Case Report

Endoscopic Decompression of Radiculopathy Caused by Vertebral Artery Loop Formation: Case Report and Literature Review

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Case Report

Endoscopic Decompression of Radiculopathy Caused by Vertebral Artery Loop Formation: Case Report and Literature Review

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Abstract

Background: Cervical radiculopathy from vertebral artery loop formation (VALF) is rare; this case highlights endoscopic management after conservative failure. **Methods:** Clinical case about VALF treated by posterior decompression was reported. And literature review was conducted to identify studies investigating surgical treatments for a VALF. **Case description:** A 69-year-old woman had 4-month right C5 radiculopathy (neck pain, arm radiation, Spurling-positive) due to VALF at C4-5 confirmed by MRI and CT angiography. After failed conservative treatment, full-endoscopic posterior foraminotomy was done; symptoms resolved at 3 months. **Conclusions:** Clinicians should be aware that vertebral artery loop formation, although rare, is an important potential cause of cervical radiculopathy. In suspected cases, the vertebral artery should be carefully evaluated with MR or CT angiography to confirm the presence of a loop formation. Full-endoscopic posterior foraminotomy safely resolves VALF-induced radiculopathy, avoiding vascular risks of open approaches.

Keywords: vertebral artery loop; cervical radiculopathy; endoscopic spine surgery

1. Introduction

Cervical radiculopathy caused by foraminal pathology either from disc herniation or degenerative narrowing of the foramen is a very common condition. However, in cases of unresolved radiating pain, clinicians must keep in mind some rare entities, such as cysts, tumors, vascular malformations, including vertebral artery loop formation (VALF).[1–5]

Whereas conservative therapy is effective in many patients, persistent symptoms may ultimately require surgical intervention. Reported surgical options for VALF include microvascular decompression, foraminotomy with sectioning of the compressed rootlet, and vascular reconstruction; VALF remains an uncommon entity without a standardized treatment algorithm, and various surgical techniques have been described.

Here, we report a rare case of cervical radiculopathy caused by vertebral artery loop formation that was successfully treated by full-endoscopic posterior decompression.

2. Materials and Methods

A literature review was conducted using PubMed to identify studies on surgical interventions for cervical radiculopathy caused by vertebral artery (VA) loop formation. Search terms included "cervical", "radiculopathy", "vertebral artery", "loop", "operation", and "surgery" cross-referenced with Boolean operators. English-language articles published between 1970 and 2025 were screened.

Eligibility was assessed by title and abstract review. Studies were included if they reported cases with clinically confirmed cervical radiculopathy due to VA loop formation (VALF). Exclusion criteria comprised trauma to skull/spine, infections, tumors, or autoimmune diseases. From eligible studies,

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we extracted demographics, symptoms, affected level, surgical approach, and outcomes for each patient. Total, 21 studies encompassing 23 patients met inclusion criteria (Table 1).

Table 1. Literature review of surgical management for cases of vertebral artery loop formation causing radiculopathy.

Authors, Year	Sex, Age	Symptoms	Level	Surgical technique	Outcome
Zimmerman et al., 1970[6]	F, 50	Cervical pain, Lt. occpital pain	C4-5, Lt.	Posterior decompression	Asymptomatic at 10 months
Anderson et al., 1970[7]	F, 54	Facial pain, Lt. neck pain	C3-4, Lt.	Posterior decompression	Asymptomatic for several months
Sharma et al., 1993[8]	F, 75	Occipital neuralgia, cervical myelopathy	C2-3, Lt.	Posterior decompression and fusion, MVD with Surgicel	Residual spasticity at 1.5 years after surgery
Satoh et al., 1993[9]	F, 59	Lt neck and arm pain	C1, Lt	Suboccipital decompression	Asymptomatic at 2 years
Duthel et al., 1994[10]	F, 37	Lt arm pain, shoulder pain	C5-6, Lt	Anterolateral decompression, MVD with Teflon	Asymptomatic at 3 months
Detwiler et al., 1998[11]	M, 70	Rt neck pain	C3-4, Rt	Posterior decompression with MVD	Asymptomatic at 2 years

