.edu); Rachana Tyagi - [tyagira@gmail.com](mailto:tyagira@gmail.com)

\*Corresponding author

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## Abstract

**Background:** Spondyloptosis involving complete subluxation of spinal vertebrae resulting in permanent spinal cord damage is rarely caused by high-force trauma. Rapid re-stabilization of the spine is crucial for maximizing chances of neural recovery and can significantly improve the patient's quality of life. In this case study, we describe the challenges associated with the surgical management of traumatic thoracic spondyloptosis, and propose a novel, safe, step-wise, spinal reduction method employing an inflatable beanbag.

**Case Description:** A 17-year-old male fell 25 feet from a tree, resulting in anterior spondyloptosis at the T11/12 level. He presented with para plegia and a T11 sensory level to pin below the umbilicus. Surgical management involved a posterior-anterior-posterior approach with initial posterior decompression, then T12 corpectomy and reconstruction and finally pedicle screw fixation. We utilized an inflatable beanbag to realign the spinal column in a stepwise fashion, thereby minimizing the risk of damage to the surrounding structures, including the thecal sac and great vessels. Postoperatively, the patient regained some sensory function below his injury level of T11 but remained plegic. X-ray imaging confirmed successful spinal fusion.

**Conclusion:** Early spinal realignment and stabilization following spondyloptosis at the T11/T12 level resulted in some improvement in sensory function without resolution of motor plegia. Here, we described how to utilize a novel beanbag reduction method to safely achieve stepwise spinal realignment.

**Key Words:** Fracture dislocation, pediatric, spine, spondyloptosis, subluxation, trauma

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## INTRODUCTION

Sagittal spondyloptosis, defined as total subluxation ( $\geq 100\%$ ) of one vertebra on another, is rare, especially in the thoracic region. The underlying mechanism of injury is typically high-energy/impact trauma (e.g., motor vehicle collisions or critical falls) causing complete cord transection, resulting in paralysis in approximately 80% of the cases.<sup>[4,11]</sup> Since 1983, seven case reports and four case series have described traumatic thoracic

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spondyloptosis.<sup>[1-10,12]</sup> Early stabilization facilitates timely mobilization and rehabilitation.<sup>[5,12]</sup> Here, we report a patient who sustained a critical fall resulting in spondyloptosis at the T11/T12 level, resulting in paraplegia with a T11 sensory level. Surgery involved a multistage decompression and reconstruction procedure using a unique sandbag-assisted step-wise reduction technique.

## CASE DESCRIPTION

### History and examination

A 17-year-old male sustained a 25-foot fall from a tree, resulting in multiple posterior spinal fractures from T9-T12 with sagittal, anterior spondyloptosis at the T11/T12 level. He presented with a full motor/sensory paraplegia at the T11 level (ASIA A spinal cord injury). Computed tomography (CT) of the thoracic spine showed acute

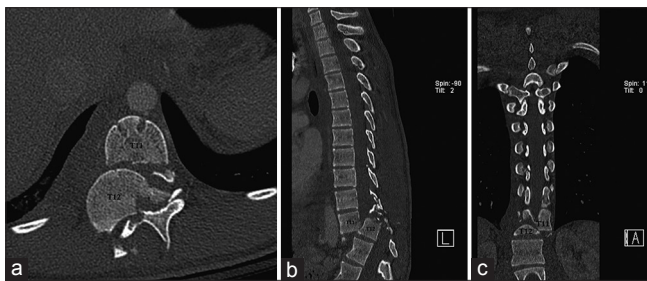
fracture dislocation at the T11/T12 level, suggesting complete cord transection, and an epidural hematoma from T4-T12 [Figure 1a-c]. He also had a right lung contusion accompanied by a pneumothorax and small pneumatocele.

