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REVIEW

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Spinal arachnoid web: a systematic review of a rare entity, with two illustrative case reports

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Abstract

Background Spinal arachnoid web (AW) is a very rare entity, with a limited number of cases documented in the literature. Our manuscript represented a comprehensive general review, encompassing various aspects of the subject matter without focusing on any single element. The objective of this systematic review was to describe and analyze reported cases of surgically proven spinal arachnoid webs (AWs) to elucidate their imaging and clinical features, pathophysiology, and optimal management strategies, and to determine the total number of documented cases in the literature. Patterns and commonalities across reported cases were identified to provide a clearer framework for diagnosing and treating this elusive condition. A search of Web of Science, PubMed, and Scopus, respecting PRISMA guidelines, was conducted to include reported cases of surgically proven spinal AW. Our surgically proven case was included as well.

Main body of the abstract The search yielded 196 cases of surgically confirmed spinal AWs in the literature. Adding our case, the total is 197. They are seen commonly in middle-aged patients, slightly more prevalent in males, and often without an evident cause. Sensation disturbances were the most frequently found clinical signs, followed by gait difficulties, weakness, and pain. Symptoms were predominantly located in the lower limbs and trunk. On imaging, an indentation to the rear aspect of the spinal cord was most frequently found at the mid-thorax followed by the upper thorax, often associated with a syrinx or a hyperintense T2 cord signal, usually extending rostrally. Excision was the most efficient treatment.

Short conclusion The assessment found that AW cases are rare in the literature, indicating the disease's scarcity. It manifests insidiously, with the shortest latency reported being 2 weeks. Upper limb symptoms occur in a quarter of cases regardless of the AW's thoracic location, likely due to rostral syrinx and cerebrospinal fluid flow disturbances. Most pathology results revealed fibrous connective tissue, similar to findings in arachnoid cysts, suggesting that AW may result from a ruptured arachnoid cyst or its precursor. Using 3D SPACE STIR and CISS MRI sequences is recommended to visualize the arachnoid band directly.

Keywords Arachnoid web, Spinal cord compression, Syringomyelia, MRI

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Background

Arachnoid web (AW) is a thickened arachnoid membrane that attaches to both the dura and pia mater of the spinal cord [1, 2]. It alters the normal flow of the cerebrospinal fluid (CSF) within the subarachnoid space (SAS) and compresses the spinal cord [1, 2]. This condition correlates with a progressive compromise of the neurological function, significantly impacting the patient's quality of life [3, 4].

First described by Mallucci et al. [5] in 1997, AW has since been documented in a limited number of case reports and small case series. The most extensive examination of surgically confirmed AW patients to date was published in 2019 by Nisson et al. [3] and identified only 43 cases. Given the limited number of cases and the lack of comprehensive reviews integrating clinical, imaging, and histopathological data, there is a critical need for a systematic review to better understand AW and guide effective management strategies.

In light of our illustrative cases and systematic literature review, we compile and analyze reported cases of surgically proven spinal AWs to determine the total number of documented cases in the literature, elucidate their clinical features, evaluate the role significance of magnetic resonance imaging (MRI) in establishing an accurate diagnosis, determine optimal management strategies, and discuss the pathophysiology of the disease which remains poorly understood. By identifying patterns and commonalities across reported cases, we aim to provide a clearer framework for understanding, diagnosing, and treating this elusive condition.

Our manuscript represents a comprehensive general review, as it encompasses various aspects of the subject matter without singular focus on any specific element. Specifically, our systematic literature review provides the most comprehensive analysis of surgically treated AW patients to date, integrating a surgically managed case from our own institution.

Main text

Methods

Study selection

A literature search was carried out on Web of Science, PubMed, and Scopus databases respecting the PRISMA (Preferred reporting items for systematic reviews and meta-analyses) guidelines. Publications were sought using these keywords: "arachnoid web", "spinal arachnoid web", "dorsal arachnoid web", and "arachnoid pouch". The search encompassed all articles published up to December 2023.

Inclusion and exclusion criteria

Cases were included in this systematic review if spinal AW was confirmed surgically. Only human studies were considered, specifically individual case reports and case series documenting surgically confirmed AW. Furthermore, only articles written in English were included.

Excluded studies comprised reviews of the literature, animal studies, in addition to articles reporting AWs located in the intracranial region. Additionally, non-English articles and duplicate studies were excluded.

The initial screening process involved reviewing the titles and abstracts of all retrieved articles to identify studies that clearly met the exclusion criteria. Articles that passed this initial screening underwent a full-text review to confirm the presence of surgically confirmed spinal AW and to ensure they met all the inclusion criteria.

Data extraction

Data were extracted directly from the full text of records of fitting articles.

Collected information encompassed author, year, age, sex, medical history, symptom onset, clinical findings, MRI findings, type of surgery, outcome, follow-up time, and pathology results. However, not every article presented information about each individual aspect. Additionally, one case managed surgically at our institution was included in the analysis. The acquired images were independently reviewed by three radiologists with 4 years, 13 years, and 38 years of experience, respectively.

Two cases presentation

Case No.1 (with surgical management) is a 62 year-old female patient, with an unremarkable medical history, presented with progressive gait difficulties (GD) and sphincter function disorders that have been progressing for 11 months. The physical examination revealed reduced muscle power in both lower limbs (LL), with a strength of 4/5 in the right and 3/5 in the left according to the Medical Research Council scale of muscle power, as well as a disturbance of deep sensation of the left lower limb. Furthermore, hyperreflexia and positive bilateral plantar reflex were also found. The rest of the physical examination was unremarkable. The biological work-up showed no abnormality.

Magnetic resonance imaging (MRI) was performed using sagittal T2WI spin echo, T1WI spin echo, and STIR (Short tau inversion recovery), in addition to axial T2WI and 3D SPACE (Sampling perfection with application optimized contrast using different flip angle evolution) STIR sequences. The MRI revealed an indentation on the rear side of the spinal cord at the T5 level. This indentation was particularly abrupt at its upper point, resembling the shape of a surgical scalpel blade (scalpel sign), enlarging the posterior subarachnoid space (SAS). This was accompanied by the presence of a thin transverse band in the posterior SAS, which was attached to the spinal cord and displayed a hypointense signal visible on both axial and sagittal 3D SPACE STIR sequence (Fig. 1). A flow artifact was observed in the posterior SAS at the level of the medullary indentation, and the anterior subarachnoid space was preserved. These findings prompted the diagnosis of spinal AW.

