

# Thoracolumbar traumatic nucleus pulposus sequestration combined with a slight flexion distraction fracture

## A rare case report and literature review

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### Abstract

**Rationale:** Traumatic nucleus pulposus sequestration (TNPS) usually occurs concurrently with severe destruction of bone. TNPS combined with a slight thoracolumbar flexion-distraction fracture, triggering a disastrous nerve injury, has rarely been reported. Due to the atypical radiologic manifestations, such a patient can easily be overlooked.

**Patient concerns:** Hereby, we present a TNPS patient as well as a slight thoracolumbar flexion-distraction fracture and serious neurologic symptoms.

**Diagnoses:** T12 spinous process fracture, L1 flexion distraction fracture, thoracolumbar traumatic nucleus pulposus sequestration and lower limbs incomplete paralysis

**Interventions:** To avoid further neurologic compromise, an urgent laminectomy and exploration of the spinal canal was performed.

**Outcomes:** After decompression OR and 4 months rehabilitation, the patient's neurologic function improved remarkably.

**Lessons:** A slight flexion-distraction fracture following injury is liable to eclipse the concurrence of TPNS. For this patient, a high-resolution MRI was needed to make a definitive diagnosis and guide surgery. Once TPNS has been diagnosed, sufficient decompression and discectomy surgery should be performed without delay.

**Abbreviations:** ASIA = AISA impairment scale, DS = dural sac, EN = epidural neoplasm, MRI = magnetic resonance image, OR = operation, PLL = posterior longitudinal ligament, ROM = range of motion, STIR = MRI STIR sequence, TEH = traumatic epidural hematomas, TLICS = the thoracolumbar injury classification and severity score, TNPS = traumatic nucleus pulposus sequestration.

**Keywords:** decompression, flexion distraction fracture, radiology diagnosis, thoracolumbar fracture, traumatic nucleus pulposus sequestration

## 1. Introduction

Traumatic nucleus pulposus sequestration (TNPS) is an extremely infrequent type of disc herniation. TNPS mostly happens concurrently with severe bone destruction, especially of cervical spine, such as cervical dislocation and vertebra burst fracture.<sup>[1]</sup> However, due to the biomechanical characteristics

of disc, shearing and torsion stress could also give rise to nucleus pulposus sequestration and subtle fracture occasionally.<sup>[2]</sup> Under these circumstances, TNPS is easily neglected because of the mild fracture. Nevertheless, this hidden disc lesion can be a catastrophe for either conservative treatment or surgery operation. Therefore, TNPS should be taken seriously regardless of the fracture types. Here, we report a patient with TNPS combined with a thoracolumbar slight flexion distraction fracture and severe neurological symptom. Owing to the atypical clinical manifestation, this patient can be easily neglected or misdiagnosed as having various other diseases. In view of above mentioned facts, we share the treatment experience hereby, and discuss the disc injury biomechanical mechanisms.

## 2. Case report

A 33-year-old male was transferred to emergency 10 hours after falling from a height of 8 m. His complain was back and leg acuteness pain. The strength of bilateral lower limbs was grade II and with hyperalgesia; a slight touch upon thigh skin provoked sharp pain from ventral thigh radiating to instep. The visual analog score (VAS) was 10, and ASIA C grade. The computed tomography (CT) scan indicated an obscure low density area behind the posterior longitudinal ligament (PLL) on T12/L1 level (Fig. 1). We performed the MRI immediately. The mid-sagittal