### Operation

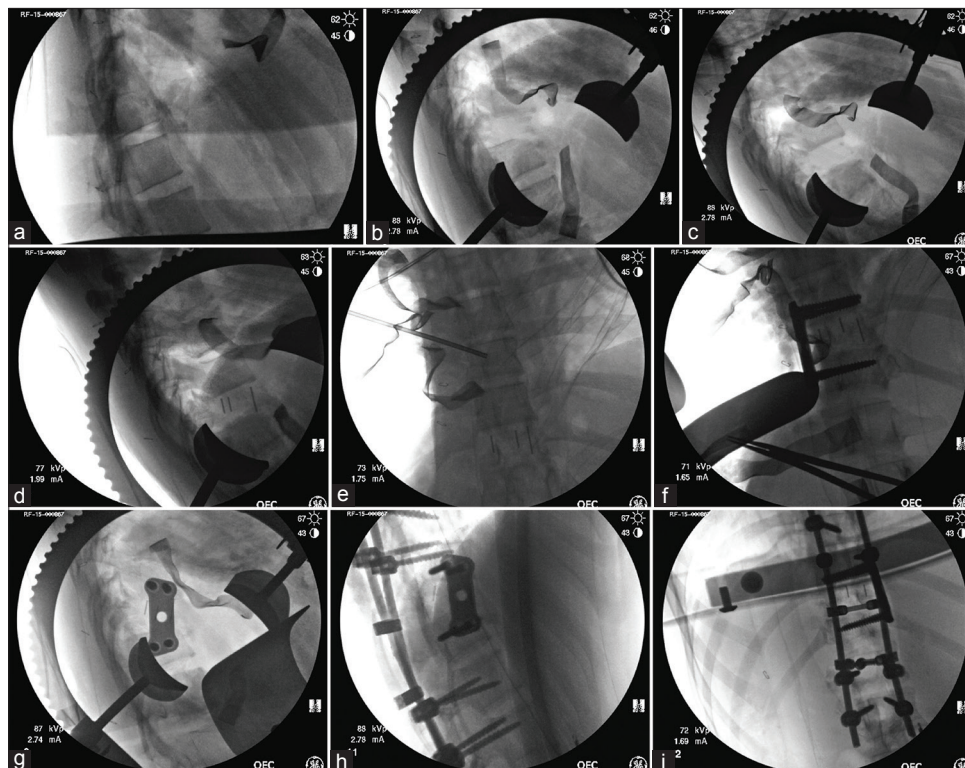
The patient underwent T10-L1 laminectomies with Ponte ostomies at T11/T12 to facilitate reduction of the fracture from the lateral approach. This was performed to prevent fracture fragments from injuring the spinal cord during reduction. In the lateral decubitus position on a beanbag, a thoracotomy was performed to expose T10-T12 and complete a T11 corpectomy with adjacent discectomies. To reduce the dislocation, we used a Cobb to elevate T10 superiorly while manually pushing the distal portion of the spine from the patient's back. This was repeated multiple times for stepwise reduction of the bony elements, with deflation and re-inflation of the sandbag to maintain reduction, until adequate alignment was achieved [Figure 2a-i]. An interbody cage was then placed between T10 and T12. The patient was then turned prone again and was internally fixed from T8 to L2 with pedicle screws/rods [Figure 3a and b].

### Postoperative course

His length of stay was 11 days. On postoperative day one, he exhibited neurogenic shock. His complete spinal cord injury with a T11 sensory level remained stable throughout to postoperative day 10. He began to regain some patchy sensation to the bilateral lower



**Figure 1:** Axial (a), sagittal (b), and coronal (c) noncontrast CT images of thoracic spine preoperatively



**Figure 2:** (a-i) Sequential intraoperative fluoroscopic images showing spinal realignment and fixation

**Table 1 : Summary of individual studies of traumatic thoracic spondyloptosis<sup>[1-10,12]</sup>**

Author, Year	N, gender, age	Injury Level	ASIA Score	Plane of dislocation	Procedure	Reduction Method	Outcome
Mishra <i>et al.</i> , 2015	20: 19 treated surgically, 17 males, 2 females, aged 12-45	T4/5 (1)	A	Sagittal	T3-5 L, T3-6 PSF	Abdominal pressure applied placing one hand below the abdomen over sterile drapes, distraction done by placing a contoured rod on one side of column, then once reduced, another rod was placed on the opposite side, followed by transpedicular corpectomy if necessary	No neurological improvement
		T5/6 (2)	A	Sagittal (1) Coronal (1)	T3 and T7/8 PSF; T4-7 PSF		No neurological improvement
		T6/7 (1)	A	Coronal	T6 L, T4-7 PSF		No neurological improvement
		T8/9 (3)	A	Coronal (2) Sagittal (1)	T9 C, T8-9L, T7/8 and T10/11 PSF; T8-9 C, T7-11 PSF; T9 C, T7-8 and T10-11 PSF		No neurological improvement (2), Death (1)
		T11/12 (1)	A	Sagittal	T11 C		Death
		T12/L1 (5)	A	Sagittal (5)	L2-3 L; T12-L1 L, T10-11 and L1-2 PSF; T11-L3 L, L1 partial C, T11-12 to L2-L3 PSF; Partial L1 C, L1 L, T11-L2 PSF; T11-12 and L1-2 PSF		No neurological improvement (4), Death (1)
		L1/2 (5)	A	Sagittal (3) Coronal (2)	L1-2 L, T11-12 and L1-2 PSF; L2 C with T12, L1, L3-4 PSF; T12, L1, L3-4 PSF; T11-12 and L1-2 PSF; T11-12 and L3-4 PSF		No neurological improvement (3), Death (2)
		L4/5 (1)	A	Coronal	L2-5 PSF		No neurological improvement
		S1/2 (1)	A	Sagittal	L2 fracture PSF, S1-2 listhesis treated conservatively		No neurological improvement
		Yadla <i>et al.</i> , 2008	5: 3 males, 2 females, aged 17-44	T7/8	A		Sagittal
T10-12	A			Sagittal	T8-L1 PSF	Not detailed	No neurological improvement
T12	A			Sagittal	Posterior thoracic fusion	Not detailed	No neurological improvement
T12/L1	A			Sagittal	T10-L3 PSF, anterior T11-L2 fusion, partial L1 C	Distractor instrument straddling rods and connecting adjacent dominoes on each rod used to separate rods longitudinally	No neurological improvement
L1-2	C			Coronal	T10-L4 PSF, L1-3 L, partial L1-2 C	Recovered ambulation, successful fusion	
Chandrashekhara <i>et al.</i> , 2011	4: all males, aged 10-27	T11/12	A	Sagittal	T10-12 and L2 PSF	Pedicle screw and rod fixation to realign vertebral column	No neurological improvement
		T12/L1	A	Sagittal	T11 and L2 PSF		No neurological improvement
		L3/4	A	Coronal	L1/2 and L4/5 PSF		No neurological improvement
		L4/5	A	Sagittal	L2-5 PSF		Mild improvement

Contd...