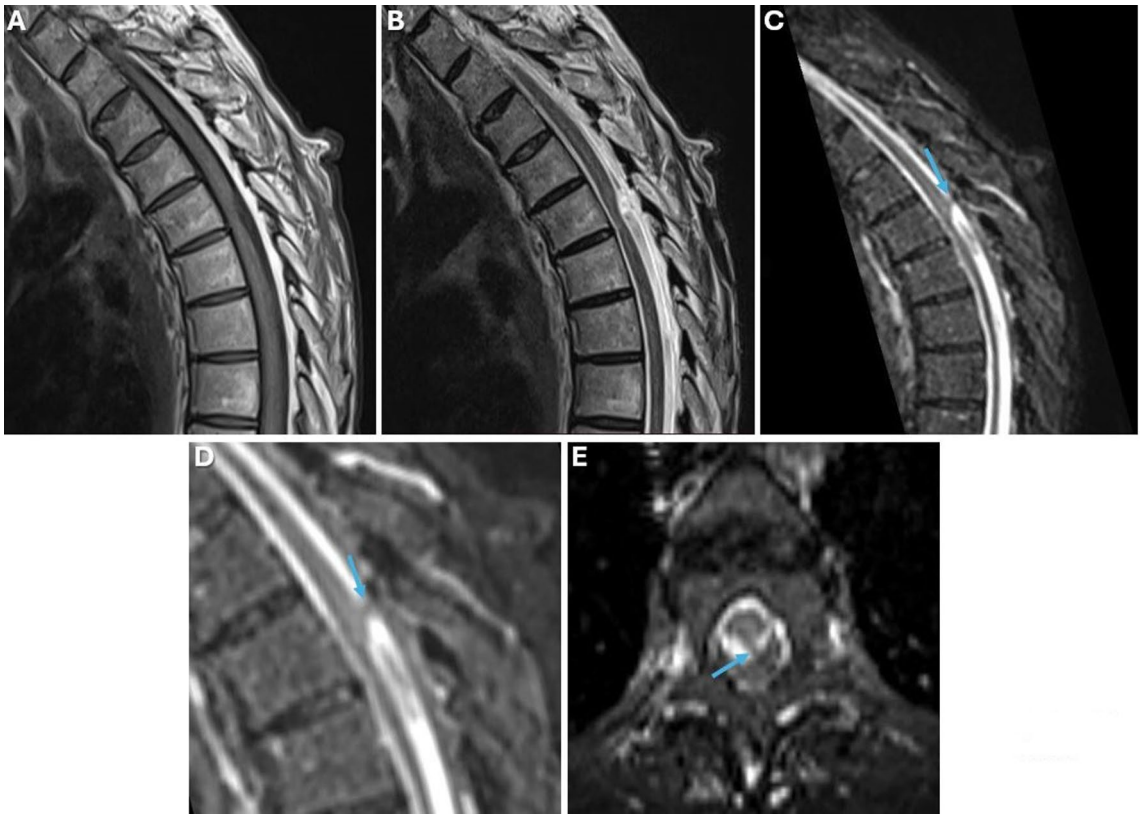

Fig. 1 Sagittal T1WI (**A**), T2WI (**B**), sagittal 3D SPACE STIR (**C**), zoomed in sagittal (**D**), and axial (**E**) 3D SPACE STIR images of a 62 year-old female patient with an unremarkable medical history, presenting with progressive gait difficulties and sphincter dysfunction for 11 months, showing the "scalpel sign" (**A** and **B**), and direct visualization of AW (**C**, **D**, and **E**, arrow)

The patient was referred to neurosurgery and benefited from a surgical intervention. A laminectomy was performed from T3 to T6, with excision of the thickened arachnoid membrane (Fig. 2). The patient's symptoms subsequently improved within the 1st day postsurgery, with a recovery in walking capability and sphincter function.

The patient presented with a recurrence of lower limbs symptoms 5 months after the surgery. She reported that during the preceding months, she had returned to normal physical activity and exercise, walking multiple miles per day, before experiencing the recurrence of lower limbs symptoms. Magnetic resonance imaging was performed, revealing the disappearance of the dorsal cord indentation and the appearance of a T4 subchondral fracture, as well as a T5–T6 intervertebral disk herniation with a ventral cord indentation associated with a hyperintense T2 cord signal (Fig. 3). The resumption of intense physical activity by the patient shortly after surgery, following a prolonged period of paraparesis, likely contributed to the development of the subchondral fracture and disk herniation. The patient was managed conservatively and exhibited good clinical improvement.

Case No.2 (with no surgical management) is a 45 year-old male patient, with no notable history, presented with gradually worsening gait difficulties and tetraparesis for 8 months. The physical examination found a reduced muscle power with a strength of 3/5 in the lower limbs and of 4/5 in the upper limbs, hyperreflexia, and a positive plantar reflex bilaterally. There were no sensory disturbances, and the rest of the physical examination was normal. The biological work-up showed no anomalies.

Magnetic resonance imaging of the spine was conducted using sagittal T2WI spin echo, T1WI spin echo, and STIR, in addition to axial T2 sequences. The MRI revealed a scalpel-like indentation on the dorsal aspect of the spinal cord at the level of T3. A flow artifact was presented in the SAS at the level of the medullary indentation, and the anterior SAS was preserved. Furthermore, an intramedullary hyperintense signal abnormality right above the medullary indentation was observed on both T1 and especially on T2-weighted sequences (Fig. 4). A diagnosis of spinal AW was made based on these findings. The patient did not benefit yet from surgery.