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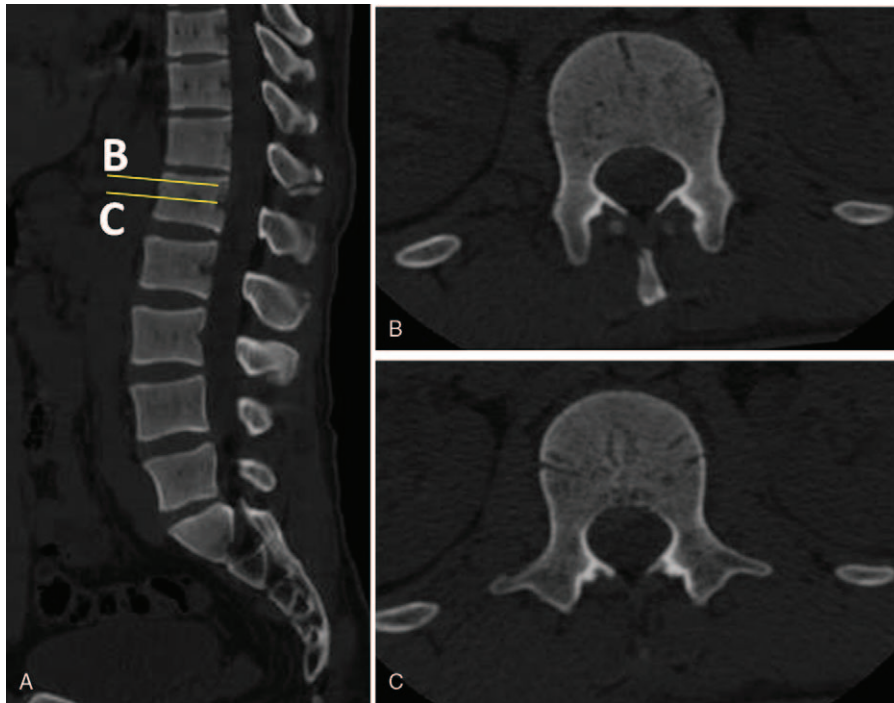
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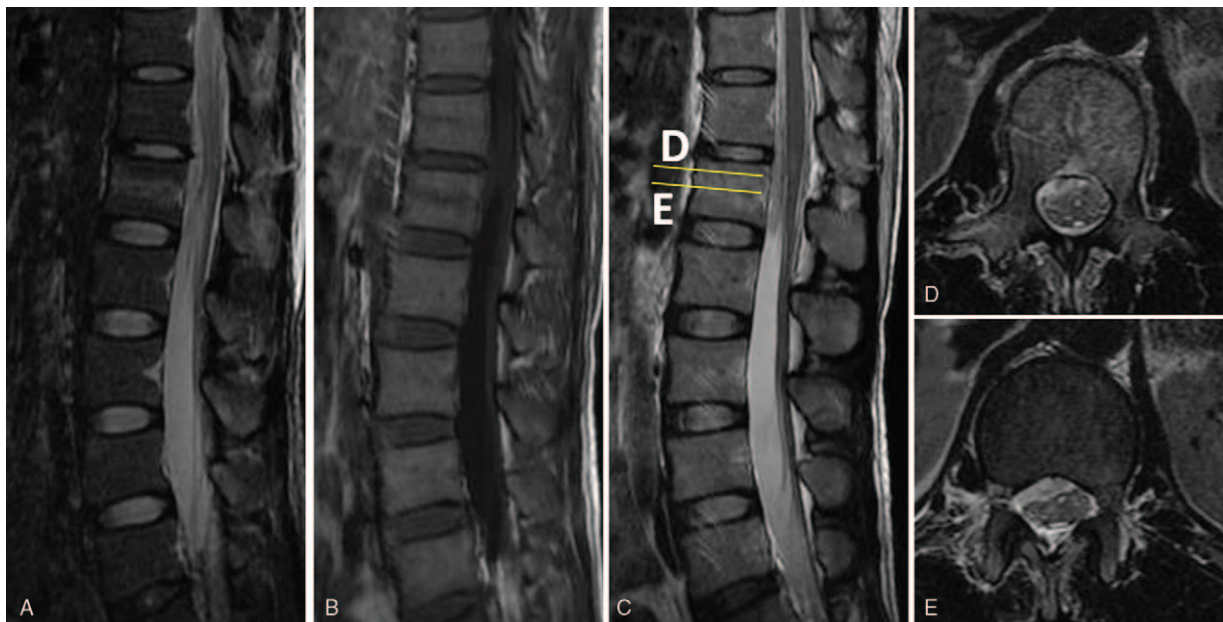


**Figure 1.** The computed tomography (CT) scan before admission indicated a atypical low density area behind the posterior longitudinal ligament on T12/L1 level. In addition the T12 spinous process was disrupted, and the posterior ligament complex was damaged.

STIR image showed not only a transverse band-like high signal zone on L1 vertebra, but an oblique high signal crack on T12 spinous process. The height of T12/L1 Intervertebral space was lower than adjacent segments. In addition, there was a T2WI iso-signal spindle-like lesion between the dural sac (DS) and PLL. The axial section indicated the T2WI iso-signal lesion compressed the sac ventrally on T12/L1 level, and its signal intensity equivalences

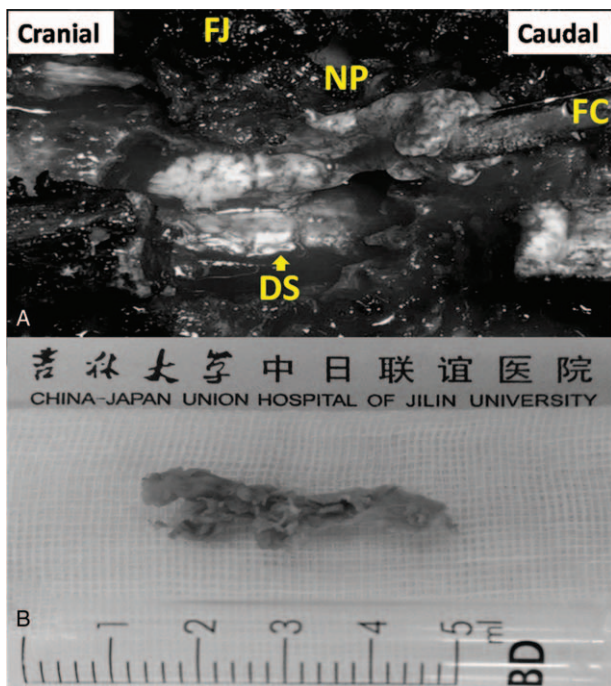
to intervertebral disc (Fig. 2). Then, we made the primary diagnosis as T12 spinous process fracture, L1 flexion distraction fracture, intraspinal occupying lesion, and incomplete paralysis of the lower limbs (TLICS=7).

