



Case Report

# A case of neurosurgical treatment of thoracic dorsal arachnoid web

Tri Duc Duy Tran<sup>1</sup>, Phong Duc Vo<sup>1</sup>, Tri Van Truong<sup>2</sup>, Thi Duc Ho<sup>3</sup>

<sup>1</sup>Department of Neurosurgery, Hoan My ITO Dong Nai Hospital, Bien Hoa, <sup>2</sup>Department of Neurosurgery, Vinmec Central Park International Hospital, Hochiminh, <sup>3</sup>Department of Radiology, Hoan My ITO Dong Nai Hospital, Bien Hoa, Vietnam.

E-mail: \*Tri Duc Duy Tran - tritranduc8485@yahoo.com.vn; Phong Duc Vo - ducphongkx@gmail.com; Tri Van Truong - drtruongtri@gmail.com; Thi Duc Ho - thixray@gmail.com



**\*Corresponding author:**

Tri Duc Duy Tran,  
Department of Neurosurgery,  
Hoan My ITO Dong Nai  
Hospital, Bien Hoa, Vietnam.

tritranduc8485@yahoo.com.vn

Received : 08 May 2023

Accepted : 01 June 2023

Published : 16 June 2023

DOI

10.25259/SNI\_398\_2023

Quick Response Code:



## ABSTRACT

**Background:** Dorsal arachnoid webs constitute abnormal formations of arachnoid that tend to occur in the upper thoracic spine and can lead to spinal cord displacement. Patients typically present with back pain, sensory disturbances, and weakness. It may also obstruct the cerebrospinal fluid (CSF) flow, leading to syringomyelia. In magnetic resonance (MR) studies, the “scalpel sign” is a classical finding, and it may also be accompanied by syringomyelia attributed to CSF flow. Definitive surgical resection is the mainstay of treatment.

**Case Description:** A 31-year-old male presented with mild weakness in the right leg and diffuse lower extremity sensory changes. The MR showed the typical “scalpel sign” at the T7 level consistent with diagnosing a spinal arachnoid web. He underwent a T6-T8 laminotomy for lysis of the web and decompression of the thoracic cord. Postoperatively, his symptoms improved markedly.

**Conclusion:** Surgical resection is the treatment of choice when an arachnoid web is documented on an MR and correlates with the patient's clinical symptoms/signs.

**Keywords:** Laminotomy, Scalpel sign, Spinal arachnoid web, Syringomyelia, Thoracic dorsal arachnoid web

## INTRODUCTION

The dorsal arachnoid web (DAW) is an abnormal thickening of arachnoid bands that cross the dorsal spinal cord.<sup>[10]</sup> These webs are sometimes considered a variant of an arachnoid cyst, a remnant of a ruptured/collapsed cyst, an incomplete formation of an arachnoid cyst.<sup>[10,13,14]</sup> DAW is rare, and we could only identify 63 reports in the literature.<sup>[5]</sup> A recent systematic review included 19 articles with 41 patients undergoing surgery.<sup>[9]</sup> Here, we present a 31-year-old patient with a T7 DAW whose myelopathy resolved following web resection/cord decompression. Previous papers are summarized in Table 1.

## CASE REPORT

### History and examination

A 31-year-old male patient began to experience numbness in his right leg in 2014. In 2016, it became somewhat atrophied, and by 2021, the patient was increasingly/persistently numb. On

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2023 Published by Scientific Scholar on behalf of Surgical Neurology International