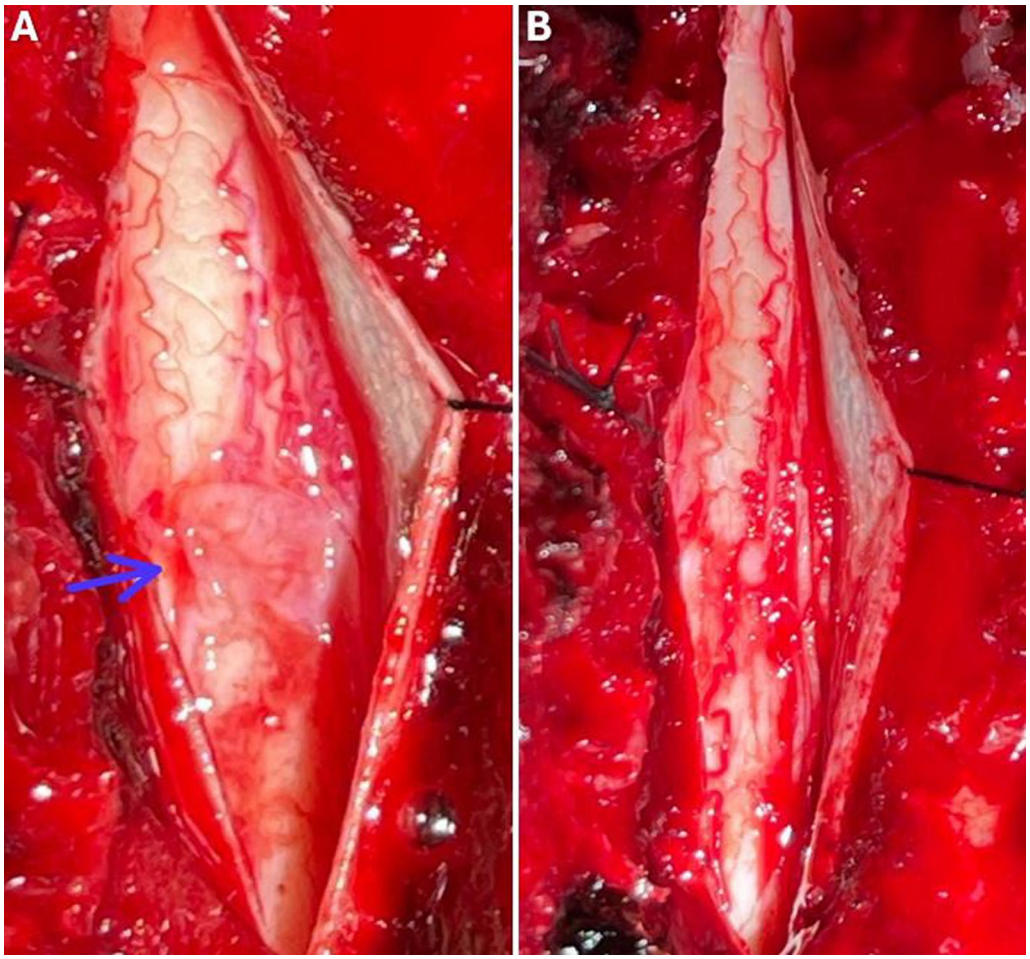

Fig. 2 Operative image of AW of the same case, before excision (**A**, arrow) and after excision (**B**)

Review of the literature

The literature search for our systematic review yielded 291 articles. Their title and abstract were screened looking for articles reporting cases of arachnoid web. Then, after excluding cases that were not confirmed surgically, we kept 60 articles reporting 196 cases of AW (Fig. 5), which we summarized in Table 1, in addition to one surgically managed patient from our institution, totaling 197 patients whose characteristics are summarized in Table 2 [1–62].

The age range among patients varied from 24 to 81 years, averaging 55.6 years, with 61.4% of the patients being male.

A history of trauma, surgery, multiple sclerosis (MS), was found, respectively, in 9.94%, 4.42%, and 1.66% of cases.

Average symptom onset was 31 months (range: 0.25–240 months), with 68% of patients having a symptom onset of 1 year or more.

The clinical signs were predominantly sensation disturbances (68.50%), pain (64.64%), and motor weakness (60.22%), including four cases with fine motor hand difficulties. Additionally, GD was presented in 52.48% of cases, including three instances of intermittent claudication. Sphincter disturbances were noted in 22.10% of cases, hyperreflexia in 25.97%, and hyporeflexia (3.31%). Symptoms were localized to the lower limbs in 69.61% of cases, the trunk in 37.56%, and the upper limbs (UL) in 25.41%. Among patients with UL symptoms, 51.85% had a syrinx extending to the cervical spine.

The level of posterior cord indentation was described in 171 cases. It was located in the cervical spine (C7) in 1 case (0.58%), in the upper thoracic spine (from the first