**Table 1 : Contd...**

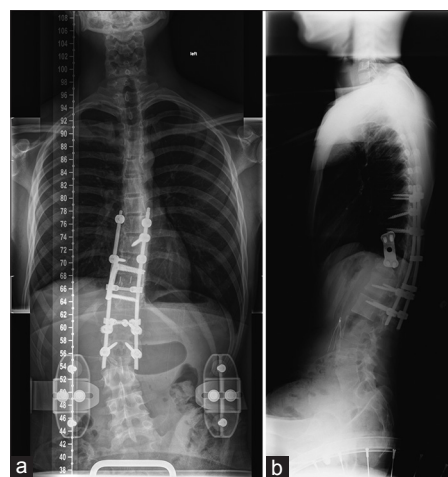
Author, Year	N, gender, age	Injury Level	ASIA Score	Plane of dislocation	Procedure	Reduction Method	Outcome
Sekhon <i>et al.</i> , 2007	2: both males, aged 22 and 36	T6/7	A	Sagittal	T5-9 L and PSF, rods connect T5, T7, T8	Manual distraction, reduction with M8 spondylolisthesis reduction forceps (Medtronic)	No neurological improvement, successful fusion
		T12/L1	A	Sagittal	T11-L1 L, T12/L1 discectomy and T11-L2 PSF	TSRH pedicle screw system (Medtronic) for distraction, placement of intervertebral body spreader	No neurological improvement
Rahimizadeh <i>et al.</i> , 2015	1: male, 29	T2/3	A	Sagittal	T2 C, C6-T7 PSF	Temporary rod placement, gentle distraction	No neurological improvement, successful fusion
Sandquist <i>et al.</i> , 2015	1: male, 20	T12/L1	A	Sagittal	L1 C, T8-L4 PSF	Spine aligned naturally after L1 vertebrectomy	No neurological improvement, successful fusion
Cappuccio <i>et al.</i> , 2014	1: male, 49	T3/T4	A	Sagittal	T4 C, T1-8 PSF	Not detailed	No neurological improvement
Hasturk <i>et al.</i> , 2013	1: male, 20	T5/6	A	Sagittal	T6C, T3-8 PSF	Rod compression maneuver	No neurological improvement
Gitelman <i>et al.</i> , 2009	1: male, 30	T6/7	E	Sagittal	T1-3 and T7-9 PSF, T5-7 L	Not attempted	Independent ambulation, neurologically intact, successful fusion
Lee <i>et al.</i> , 2004	1: male, 32	T8/9	A	Sagittal	T5-7 and T9-10 PSF	Manual distraction with pedicle screws as lever	No neurological improvement
El Masri <i>et al.</i> , 1983	1: male, 21	T8/9	C	Coronal	Treated conservatively	N/A	No neurological improvement

C: Corpectomy, L: Laminectomy, PSF: Pedicle screw fixation



**Figure 3:**Anterior-posterior (a) and lateral (b) radiographs of spinal construct immediately postoperatively

extremities levels starting 2 weeks after surgery, with return of sensation at the T11-T12 levels by 2 months post-operation. Although sensory function continues to improve, he remains paraplegic below T12. Three months post-operation, he started to develop a flexible scoliosis of his lumbar spine, which progressed [Figure 4a and b], which was successfully managed with bracing.



**Figure 4:**Anterior-posterior (a) and lateral (b) radiographs of spine six months postoperatively showing increased scoliosis

## DISCUSSION

Traumatic thoracic spondyloptosis is an uncommon injury. There have been four case series and seven case reports published involving a total of 38 patients with traumatic spondyloptosis [Table 1].<sup>[1-10,12]</sup> All operations utilized a posterior in conjunction with posterior spinal

TSRH pedicle screws (Medtronic Sofamor-Danek) to reduce the dislocated vertebral body. However, our patient had comminuted fractures of the pedicles, thus precluding this technique.

Here, we utilized a new technique employing sequential sandbag deflation and reinflation to attain a stepwise correction of alignment. With multiple cycles of inflating and deflating the sandbag in lateral decubitus position, with light Cobb distraction, the dislocation could be incrementally reduced. Advantages of this technique included minimizing risk of the spinal cord injury and accidental durotomy. The 360-degree decompression, reduction, and circumferential reconstruction also increased construct stability.

## CONCLUSION

Thoracic spondyloptosis is an uncommon injury. Stepwise decompression, step-wise reduction utilizing a sandbag method, and fusion allows for 360-degree correction of the deformity while reducing the risk of potential complications.

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## Conflicts of interest

There are no conflicts of interest.

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