 doi:10.20944/preprints202603.1406.v1

Sakaida et al., 2001[12]	M, 62	Lt shoulder pain, arm pain	C4-5, Lt	Anterolateral decompression, VA transection with anastomosis	Asymptomatic at 2 years
Korinth et al., 2007[13]	F, 68	Cervical radiculopathy	C4-5, Rt	Anterolateral decompression, MVD with Teflon	Follow up length not reported
Dahdaleh et al., 2010[14]	M, 55	Neck pain, shoulder pain	C2-3, C3-4, Lt.	Post cervical fusion w/o decompression	Asymptomatic at 6 months
Hage et al., 2012[15]	F, 27	Cervical radiculopathy	C6-7, Rt	Anterolateral decompression, MVD	Asymptomatic at 13 months
Chibbaro et al., 2012[2]	F, 50	Cervical radiculopathy	C5-6, Lt	Anterolateral decompression, MVD	Asymptomatic at 1 year
Tandon et al., 2013[16]	F, 52	Neck pain, arm pain	C4-5, Rt	Anterolateral decompression, MVD with sling	Asymptomatic at 1 year
Eksi at al., 2016[17]	M, 60	Neck pain, Lt arm weakness	C5-6, Lt.	Posterior decompression	Follow up length not reported
Ju et al., 2017[18]	F, 52	Neck pain, Lt arm numbness	C6-7, Lt	Anterolateral decompression, MVD with sling	Follow up length not reported

 doi:10.20944/preprints202603.1406.v1

Wang et al., 2017[19]	F, 51	Cervical radiculopathy	C5-6, Lt	Anterolateral decompression, MVD with Teflon	Numbness at 4 months
	F, 49	Neck pain, occiput pain	C3-4, Lt.	Anterolateral decompression, MVD	Improved at 6months
Venteicher et al., 2019[20]	F, 72	Cervical radiculopathy	C4-5, Rt	Anterolateral decompression, MVD with pledget	Asymptomatic at 1 year
Khansuheb et al., 2020[21]	F, 62	Cervical radiculopathy	C6-7, Lt	Endovascular coiling for VA sacrifice	Asymptomatic at 9 months
Wood et al., 2021[4]	M, 35	Cervical radiculopathy	C5-6, Lt.	Anterolateral decompression, MVD with Dacron	Follow up length not reported
	F, 48	Cervical radiculopathy	C3-4, C4-5, Lt	Anterolateral decompression, MVD with Dacron	Follow up length not reported
Farshad et al., 2022[22]	F, 76	Cervical radiculopathy	C5-6, Rt	Anterior discectomy and fusion, foraminotomy	Asymptomatic at 1 year
Semonche et al., 2024[23]	M, 49	Neck pain, migraine	C3-4, Lt	Posterior decompression and	Asymptomatic at 1 year

 doi:10.20944/preprints202603.1406.v1

				fusion, MVD with Teflon	
Benato et al., 2025[24]	M, 57	Neck pain, shoulder pain	C5-6, Lt.	Posterior decompression, MVD with grafton	Follow up length not reported
MVD; microvascular decompression, VA; vertebral artery					

3. Case Description

A 69-year-old woman presented to neurosurgical department with a 4-month history of neck pain, right upper extremities radiating pain, and tingling sensation in her arm. Her symptoms were aggravated by the Spurling maneuver and partially relieved on shoulder abduction. The symptom was prevalent concordant to right C5 dermatomal innervation. Magnetic resonance imaging (MRI) of the cervical spine revealed a vascular structure in the right C4-5 foramen compressing the right C5 nerve root (Figure 1). Neck computed tomography angiography (CTA) also revealed a vertebral artery in the right C4-5 foramen (Figure 2). Three-dimensional reconstruction image consistent with vertebral artery loop formation at right C4-5 level (Figure 3).

After 3 months of failed conservative management (analgesics, physical therapy), uniportal full-endoscopic posterior C4-5 foraminotomy was performed prone under general anesthesia. The V-point (medial facet border) was identified fluoroscopically. Sequential dilators created a working channel; drilling targeted the superior lamina inferior edge to the medial inferior/superior articular processes. Ligamentum flavum was resected, exposing dura and venous plexus. Radiofrequency ablation achieved hemostasis; a nerve hook dissected the C5 root from the vascular loop, confirming decompression. Anti-adhesion agent was applied. Operative time was 50 minutes and estimated blood loss was 20 mL. At the 3-month follow-up, symptoms had resolved completely (VAS-neck 0/10, VAS-arm 0/10), and no complications were observed.

