HENRY FORD HEALTH®

The Scalpel Sign: Imaging Findings of Dorsal Arachnoid Web

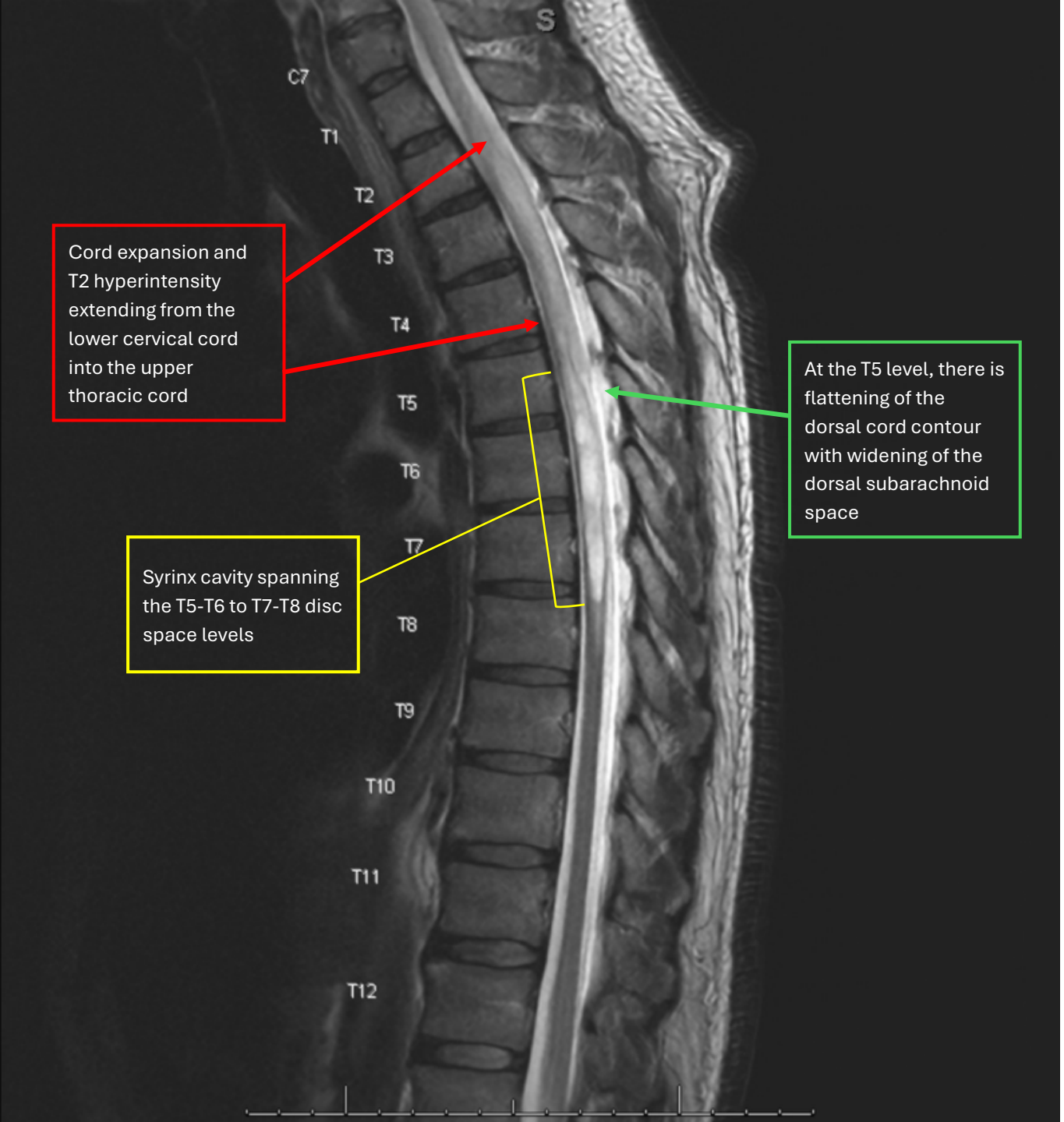
Mohull Mehta BS[1], Maliyan Binette MD[2], Pranav Doshi MD[2]