**Table 1:** Summary of published studies on DAW.

Authors	DAW/total	Age	Gender	Location	Symptoms*	Syrinx	Treatment
Aiyer <i>et al.</i> 2016 <sup>[1]</sup>	1/1	52	Male	T3-T4	5, 6, 10	No	Surgery
Hines <i>et al.</i> 2021 <sup>[5]</sup>	2/2	73	Male	T3	6, 8, 9, 10	No	T2-T4 laminectomy
Hirai <i>et al.</i> 2019 <sup>[6]</sup>	5/5	58	Male	T7-T8	8, 1, 3	Yes	T7-T9 laminectomy
		71	Male	T4	T-JOA (8.5)	Yes	T4 laminectomy
		59	Male	T3-T4	T-JOA (8)	Yes	T2-T5 laminectomy
		71	Female	T7	T-JOA (3.5)	Yes	T7 laminectomy
		78	Male	T3	T-JOA (6)	Yes	T3 laminectomy
Inoue <i>et al.</i> 2020 <sup>[7]</sup>	2/2	72	Female	T7	T-JOA (8.5)	No	T6-T8 laminectomy
		79	Male	T4	10	No	T2-T3 laminectomy
		43	Female	T5	7, 10	No	T4-T6 laminectomy
Reardon and Raghavan, 2013 <sup>[10]</sup>	5/14	51	Male	T4	7, 9	Yes	T2-T4 laminectomy
		56	Female	T3	6, 10	Yes	T3-T4 laminectomy
		56	Female	T6-T8	6	Yes	T5-T9 laminectomy
		45	Male	T5	4	No	T5 laminectomy
		56	Male	T7	6	No	T5-T9 laminectomy
Sayal <i>et al.</i> 2016 <sup>[11]</sup>	2/2	43	Male	T1-T2	4, 5, 6, 7, 8	Yes	T1-T2 laminectomy
		45	Male	T3-T5	4, 5, 6, 10	Yes	T3-T5 laminectomy
Sridharan and Heilman, 2009 <sup>[13]</sup>	1/1	43	Male	T4	2, 7	Yes	T4 laminectomy
Wali <i>et al.</i> 2019 <sup>[14]</sup>	1/1	47	Male	T7-T8	7	No	T7-T8 laminectomy

\*1: Upper extremity pain, 2: Upper extremity paresthesia, 3: Upper extremity weakness, 4: Lower extremity pain, 5: Lower extremity paresthesia, 6: Lower extremity weakness, 7: Back pain, 8: Neck pain, 9: Shoulder pain, 10: Hyper deep tendon reflexes, DAW: Dorsal arachnoid web, T-JOA, Thoracic Japanese orthopaedic association

examination, he had a right leg with 4/5 motor strength and 3+ deep tendon reflexes at the Patellar and Achilles levels.

**Imaging**

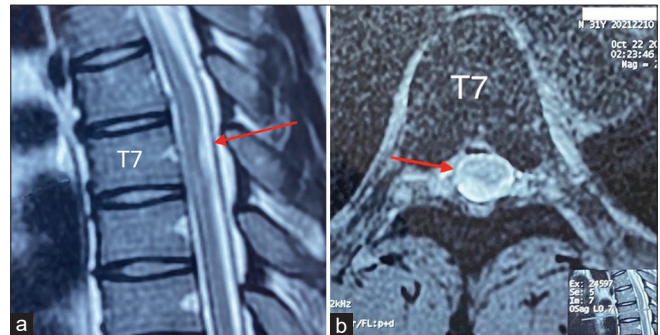
He underwent a thoracic magnetic resonance imaging (MRI) without contrast that showed spinal cord compression at the T7 level (i.e., cord displaced to the left on the axial images) due to a DAW. On the T2-weighted sagittal image, there was a sharp dorsal indentation of the spinal cord consistent with the positive “scalpel sign” [Figures 1a and b].

**Surgery**

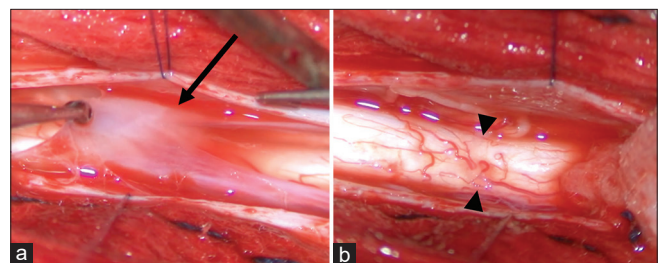
The patient underwent a T6-T8 laminectomy with preservation of the joints to avoid instability. The dura was exposed in the midline, and the arachnoid web (AW) was immediately visualized [Figure 2a]. The arachnoid band at the T7 level was carefully microdissected under a surgical microscope, and adherent fibrous tissue was carefully and meticulously removed freeing the cord [Figure 2b]. The T6-T8 fusion utilized fixed plates and titanium screws. The histological findings were consistent with a DAW and included low columnar epithelial cells and fibrous tissue but no malignant cells.

**Postoperative course**

Postoperatively, the numbness in the right leg decreased significantly, and the right leg muscle strength also improved



**Figure 1:** Preoperative magnetic resonance images obtained in the patient. T2-weighted sagittal (a) revealed a “scalpel sign” at the T7 segment (red arrow). The T7 axial image (b) showed spinal cord deviation (red arrow).