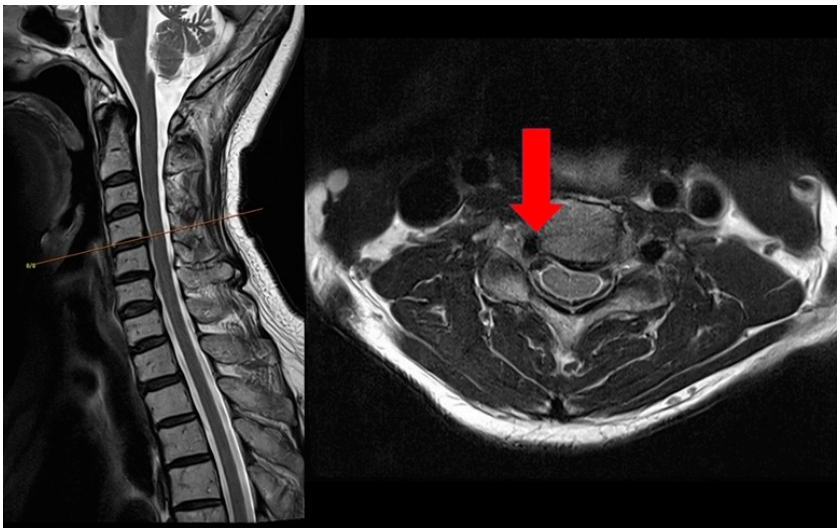

Figure 1. Magnetic resonance imaging of the cervical spine showing a vascular structure occupying the right C4–5 neural foramen.

 doi:10.20944/preprints202603.1406.v1

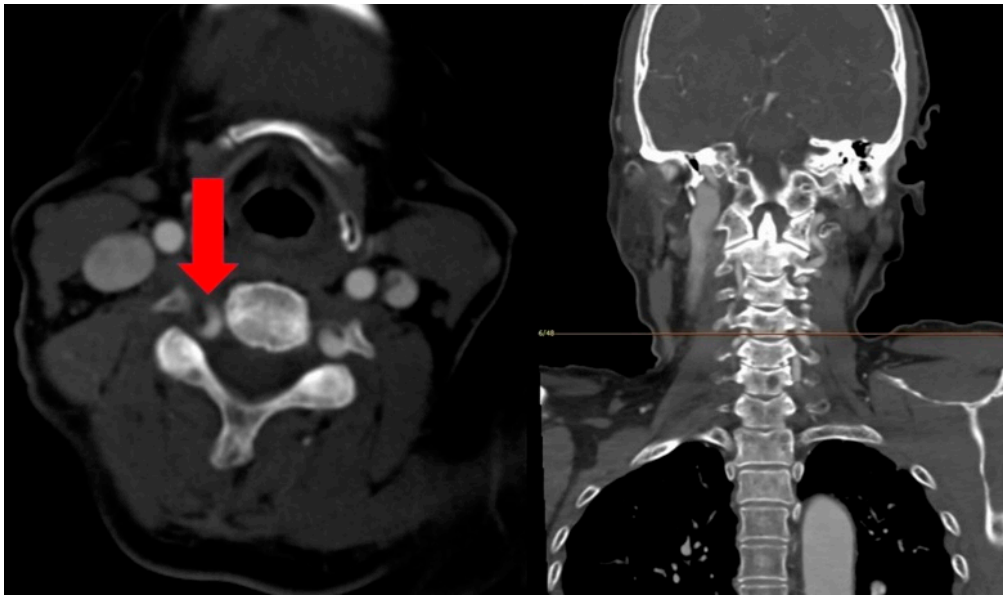

Figure 2. Neck computed tomography angiography demonstrating the vertebral artery coursing into and compressing the right C4–5 neural foramen.