[1]Wayne State University School of Medicine

[2]Henry Ford Hospital Department of Radiology

Clinical Presentation

- 50 yo. M with chronic mid-back pain for several years
- Progressive numbness affecting his torso, bilateral shoulders, and more recently involving upper left thigh
- Occasional pins and needle sensation
- Denies weakness, falls, or bowel/bladder incontinence



Imaging Discussion

- **Figure 1: Sagittal T2-weighted MRI of the thoracic spine**
- At the T5 level, there is flattening of the dorsal cord contour with widening of the dorsal subarachnoid space (green), raising suspicion for a dorsal arachnoid web

HENRY FORD HEALTH®

Imaging Discussion

- To further characterize the dorsal cord indentation, CT myelogram was obtained:
- **Figure 2: Sagittal CT myelogram of the thoracic and lumbar spine**
- Demonstrates posterior indentation and anterior displacement of the spinal cord just below the level of T4-T5 (blue arrow)



Imaging Discussion

- Dorsal arachnoid webs are thickened bands of arachnoid tissue that occur almost exclusively in the dorsal thoracic subarachnoid space, with up to 87% located between T2 and T6[6]
- **Hallmark imaging finding is the "scalpel sign”**
  - a focal, abrupt dorsal indentation of the spinal cord on sagittal MRI or CT myelography that resembles the blade of a scalpel[1]
- The web itself is not directly visualized on conventional imaging
  - Instead, the scalpel sign reflects displacement of the spinal cord caused by the overlying thickened arachnoid band[7]

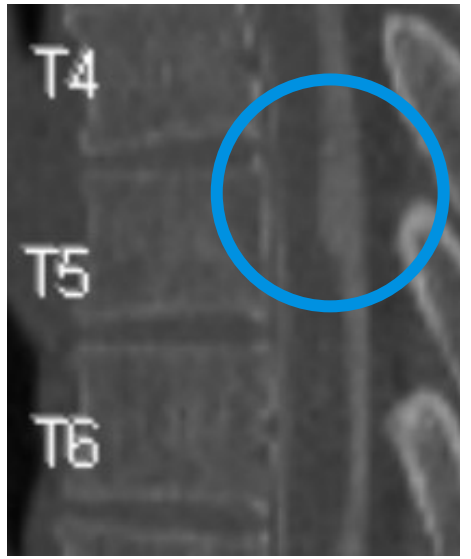


Figure 2: Sagittal CT myelogram of the thoracic and lumbar spine



Imaging Discussion

- Cord expansion and T2 signal change are supportive but nonspecific[1]
- Most patients also demonstrate associated syringomyelia, thought to result from CSF outflow obstruction by the web leading to progressive cord expansion and syrinx formation[7]
- Compared to MRI, CT myelography provides superior spatial resolution of the thecal sac and is often performed following MRI to further characterize the abnormality and assist with surgical planning

Differential Diagnosis for **focal anterior displacement of the spinal cord**

Dorsal thoracic arachnoid web

- Abrupt dorsal "scalpel indentation"
- **preserved** ventral subarachnoid space
- associated syringomyelia
- no enhancement

Idiopathic spinal cord herniation

- broad, **C-shaped** dorsal contour
- **interrupted** ventral subarachnoid space (ventral herniation through dural defect)
- commonly presents with Brown-Séquard syndrome[3]

Adhesive arachnoiditis

- inflammatory scarring of arachnoid membrane
- identifiable cause (infection, trauma, SAH)
- can see nerve root clumping & enhancement, septations, and loculated CSF collections[5]