The patient underwent urgent laminectomy spinal canal exploration and pedicle fixation. After T12/L1 partial laminectomy, the tight and pulsation-free DS was showed. We gently



**Figure 2.** The sagittal STIR/T1WI/T2WI MRI showed a transverse band-like high signal zone on L1 vertebra, and an oblique high signal crack on T12 spinous process (A–C). Axial T2WI MRI demonstrated a spindle-like mass compressed the dural sac ventrally, and the signal intensity of mass equivalences to intervertebral disc (D, E).





**Figure 3.** One rope-like gelatinous mass was encountered in the spinal canal. In addition, the sac was in tight and pulsation-free condition (A). The lesion removed from the canal (PFA fixed), the size of the lesion was 1X4.6cm (B). DS=dural sac, FC=nucleus pulposus forceps, FJ=facet joint, NP=nucleus pulposus.

retracted the sac and explored the canal, and one rope-like gelatinous mass was encountered (Fig. 3). Then, we removed those mass completely. Later, the sac pulsation was restored. The pathological examination demonstrated the specimen was nucleus pulposus, and we updated the clinical diagnosis as

TNPS (Fig. 4). After 4 months of rehabilitation, the patient’s hyperalgesia and muscle weakness improved remarkably, his VAS was 3, and ASIA D grade.

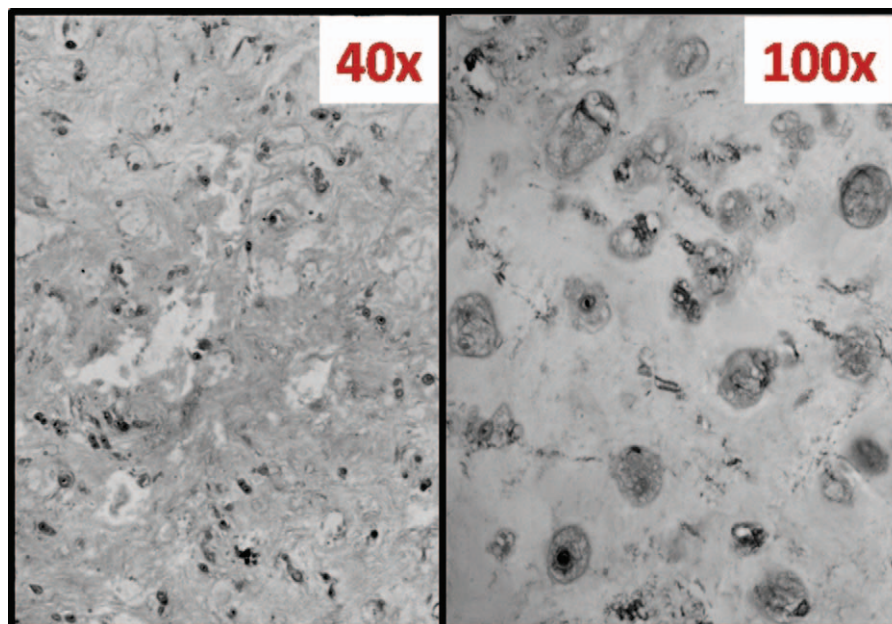
Written informed consent was obtained from the guardian of the patient for publication of this case report and any accompanying images.

### 3. Discussion

Traumatic nucleus pulposus sequestration is a infrequent type of disc herniation, especially on thoracolumbar spine.<sup>[3]</sup> It usually occurs concurrently with severe bone structure destruction, such as dislocation and burst fracture, and often triggers disastrous nerve injury.<sup>[4]</sup> Nevertheless, a slight flexion distraction fracture combined with TNPS was unusual and still rarely reported, but might cause acute nerve compression. Consequently, TNPS and its complications should be taken seriously. For this case, the tricky spindle-like lesion should be distinguished from traumatic epidural hematomas (TEHs) and epidural neoplasm (EN).