**Figure 2:** (a) Intraoperative visualization of the arachnoid web following a T7 durotomy to expose the web (arrow). (b) Indentation of the cord (arrowheads) following lysis of the arachnoid tissue band.

gradually. About 10 days after surgery, the incision healed well, and the patient walked with 5/5 muscle strength. The

patient returned to work after 1 month. MRI 6 months after surgery showed that the scalpel sign had disappeared, and the spinal cord was no longer deviated [Figure 3].

## DISCUSSION

### Clinical presentations

Patients with DAW typically present with: neurogenic back pain associated with myelopathy and/or radiculopathy, and potentially urinary incontinence. The physical examination frequently shows: motor deficits, hyperreflexia, sensory deficits, and cerebellar dysfunction.<sup>[2]</sup>

### Pathophysiology

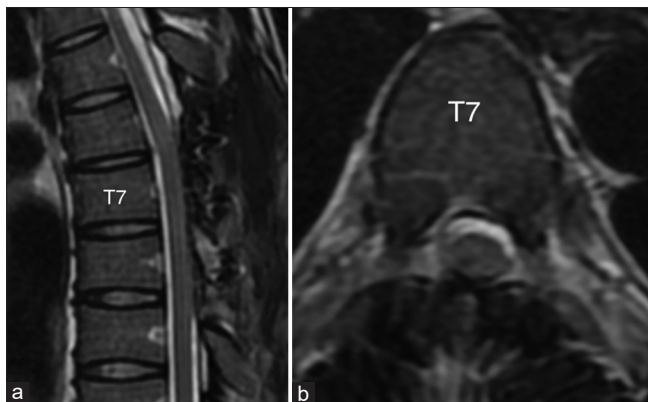
The mechanisms of AW formation remain unknown.<sup>[10]</sup> Several theories about the etiology include the strong outflow of cerebrospinal fluid (CSF) leads to arachnoid herniation into congenital, post-traumatic, post-infectious, and postoperative dural defects idiopathic DAW is still being proposed.<sup>[2]</sup>

### Histology

According to Chang *et al.*,<sup>[3]</sup> the histology of AW reveals connective tissue, a limited amount of asymptomatic calcification, and few CD3+ T cells. In his two cases, Inoue *et al.*<sup>[7]</sup> there was calcification, so the author assumed that there was arachnoiditis. In our case, only fibrosis of the arachnoid was seen, and no calcification was observed.

### DAW location and syrinx formation

The DAW webs are usually dorsal to the spinal cord in the thoracic region and occasionally occur with accompanying syrinx formation.<sup>[10]</sup> The prevailing belief is that increased pulse pressure in the subarachnoid space forces CSF through the spinal cord and into the syrinx.<sup>[2,11]</sup> Another mechanism



**Figure 3:** (a and b) Postoperative sagittal and axial magnetic resonance imaging showed vanished “scalpel sign” and no spinal cord deviation.

is the “one-way valve.” Using MRI in a cardiac-gated phase-contrast cine-mode, Chang *et al.* measured the CSF flow rate to verify CSF dynamics; this confirmed the one-way valve that enabled AW to compress the spinal cord.<sup>[3]</sup>

### MR findings of DAW

MRI is the primary tool for diagnosing DAWs. However, it is not very sensitive due to the relatively thin size of the web compared to adjacent tissue.

Features of DAW on MR include a thick fibrous band of arachnoid tissue in a dorsal and extramedullary location accompanied by focal dorsal cord compression that yields the positive “scalpel sign”, pathognomonic for DAW.<sup>[11]</sup> This image shows the compressed and deformed cord in combination with the enlargement of the CSF space that resembles a scalpel (i.e., its blade pointing posteriorly).<sup>[10]</sup> MRI with constructive interference in steady state has also been used to identify webs not readily seen on myelographic images.<sup>[4]</sup> MRI also helps to distinguish between spinal arachnoid web (SAW) and spinal cord herniation.<sup>[12]</sup>

### CINE — cardiac-gated phase-contrast cine-mode MR

The CINE MR may locate SAW and illustrate one-way CSF flow attributed to DAW.<sup>[3]</sup> Nada *et al.*<sup>[8]</sup> and Reardon *et al.*<sup>[10]</sup> both use this to demonstrate abnormalities in CSF flow dynamics and to help monitor treatment efficacy.

### Myelogram findings of DAW

The utility of the computed tomography myelogram is based on the theory that DAW partially obstructs CSF outflow. However, the DAW may also be missed in these studies.