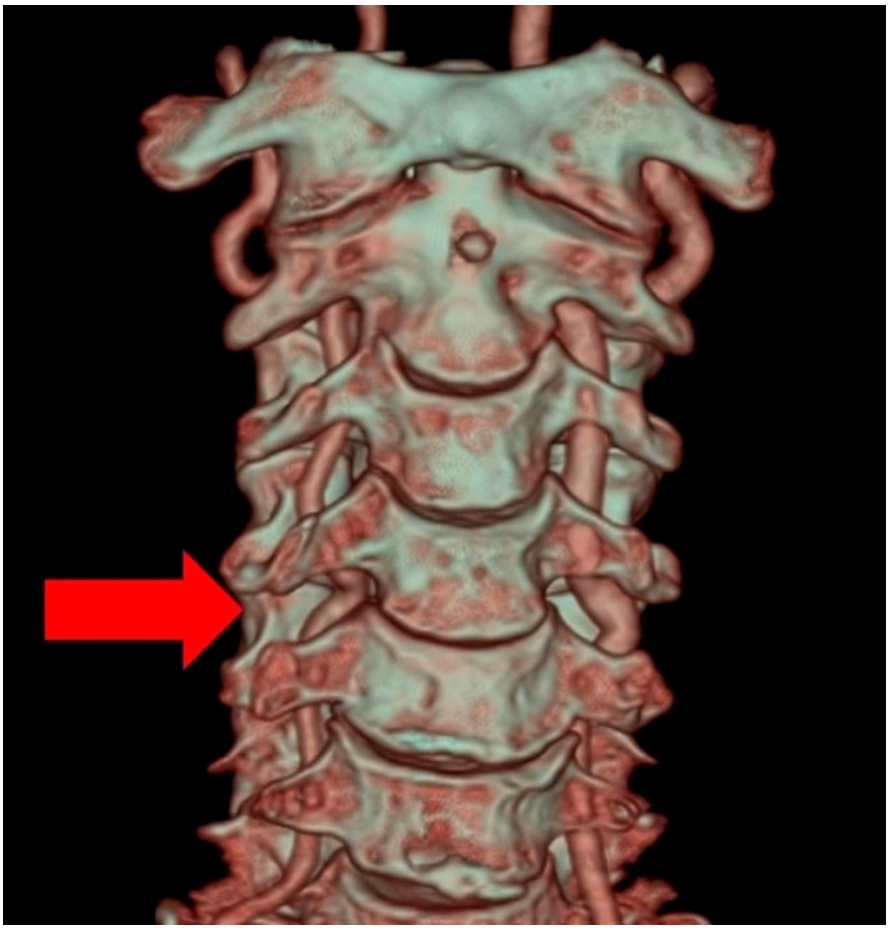

Figure 3. Three-dimensional reconstruction of computed tomography angiography showing a vertebral artery loop at the right C4–5 level.

 doi:10.20944/preprints202603.1406.v1

4. Discussion

VALF represents a tortuous course of the VA that may protrude into the neural foramen or spinal canal. The clinical significance of VALF is twofold: it can directly compress neural structures, resulting in radiculopathy, and it markedly increases the risk of catastrophic vertebral artery injury during cervical spine surgery or transforaminal epidural steroid injections.[17] Clinicians should therefore recognize VALF as both a potential pain generator and an important vascular hazard in the cervical spine.

The pathophysiology of VALF-related radiculopathy primarily involves mechanical compression of the cervical nerve root by the aberrant arterial loop.[17] Dynamic factors may also contribute, as arterial pulsation and cervical motion can exacerbate irritation of the nerve root, which is consistent with the reproduction of radicular symptoms on provocative maneuvers such as the Spurling test.[22] This mechanism explains how a vascular lesion can mimic typical degenerative cervical lesion both clinically and radiologically.

Few cases of VALF causing cervical radiculopathy or other neurological symptoms have been reported in the literature. The reported incidence ranges from approximately 0.6% to 7.5%, depending on the population studied and imaging modality used.[1–5] Once VALF-related radiculopathy is identified, first-line conservative therapy (analgesics, physical therapy, and injections) is unlikely to provide durable symptom relief in most cases. Surgical treatment should therefore be considered in patients with refractory pain or neurological deficits despite adequate conservative management. Various surgical strategies have been described, including anterior and posterior decompression, microvascular decompression (MVD), vascular reconstruction, and, in selected cases, endovascular coiling.[7,11,14,15,25]

Our review of the literature identified 21 articles including 23 patients who underwent surgical management for VALF-related cervical radiculopathy between 1970 and 2025 (Table 1). Among these, 12 patients were treated via an anterior approach for bony decompression with or without MVD, 9 via posterior decompression, 1 with endovascular coiling, and 1 with anterior cervical discectomy and fusion. In cases using MVD, surgeons employed either an interposition graft (such as Teflon or Dacron) or an allograft sling to transpose or separate the vertebral artery loop from the affected nerve root.