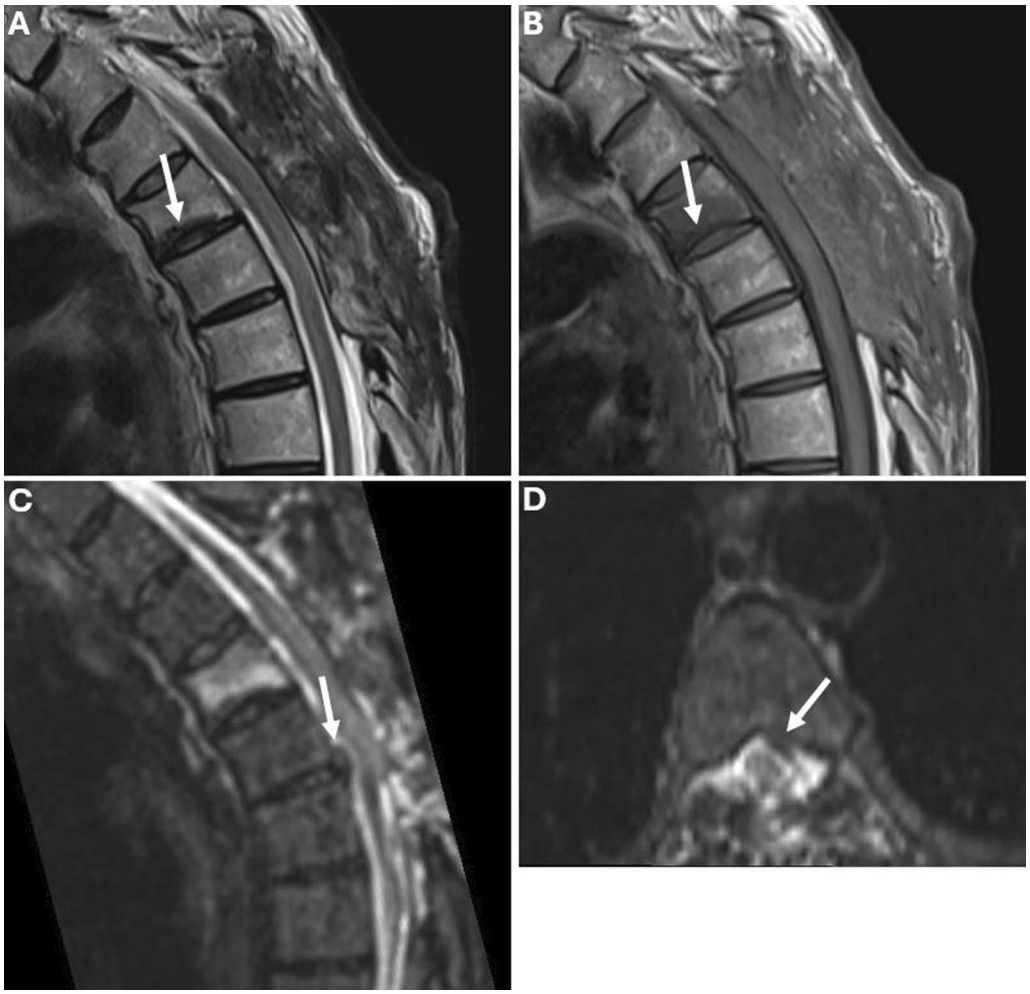

Fig. 3 Sagittal T2WI (**A**), sagittal T1WI (**B**), sagittal (**C**), and axial (**D**) 3D SPACE STIR images obtained 5 months postoperatively, showing T3–T6 laminectomies with subchondral fracture of the T4 inferior end plate (**A** and **B**, arrow), and the T5–T6 intervertebral hernia (**C** and **D**, arrow), associated with ventral cord indentation and hyperintense T2 cord signal

thoracic vertebra to the inferior end plate of the fourth thoracic vertebra) in 45% of cases, in the mid thoracic spine (from T5 to the inferior end plate of T8) in 52.63% of cases, and in the lower thoracic spine (from T9 to the inferior end plate of T12) in 1.75% of cases (Fig. 6).

Syrinx or cord T2 hypersignal was found in 75.13% of cases, extending rostrally in 62.62% of cases, caudally in 29.90%, both in 5.61%, and at the same level of indentation in 11.21% of cases.

Surgical techniques consisted of excision of AW in all cases except for two patients where only syringopleural shunt was performed (these two patients showed no clinical improvement).

Excision of AW with laminectomy was performed in almost all cases. And approaches other than laminectomy were noted in 11 cases, namely hemilaminectomy in eight cases and minimally invasive surgery (laminotomy) in three cases. Treatments associated with excision included stent placement (four cases), myelotomy (two cases), syringopleural shunt (three cases), and syringo-subarachnoid shunt (one case).

Postoperative clinical improvement was observed in 90.64% of patients, with a mean follow-up of 14.55 months (range: 1–109.2 months). Postoperative complications were reported in only three patients, specifically one case of epidural hematoma and two cases of cerebrospinal fluid leak with pseudomeningocele.

Pathology results revealed mostly fibrous connective tissue, which is bordered sometimes by arachnoid cells or meningothelial cells, with CD3-positive T cells found in two cases.

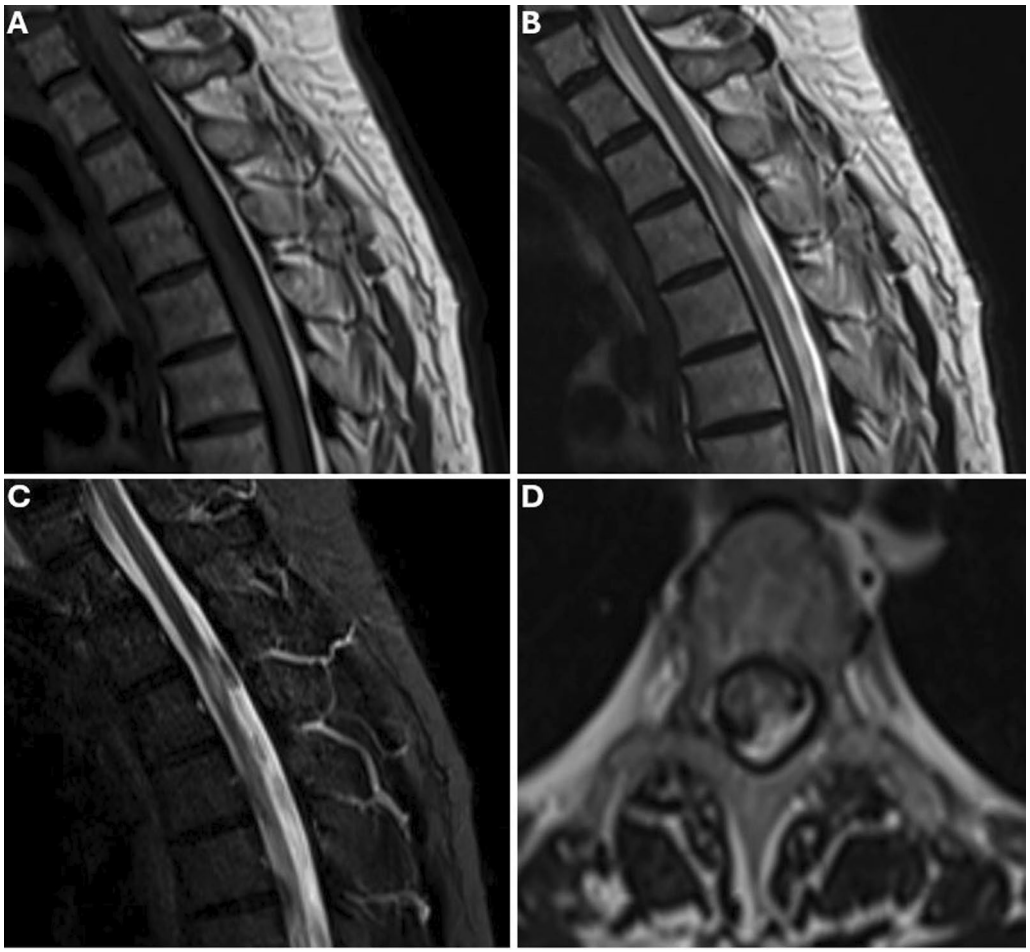

Fig. 4 Sagittal T1WI (**A**), T2WI (**B**), sagittal STIR (**C**), and axial T2WI (**D**) images of a 45-year-old male patient (our second case report) with no notable history, presenting with gradually worsening gait difficulties and tetraparesis for 8 months, showing the "scalpel sign", associated with hyperintense T2 cord signal extending rostrally. The rear spinal cord indentation was slightly lateralized to the left side (**D**)