Traumatic epidural hematoma usually leads to devastating neurological symptom. Reported incidence of TEH was 0.63% among traumatic patients, and 34% of the were due to falling injury.<sup>[4]</sup> The hematomas hyperacute phase presented as T1WI iso-signal and T2WI high-signal spindle-like image, and behind or surrounding the DS.<sup>[5]</sup> However, the lesion here was anterior to the DS, and its signal intensity equaled to the disc. Meanwhile, the T12/L1 disc was thinner than adjacent segments. EN often results in neurologic deficits, no matter whether injured or not.<sup>[6]</sup> The direct sign of EN is “the endorachis sign” which stands for the DS and spinal cord compression.<sup>[7]</sup> Although the radiologic findings of this case and EN were roughly matched, the patient’s traumatic induced symptoms were helpful for differentiation.

Owing to the wide ROM and the fragile paraspinous muscle, TNPS mainly occurs in cervical, and is combined with severe bony destruction.<sup>[1]</sup> However, in this case, TNPS happened together with a slight thoracolumbar flexion distraction fracture



**Figure 4.** The gelatinous-like mass was observed under microscope after HE staining, and some chondrocytes were detected in the specimen. All chondrocytes were surrounded by extracellular cartilage matrix, without inflammatory infiltration. This demonstrated the removed mass was degenerated disc tissue.

rather than severe spinal column skeleton damage. The following reasons could interpret this phenomenon biomechanically. Firstly, intervertebral disc processes higher vertical compressive strength than vertebra. Thus, huge compressive violence usually leads to vertebral fracture alone other than disc injury.<sup>[8]</sup> Second, the energy absorption of the fracture not only dissipates the violence momentum, but also protects disc from further injury.<sup>[8]</sup> In addition, the multilayer reversed arrangement structure of annulus fibrosus makes the disc vulnerable to shear and torsion stress.<sup>[2,8]</sup> Quantitatively, shear and torsion stiffness of disc were less than 10% of the compressive stiffness.<sup>[9]</sup> For this patient, even if a flexion distraction only results in slight chance fracture, the nucleus pulposus was badly squeezed and migrated because of the shear stress.

The volume of sequestered nucleus pulposus must be evaluated accurately to guarantee the complete removal. After discectomy, we noticed the sac powerful pulsation returned, and we regarded this phenomenon as the criterion of sufficient decompression. Because the ratio of thoracolumbar spinal canal versus the spinal cord was small, single semi-laminectomy was not recommended on thoracolumbar spine.

In summary, we report a rare case of thoracolumbar TNPS tied to flexion distraction fracture with severe neurological symptom. Apart from the slight vertebral lesion, we must notice the disc condition. According to the treatment experience of this case, following lessons should be learnt. Initially, owing to the atypical clinical manifestation and unfamiliar injury mechanism, TNPS is prone to be neglected or misdiagnosed as various diseases. Consequently, a high-resolution MRI is needed to make a definite diagnosis and guide the operation. Furthermore, provided TNPS was discovered, an urgent surgery intervention should be performed immediately to rescue neurological function. Additionally, a whole laminectomy guarantees comprehensive canal exploration and discectomy.

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### References

- [1] Yue JJ, Lawrence BD, Sutton KM, et al. Complete cervical intervertebral disc extrusion with spinal cord injury in the absence of facet dislocation: a case report. *Spine* 2004;29:181–4.
- [2] Goel VK, Monroe BT, Gilbertson LG, et al. Interlaminar shear stresses and laminae separation in a disc. Finite element analysis of the L3-L4 motion segment subjected to axial compressive loads. *Spine* 1995;20:689.
- [3] Jang JW, Lee JK, Seo BR, et al. Traumatic lumbar intradural disc rupture associated with an adjacent spinal compression fracture. *Spine* 2010;35:726–9.
- [4] Brichko L, Giddey B, Tee J, et al. Cervical spine traumatic epidural haematomas: incidence and characteristics. *Emerg Med Australas* 2017; doi: 10.1111/1742-6723.12920 [Epub ahead of print].
- [5] Braun P, Kazmi K, Nogués-Meléndez P, et al. MRI findings in spinal subdural and epidural hematomas. *Eur J Radiol* 2007;64:119–25.
- [6] Ahlhelm F, Schultealtdorneburg G, Naumann N, et al. Imaging of extradural spinal lesions. *Der Radiologe* 2006;46:1035.
- [7] Spirig J, Fournier JY, Hildebrandt G, et al. Spinal tumors: part 1: extradural tumors. *Epidemiology, clinical aspects and therapy. Praxis* 2011;100:839–48.
- [8] Marchand F, Ahmed AM. Investigation of the laminate structure of lumbar disc annulus fibrosus. *Spine* 1990;15:402.
- [9] Markolf KL. Deformation of the thoracolumbar intervertebral joints in response to external loads: a biomechanical study using autopsy material. *J Bone Joint Surg Am* 1972;54:511–33.