Surgically, the anterolateral approach permits direct exposure and relocation or reconstruction of the vertebral artery loop, thereby addressing the primary compressive pathology. This route offers the possibility of arterial transposition or re-anastomosis but carries potential risks such as injury to the recurrent laryngeal nerve, dysphagia, and direct vascular damage, even though these complications have rarely been reported in published series.[19] In contrast, the posterior approach is more familiar to most neurosurgeons and provides direct access to the exiting nerve root, allowing direct decompression of the neural elements and indirect decompression of the artery without necessarily manipulating the vertebral artery loop itself.

However, the posterior approach has important limitations. It often requires more extensive bone removal, including laminectomy and foraminotomy, and may necessitate drilling of the transverse foramen to mobilize the artery. Because the cervical nerve root typically lies between the vertebral artery and the surgeon, visualization and control of the artery can be limited, increasing the risk of nerve injury and iatrogenic instability that may require additional fusion.[19] Thus, the choice of approach should be individualized, balancing the need for definitive decompression against the risks of vascular and neural complications.

Although the anterior approach is more frequently reported, several authors have shown that a posterior approach for vertebral artery loop–related nerve compression is also safe and effective, with good rates of symptomatic improvement. In previously described posterior cases, surgeons performed direct decompression of both the nerve root and the vertebral artery using combinations of foraminotomy, partial facetectomy, and MVD. Nevertheless, both anterior and posterior open procedures carry an inherent risk of vertebral artery injury and potential subsequent posterior circulation infarction.

 doi:10.20944/preprints202603.1406.v1

In our case, we treated the patient using a uniportal full-endoscopic posterior approach through an approximately 1-inch incision. Although the vertebral artery loop could not be completely visualized, the compressed cervical nerve root was sufficiently decompressed from the dorsal aspect, and careful dissection of the ventral portion of the root using a hook created a safe corridor between the VALF and the nerve. The use of an endoscopic drill, combined with frequent palpation of the medial pedicle wall using a nerve hook, helped to limit facet joint resection and may reduce the risk of iatrogenic segmental instability compared with more extensive open posterior decompression.

This experience suggests that radiculopathy caused by vascular malformations such as VALF can be effectively managed by selectively decompressing the posterior aspect of the compressed nerve root using minimally invasive full-endoscopic surgery. Rather than focusing on detailed technical nuances, our report emphasizes the conceptual feasibility of treating VALF-related cervical radiculopathy with an endoscopic posterior approach that avoids direct manipulation of the vertebral artery. As endoscopic spine techniques continue to evolve, this strategy may represent an attractive alternative to traditional open procedures in carefully selected patients.

Clinicians should maintain a high index of suspicion for vertebral artery loop formation in patients with atypical or refractory cervical radiculopathy, especially when imaging reveals unusual foraminal vascular structures or bony erosion. In suspected cases, preoperative MR angiography or CT angiography is essential to confirm the presence and exact course of the loop and to guide surgical planning while minimizing the risk of iatrogenic vascular injury. Full-endoscopic posterior decompression, as demonstrated in this case, offers a safe, minimally invasive option after failure of conservative management and expands the armamentarium of surgical techniques for this rare but clinically significant condition.

5. Conclusions

This report describes a rare case of vertebral artery loop formation (VALF) causing refractory cervical radiculopathy that was successfully treated with uniportal full-endoscopic posterior foraminotomy. This minimally invasive technique achieved adequate neural decompression while avoiding direct manipulation of the vertebral artery, minimizing risks of vascular injury, segmental instability, and other complications associated with traditional open anterior or posterior approaches. Full-endoscopic posterior foraminotomy thus represents a safe and effective surgical option for select patients with VALF-related radiculopathy following failure of conservative management.

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Informed Consent Statement: Informed consent was obtained from the individual for the publication of this case.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author. No new data were created or analyzed in this study.

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Conflicts of Interest: The authors declare no conflicts of interest.

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Abbreviations

The following abbreviations are used in this manuscript:

VALF	Vertebral artery loop formation
VA	Vertebral artery
MRI	Magnetic resonance imaging
CTA	Computed tomography angiography
VAS	Visual analogue scale
MVD	Microvascular decompression

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