Arachnoid cyst

- CSF-filled sacs spanning multiple vertebral levels
- filling defect on CT myelography (not seen in arachnoid web)[4]

Clinical Features

- Dorsal arachnoid webs are rare intradural extramedullary bands of arachnoid tissue with uncertain etiology
- Mean age at presentation is 50 years with a slight male predominance[1]
- Patients typically present with progressive myelopathy, focal thoracic back pain, lower extremity weakness, numbness and sensory changes, and lower extremity radicular pain[2]
- Upper extremity symptoms, including weakness and radicular pain, may also occur, particularly in more extensive or higher thoracic lesions[2]
- Some webs demonstrate a one-way ("ball-valve") CSF flow mechanism, allowing CSF passage in one direction but not the other, which contributes to focal cord compression and syrinx formation[7]

Management

- Classic imaging findings + progressive symptoms → definitive surgery
- **Laminectomy with intradural exploration and web excision is often curative** for dorsal arachnoid webs[2]
- Intraoperative ultrasound is a useful adjunct to localize the web and confirm restored CSF flow

Outcome

- Given the classic imaging findings of a dorsal arachnoid web and progressive symptomatology, the patient was taken for definitive surgical treatment
  - Underwent T4–T7 laminectomy with intradural exploration for excision/release of the arachnoid band/cyst, subarachnoid shunt placement, and duraplasty
- Surgery was uncomplicated
- Postoperatively, reported improvement in pain

Take Home Points

- Spinal arachnoid webs are a rare, underrecognized cause of thoracic myelopathy that can be misdiagnosed as idiopathic spinal cord herniation or arachnoid cyst, potentially leading to inappropriate surgical planning[1]
- This case demonstrates the pathognomonic "scalpel sign" of a dorsal arachnoid web
- **Up to 39% of patients with arachnoid webs have undergone a previous unsuccessful surgery at a different spinal level before the correct diagnosis was made**[2]
- Radiologists should routinely inspect sagittal thoracic spine imaging for the scalpel sign to enable early surgical management

References

1. Delgardo M, Higgins D, McCormick KL, Reid P, Canoll P, McCormick PC. Clinical Characteristics, Outcomes, and Pathology Analysis in Patients With Dorsal Arachnoid Web. Neurosurgery. 2022;90(5):581-587. doi:10.1227/neu.0000000000001884
2. Laxpati N, Malcolm JG, Tsemo GB, et al. Spinal Arachnoid Webs: Presentation, Natural History, and Outcomes in 38 Patients. Neurosurgery. 2021;89(5):917-927. doi:10.1093/neuros/nyab321
3. Schultz R Jr, Steven A, Wessell A, et al. Differentiation of idiopathic spinal cord herniation from dorsal arachnoid webs on MRI and CT myelography. J Neurosurg Spine. 2017;26(6):754-759. doi:10.3171/2016.11.SPINE16696
4. French H, Somasundaram A, Biggs M, et al. Idiopathic intradural dorsal thoracic arachnoid cysts: A case series and review of the literature. J Clin Neurosci. 2017;40:147-152. doi:10.1016/j.jocn.2017.02.051
5. Anderson TL, Morris JM, Wald JT, Kotsenas AL. Imaging Appearance of Advanced Chronic Adhesive Arachnoiditis: A Retrospective Review. AJR Am J Roentgenol. 2017;209(3):648-655. doi:10.2214/AJR.16.16704
6. Elkadi S, Kraus A, Krisanda E, Sayah A. Spinal arachnoid webs in adults: Clinical and imaging features in a multicenter study. J Neuroimaging. 2023;33(2):235-239. doi:10.1111/jon.13086
7. Reardon MA, Raghavan P, Carpenter-Bailey K, et al. Dorsal thoracic arachnoid web and the "scalpel sign": a distinct clinical-radiologic entity. AJNR Am J Neuroradiol. 2013;34(5):1104-1110. doi:10.3174/ajnr.A3432