Discussion

Arachnoid webs are a relatively rare but clinically significant pathology of the spine. Despite their rarity, AWs can lead to significant morbidity due to their propensity to cause spinal cord compression and subsequent neurological deficits [3, 4].

This discussion synthesizes findings, providing a comprehensive overview of the current understanding of this condition. The aim of this review was to consolidate and analyze the available data from the literature to elucidate the pathophysiology, clinical presentation, diagnostic imaging features, and treatment outcomes associated with AWs. This synthesis of evidence from reported cases aims to enhance understanding and provide valuable insights into the natural history and optimal management of this uncommon yet impactful spinal disorder.

Arachnoid webs are characterized by fibroconnective adhesions [2, 4, 19, 38], whose pathophysiology is not well understood but is possibly the result of a known or insidious segmental inflammation of the arachnoid mater or the intermediate leptomeninges. This inflammation can be a consequence of various factors, including trauma, surgery, hemorrhage, and infection [33, 51]. Other factors may be involved, such as a history of systemic inflammation, the use of an intrathecal pain pump, or myelitis (multiple sclerosis or transverse myelitis) [3, 11, 36]. It has also been suggested that AWs could result from a ruptured arachnoid cyst [1, 33, 51], as shown in a case report that found a thickened arachnoid membrane expanding like a septum within an adjacent arachnoid cyst [18]. Delgardo et al. [22] reported the largest series of histology results for AW, with 16 cases having available

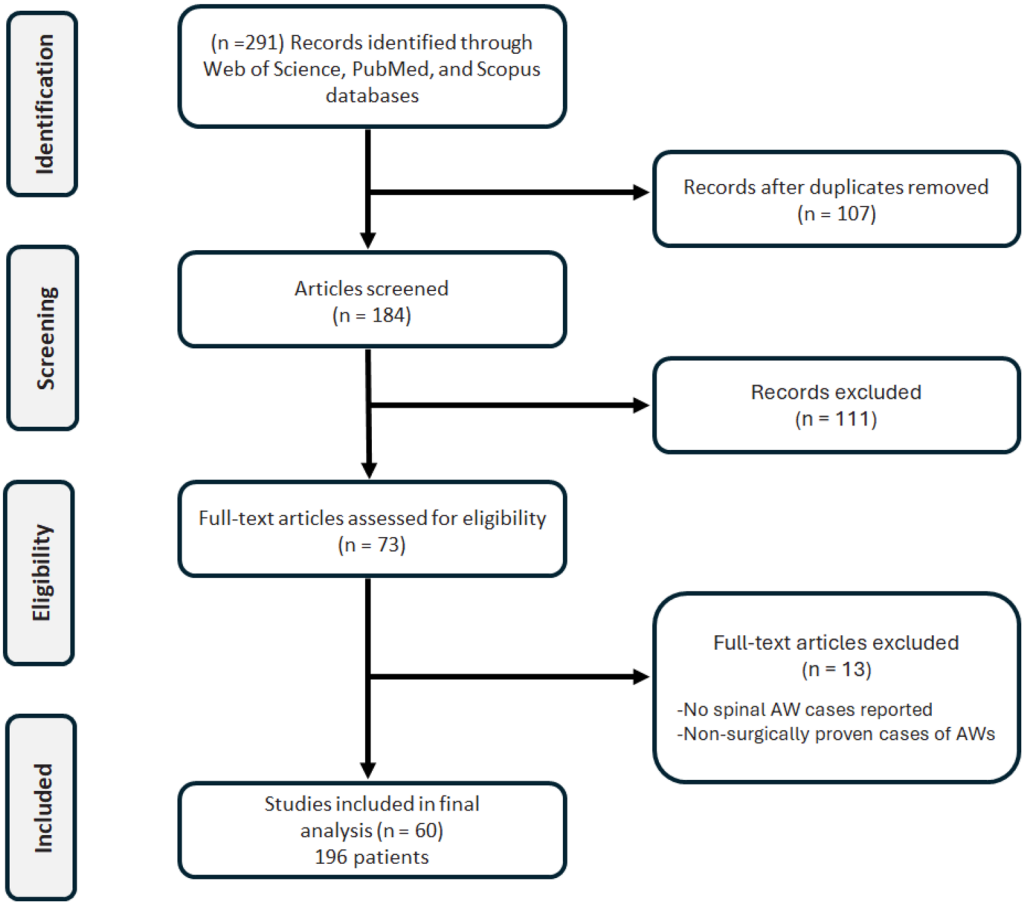

Fig. 5 Flow chart of the literature search strategy and article selection

histology data. Fibrous connective (collagenous) tissue was found in all cases, associated with meningothelial cells in 10 cases, arachnoid cells in one case, and calcifications in three cases. Others reported the presence of a small number of infiltrating CD3-positive T cells, suggesting an inflammatory process [10, 58].

In our review, most pathology results revealed fibrous connective tissue, lined sometimes by meningothelial cells or arachnoid cells. This is similar to the pathology findings in arachnoid cysts, supporting the hypotheses that AW might be resulted from a ruptured arachnoid cyst or be its precursor very likely.

Arachnoid webs were observed in the adult middle-aged population with a mean age of 55.3 years and male predominance. They were typically located in the upper or mid thoracic spine (97.63% of cases) within the dorsal subarachnoid space. These findings align closely with those reported in the review by Nisson et al. [3]. Additionally, three cases reported the presence of AW in the lower thoracic spine, while one case documented their occurrence in the cervical spine.