### Time to diagnosis and treatment

Nisson *et al.*<sup>[9]</sup> reported that nearly half (47%) of patients had symptomatic DAW for 1 year or longer before surgical intervention (median time from symptom onset to treatment of 3.3 years, and that most would consider early surgery for symptomatic DAW. Surgical techniques for DAW include unilateral or bilateral thoracic laminectomy (84%), with minimally invasive procedures being utilized in a smaller 5% of cases. Other techniques have included endoscopic surgery, the placement of lumbar drainages, and/or shunts (i.e., shunt or stent placed in 17% of cases due to syrinxes of cases.<sup>[9]</sup>

### Outcomes of DAW

Several articles report on the effectiveness of surgery for DAW patients.<sup>[2,5,9]</sup> According to Nisson *et al.*, 91% of patients improved neurologically.<sup>[9]</sup> Hirai *et al.*<sup>[6]</sup> showed partial improvement in five cases.

## CONCLUSION

The SAW is a rare disease characterized on MRI by the positive “scalpel sign.” For patients with significant myelopathy, operative decompression of the DAW is warranted.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

## REFERENCES

- Aiyer R, El-Sherif Y, Voutsinas L. Dorsal thoracic arachnoid web presenting as neuropathic pain: ‘Scalpel’ sign found on MRI. *Neuroradiol J* 2016;29:393-5.
- Ben Ali H, Hamilton P, Zygmunt S, Yakoub KM. Spinal arachnoid web-a review article. *J Spine Surg* 2018;4:446-50.
- Chang HS, Nagai A, Oya S, Matsui T. Dorsal spinal arachnoid web diagnosed with the quantitative measurement of cerebrospinal fluid flow on magnetic resonance imaging. *J Neurosurg Spine* 2014;20:227-33.
- Grewal SS, Pirris SM, Vibhute PG, Gupta V. Identification of arachnoid web with a relatively novel magnetic resonance imaging technique. *Spine J* 2015;15:554-5.
- Hines T, Wang C, Duttlinger C, Thompson J, Watford K, Motley B, *et al.* Thoracic dorsal arachnoid web with rapid onset of symptoms: A report of two cases and brief review of the literature. *Surg Neurol Int* 2021;12:323.
- Hirai T, Taniyama T, Yoshii T, Mizuno K, Okamoto M, Inose H, *et al.* Clinical outcomes of surgical treatment for arachnoid web: A case series. *Spine Surg Relat Res* 2019;3:43-8.
- Inoue J, Miyakoshi N, Hongo M, Kobayashi T, Abe T, Kikuchi K, *et al.* Diagnosis and surgical treatment of thoracic dorsal arachnoid web: A report of two cases. *Case Rep Orthop* 2020;2020:8816598.
- Nada A, Mahdi E, Mahmoud E, Cousins J, Ahsan H, Leiva-Salinas C. Multi-modality imaging evaluation of the dorsal arachnoid web. *Neuroradiol J* 2020;33:508-16.
- Nisson PL, Hussain I, Härtl R, Kim S, Baaj AA. Arachnoid web of the spine: A systematic literature review. *J Neurosurg Spine* 2019;31:175-84.
- Reardon MA, Raghavan P, Carpenter-Bailey K, Mukherjee S, Smith JS, Matsumoto JA, *et al.* Dorsal thoracic arachnoid web and the “scalpel sign”: A distinct clinical-radiologic entity. *AJNR Am J Neuroradiol* 2013;34:1104-10.
- Sayal PP, Zafar A, Carroll TA. Syringomyelia secondary to “occult” dorsal arachnoid webs: Report of two cases with review of literature. *J Craniovertebr Junction Spine* 2016;7:101-4.
- Schultz R Jr, Steven A, Wessell A, Fischbein N, Sansur CA, Gandhi D, *et al.* Differentiation of idiopathic spinal cord herniation from dorsal arachnoid webs on MRI and CT myelography. *J Neurosurg Spine* 2017;26:754-9.
- Sridharan A, Heilman CB. Transverse dorsal arachnoid web and syringomyelia: Case report. *Neurosurgery* 2009;65:E216-7; discussion E217.
- Wali AR, Birk HS, Martin J, Santiago-Dieppa DR, Ciacci J. Neurosurgical management of a thoracic dorsal arachnoid web: Case illustration. *Cureus* 2019;11:e4945.

**How to cite this article:** Tran TD, Vo PD, Truong TV, Ho TD. A case of neurosurgical treatment of thoracic dorsal arachnoid web. *Surg Neurol Int* 2023;14:210.

### Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Journal or its management. The information contained in this article should not be considered to be medical advice; patients should consult their own physicians for advice as to their specific medical needs.