The latency between the onset of symptoms and consultation was 1 year or more in most cases (68%), attributed to the gradual progression of symptoms. This percentage is higher than the 47% reported by Nisson et al. [3]. The shortest latency reported in the literature, however, was 2 weeks [3, 4, 43].

The clinical signs are linked to cord compression; patients commonly note sensation disorders, followed by pain, weakness, gait disturbances, and sphincter disorders. These findings differ from those of Nisson et al. [3], who reported weakness as the most common symptom, followed by sensation disorders, with pain being less frequently reported. The lower limbs tend to be the most frequently involved with symptoms (69.61%) due to the high frequency of the thoracic location of AW, followed by the trunk and then the upper limbs, consistent with the findings of Nisson et al. [3].

We noted a trend when it comes to patients presenting with upper limbs symptoms, as most of them (51.85%) had a syrinx reaching up to the cervical spine. Laxpati et al. [30], in the other hand, noted that more

Table 1 Summary of articles included in the systematic review [1–62]

Author and year	Number of surgically confirmed cases
Our present case	1
Derouen K et al. [6]	2
Castillo JA et al. [7]	1
Bugdadi A [8]	12
Tran TDD et al. [9]	1
Adib SD et al. [10]	3
Suzuki YI et al. [11]	1
Nakamura S et al. [12]	2
Keister A et al. [13]	1
Elkadi S et al. [14]	26
Mittal AM et al. [15]	2
Krishnan P et al. [16]	1
Bamba Y et al. [17]	1
Kawaguchi H et al. [18]	1
Buntting CS et al. [19]	1
Arora V et al. [2]	1
Nieves-Ríos C et al. [20]	1
Nagashima Y et al. [21]	1
Delgardo M et al. [22]	17
Morrison T et al. [23]	3
Bertholon S et al. [24]	2
Voglis S et al. [25]	12
Ruella M et al. [26]	2
Buttiens A et al. [27]	1
Zhao Z et al. [28]	1
Dauleac C et al. [29]	1
Laxpati N et al. [30]	26
Hines T et al. [4]	2
Rodrigues AB et al. [31]	2
Ramos-Fresnedo A et al. [32]	1
Hamilton P et al. [33]	1
Yamamoto A et al. [34]	1
Pham N et al. [35]	1
Agarwal P et al. [36]	1
Andrews JP et al. [37]	1
Nada A et al. [38]	5
Inoue J et al. [39]	2
Aljuboori Z et al. [40, 41]	1
Brasil PM et al. [42]	1
Hussain I et al. [43]	1
Wali AR et al. [44]	1
Nisson PL et al. [3]	2
Hirai T et al. [45]	5
Kovai P et al. [46]	1
Vergara P et al. [47]	2
Fujiwara Y et al. [48]	1
Ali HB et al. [49]	1
Hubbard ME et al. [50]	1
Zhang D et al. [51]	3
Schultz R et al. [52]	6
Ruschel LG et al. [53]	1
Sayal P et al. [54]	2
Yamaguchi S et al. [55]	2
Grewal SS et al. [56]	1
Jayabal J et al. [57]	1
Chang HS et al. [58]	2
Reardon MA et al. [59]	5
Gottschalk A et al. [60]	1
Sridharan A et al. [61]	1
Brodbelt AR et al. [62]	3
Paramore CG et al. [1]	2
Mallucci CL et al. [5]	9

superiorly located AWs were more frequently causing upper extremity symptoms, however, we did not find a similar trend in our review, since only 29.6% of patients with upper limbs symptoms had a compression located at the level of T3 or above. The mechanisms underlying the upper limb symptoms in cases of AW without cervical syrinx are not well understood; nevertheless, they may result from subtle changes in cerebrospinal fluid flow within the ependymal canal above the AW, leading to mild compression of the medial aspect of the spinothalamic and corticospinal tracts, where upper limb axons are located more medially compared to thoracic, lumbar, and lower limb axons (Fig. 7).

Imaging is the gold standard for establishing the diagnosis, by showing a scalpel-shaped indentation on the rear aspect of the spinal cord on the sagittal plane, which is a highly specific (but not pathognomonic) indirect sign for AW, with typically a preserved anterior SAS [19, 26, 40]. To note, the scalpel sign can have a more abrupt upper point or, less commonly, a more abrupt lower point [59]. This sign can be visible on MRI or computed tomography (CT) myelography, the latter should only be performed if MRI did not provide answers (due to the invasive nature of CT myelogram) [27, 54, 59]. The scalpel sign is not always presented, as cases of AW with a "C"-shaped dorsal indentation or with no indentation at all on MRI have been reported [54, 58, 63]. CT myelography, although more invasive, may be a more sensitive tool to perceive the location of the AW. An air bubble unintentionally introduced into the subarachnoid space

Table 2 Summary of patient's characteristics

Variable	Number (percentage) [Range]
Number of cases	197
Age	Mean: 55,6 year [24–81]
Sexe	
Male	116/189 (61.4%)
Female	73/189 (38.6%)
History	
Trauma	18/181 (9.94%)
Surgery	8/181 (4.42%)
MS	3/181 (1.66%)
Mixed connective tissue disorder	2/181 (1.1%)
Corticoid responsive myelopathy	1/181 (0.55%)
Systemic inflammation	1/181 (0.55%)
Subarachnoid hemorrhage	1/181 (0.55%)
Intrathecal pain pump	1/181 (0.55%)
Tethered cord syndrome	1/181 (0.55%)
Postlyme disease	1/181 (0.55%)
Symptom onset	Mean: 31 months [0.25–240]
Localization of symptoms	
Trunk	68/181 (37.56%)
UL	46/181 (25.41%)
LL	126/181 (69.61%)
Type of symptoms	
Sensation disturbances	124/181 (68.50%)
Pain	117/181 (64.64%)
Motor weakness	109/181 (60.22%)
GD	95/181 (52.48%)
Sphincter disturbances	40/181 (22.1%)
Hyperreflexia	47/181 (25.97%)
Hyporeflexia	6/181 (3.31%)
Level of cord indentation	
Cervical	1/171 (0.58%)
Upper thorax (T1-T4)	77/171 (45%)
Mid-thorax (T5-T8)	90/171 (52.63%)
Lower thorax (T9-T12)	3/171 (1.75%)
Syrinx/Cord T2 hypersignal	
Present	142/189 (75.13%)
Absent	47/189 (24.86%)
Syrinx/Cord T2 hypersignal topography in relation with cord indentation:	
→Location was not described-in	35/142 (24.65%)
→Location was described-in	107/142 (75.35%)
Extending rostrally	67/107 (62.62%)
Extending caudally	32/107 (29.90%)
Extending both rostrally and caudally	6/107 (5.61%)
At the same level of indentation	12/107 (11.21%)
Postoperative clinical improvement	155/171 (90.64%)
Follow-up	14.55 months [1–109.2]

during the procedure can become trapped at the level of the AW, providing a clue to its location [54].

The direct visualization of the AW is only possible on MRI in a minority of cases, it is especially possible on 3D T2 sequences or constructive interference in steady state (CISS) sequences [10, 25, 38, 49]. It manifests as an intradural extramedullary thin transverse band, attached to the dorsal aspect of the spinal cord, displaying a hypointense signal on T2 sequences [38, 49]. In our first case, the AW was visible as a thin hypointense band on the 3D SPACE STIR sequence on both axial and sagittal planes.

A syringomyelia is associated with AW in most cases, typically extending above the level of the AW. The most probable theory explaining the development of syringomyelia is that the compression on the spinal cord induced by the AW disrupts the propagation of the systolic pulse pressure wave of the intramedullary cerebrospinal fluid, either caudally, cranially, or both. Consequently, this disruption results in a pressure differential originating from the center of the cord, where pressure is higher and extends outward. Thus, leading to the dilation of the spinal cord, increasing the extracellular space, and allowing the cumulation of cerebrospinal fluid within the cavity. Partial obstruction could lead to the dilation of the spinal cord through a suction effect or a reduction of pressure, thereby increasing the velocity of cerebrospinal fluid in the narrowed segment [63, 64]. Moreover, the location of the syrinx is developed above the AW if the caudorostral flow is impeded, below the AW if the rostrocaudal flow is impeded, and probably on its two sides if both flows are impeded, as indicated by the quantitative CSF flow studies performed by Chang et al. [58].

Differential diagnoses of arachnoid webs include spinal arachnoid cysts (AC) and spinal cord herniation (SCH) [2, 19, 65]. Magnetic resonance imaging plays a fundamental role in distinguishing these entities (Table 3). Arachnoid cysts typically exhibit well-defined borders, a gradual filling pattern on MRI cerebrospinal flow imaging or CT myelography, and a smooth spinal cord indentation (which is not scalpel-shaped) [2]. Artifacts in the flow of cerebrospinal fluid have the potential to distinguish between arachnoid web and arachnoid cyst, as they are increased in arachnoid web, indicating impediments in dynamic flow at the obstruction site, and are decreased in arachnoid cysts [37, 42]. Furthermore, MRI CINE sequences and flow sequences can show a blockage of cerebrospinal fluid flow or a disturbed flow with accelerated velocities [10, 24, 58, 60]. In the other hand, spinal cord herniation is typically characterized by anterior shift

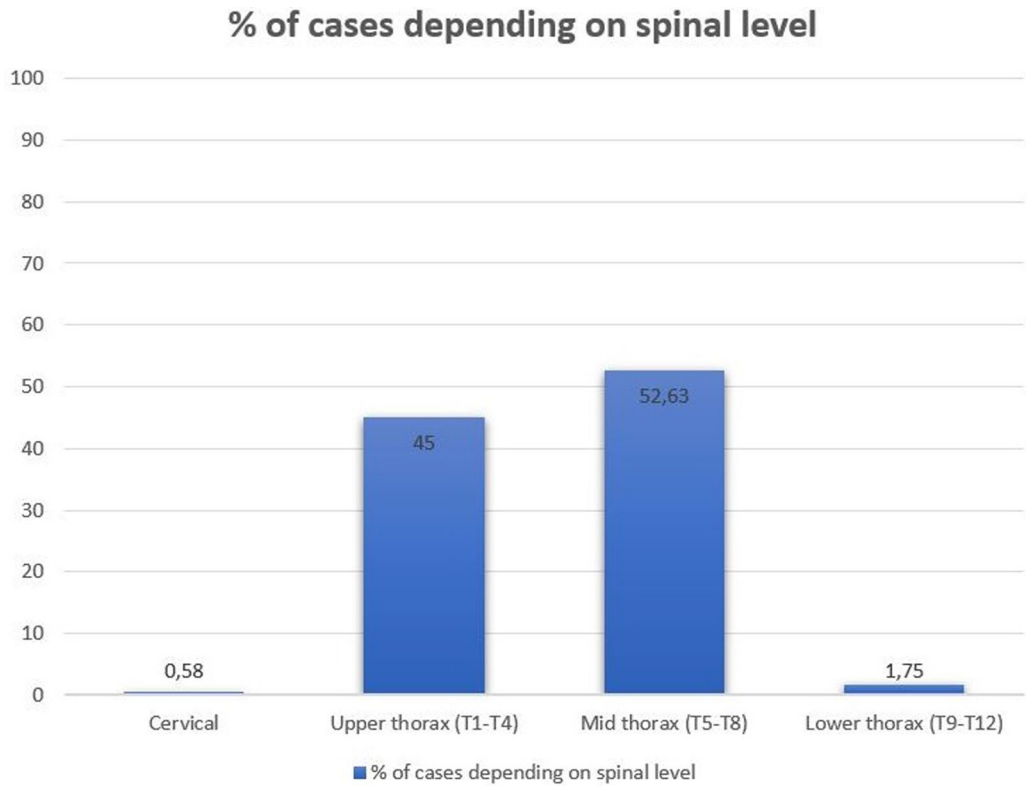

Fig. 6 Graph showing percentage of cases depending on spinal level of arachnoid web indentation

of the spinal cord, an interrupted anterior SAS, and a distorted rear aspect of the cord shaped like the letter "C" [2]. The preservation of the anterior SAS is sometimes more easily visible on CT myelogram [21].

Surgery, consisting of laminectomy or hemilaminectomy at the level of compression with excision of the arachnoid band, is the most commonly used procedure and is very efficient in relieving patients' symptoms. A small midline incision (myelotomy) at the level of the utmost expanded portion of the syrinx can be performed to facilitate syrinx drainage [4, 59]. A minimally invasive approach consisting of drilling the vertebral lamina (laminotomy) is possible [29, 47]. Catheter-directed fenestration is also an option that provides good clinical results [38, 66].

Intraoperative ultrasound can be used to visualize the arachnoid band, locate it before durotomy, ensure complete resection of the arachnoid web, and verify the return of normal CSF flow [7, 15, 21].

Postoperative complications are rare and mainly represented by epidural hematoma [11] and cerebrospinal fluid leak with pseudomeningocele [14, 22].

While this study provides pertinent insights into AW, it is constrained by certain limitations. All patients were drawn from reported cases, introducing the possibility of description and reporting bias. Moreover, the review exclusively incorporates articles published in English. Despite these limitations, this review still consolidates all the accessible cases and offers a valuable insight into this uncommon disease.

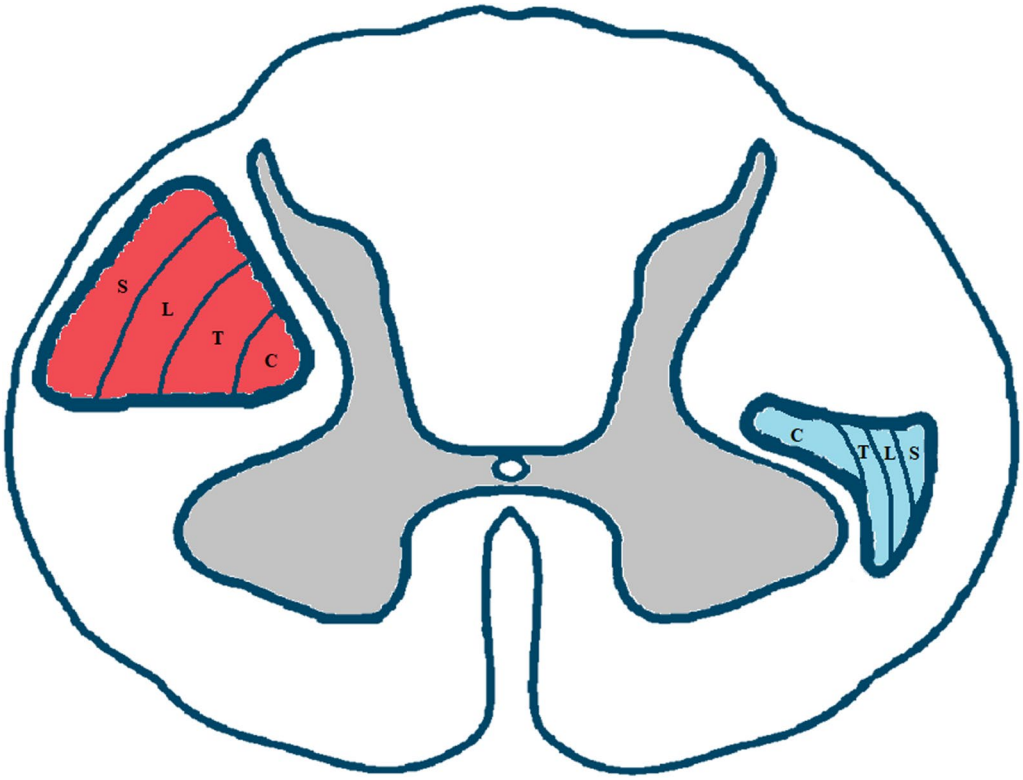

Fig. 7 Drawing illustrating the axial anatomy of the cervical spinal cord, demonstrating the medial location of cervical fibers (C) innervating the upper limbs within the spinothalamic (blue) and corticospinal (red) tracts, in contrast to thoracic (T), lumbar (L), and sacral (S) fibers which are located more laterally

Table 3 AW differential diagnoses on MRI

	Scalpel sign	Flow artifact	Anterior SAS preservation	Well-defined cystic SAS lesion
AW	+	+	+	−
AC	−	−	+	+
SCH	−	+	−	−

Conclusions

Arachnoid web is a rare entity with 197 cases of surgically treated cases documented in the literature. It is characterized mainly by fibrous connective tissue, which shares histologic similarities with arachnoid cysts, leading to the hypothesis that arachnoid web may be the result of a ruptured arachnoid cyst or its precursor. Future studies should include immunohistochemistry for CD3 to explore underlying inflammation.

Clinical signs manifest insidiously, with the shortest reported latency being 2 weeks. They most commonly affect the lower limbs and trunk, but upper limb symptoms are presented in a quarter of cases regardless of the thoracic location of the AW. This is due to rostral syrinx and disturbances in rostral cerebrospinal fluid flow.

Spine MRI is the best tool to diagnose this condition. We recommend using 3D SPACE STIR or CISS sequences for direct visualization of the arachnoid band.

Excision of the arachnoid band is very reliable in alleviating the patient's symptoms.

Abbreviations

AW	Arachnoid web
CSF	Cerebrospinal fluid
SAS	Subarachnoid space
MRI	Magnetic resonance imaging
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
GD	Gait difficulties
LL	Lower limbs
SPACE	Sampling perfection with application optimized contrast using different flip angle evolution
STIR	Short tau inversion recovery
MS	Multiple sclerosis
UL	Upper limbs
CT	Computed tomography
CISS	Constructive interference in steady state
AC	Arachnoid cysts
SCH	Spinal cord herniation

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AN contributed to the conception, acquisition, analysis, interpretation of data, and drafted the manuscript. IEO, SA, AM, NEK, and MF contributed to the acquisition and interpretation of data. MJ and FT contributed to the conception and acquisition of data and critically revised the manuscript. All authors read and approved the final manuscript.

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Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Written informed consent was obtained from our two patients.

Competing interests
The authors declare that they have no competing interests.

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