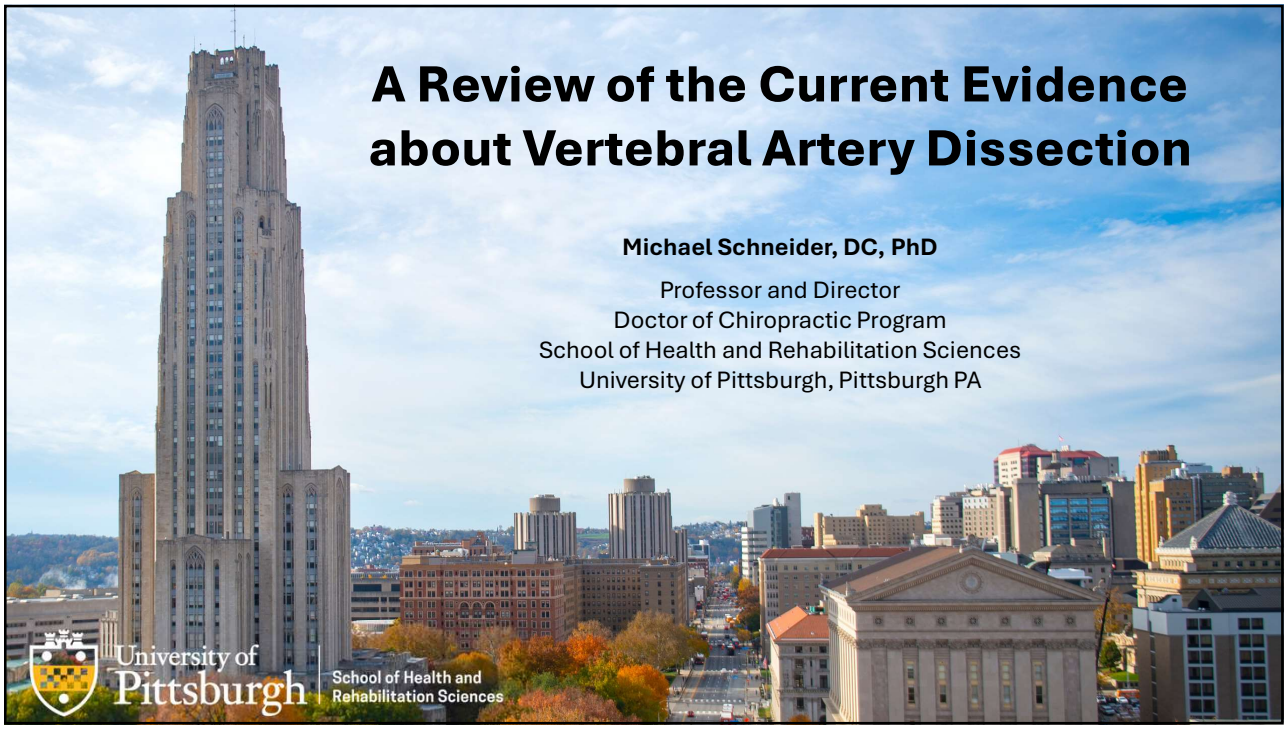


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## Learning Objectives

1. Review of epidemiology and demographics of vertebral artery dissection (VAD).
2. Review of anatomy and pathophysiology of VAD.
3. Evidence supporting a genetic predisposition for VAD.
4. alid diagnostic tests for VAD.
5. Differentiating between symptoms/clinical presentations of Dissection and Stroke.
6. Recognizing the VAD in progress.
7. Discussion about medico-legal and media issues.
8. Q&A

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# Epidemiology of VAD

(based upon estimates)

- Prevalence of cervical artery dissections:
  - ICA = 2.5 per 100,000 = 0.0025%
  - VAD = 1 per 100,000 = 0.001% (10 per million)
- Prevalence of serious adverse events from vaccines
  - 1-2 per million
- US Population = 345 Million
  - VAD = 3,450 cases per years?
- How many related to C manipulation?
  - 1 in 20,000?
  - 1 in 5 million?
  - Pure conjecture?
- 70,000 DCs in the U.S.
  - 20 C spine adj/week x 50 weeks = 1,000 adj/year
  - 70 million adj/year

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# VAD demographics/risk factors

- Average age = <45 years
- Males 53-57%
- Association with high blood pressure and history of migraine
  - ? Smoking, birth control pills, obesity, recent infection ?
- May be relatively asymptomatic
  - If symptomatic, most common symptoms are neck pain and HA
- Delay in seeking treatment = 9 days to 3 months
- Gold standard tests = MRA and CTA

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## Epidemiology

Go to:

It is estimated that vertebral artery dissection is the cause of approximately 2% of all ischemic strokes. However, in middle-aged and younger patients (30 to 45 years of age), it is believed to be as high as 10% to 25%, representing a significant population affected by this condition. The combined incidence of both vertebral artery and carotid artery dissections is estimated to be 2.6 per 100,000. Carotid artery dissections are three to five times more common than vertebral artery dissections. It should be noted that chiropractors dismiss the association between manipulation and vertebral artery dissection on the grounds that the dissection is the cause of neck pain and the reason why the patients seek out chiropractic care. There is no conclusive evidence linking the two leading some medical associations only to suggest a causative link.

https://www.ncbi.nlm.nih.gov/books/NBK441827/

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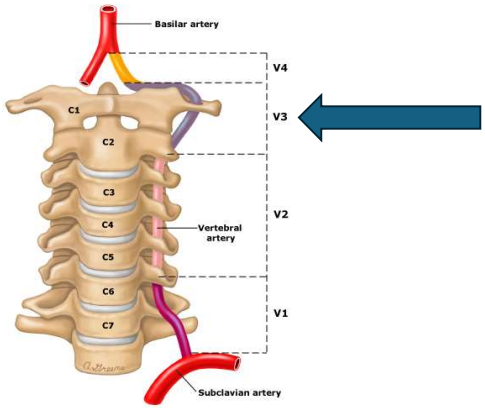
# Anatomy of the VA




The vertebral artery is divided into four anatomic segments:

- V1 – Origin of the vessel to the foramina of the sixth cervical (C6) transverse process.
- V2 – Intraforaminal segment from the sixth to the second cervical vertebral body (C6 to C2).
- V3 – From the second cervical (C2) foramina to the base of the skull.
- V4 – Intracerebral segment of the vertebral artery. The vertebral arteries merge to form the basilar artery and are intradural.

Graphic 56466 Version 6.0



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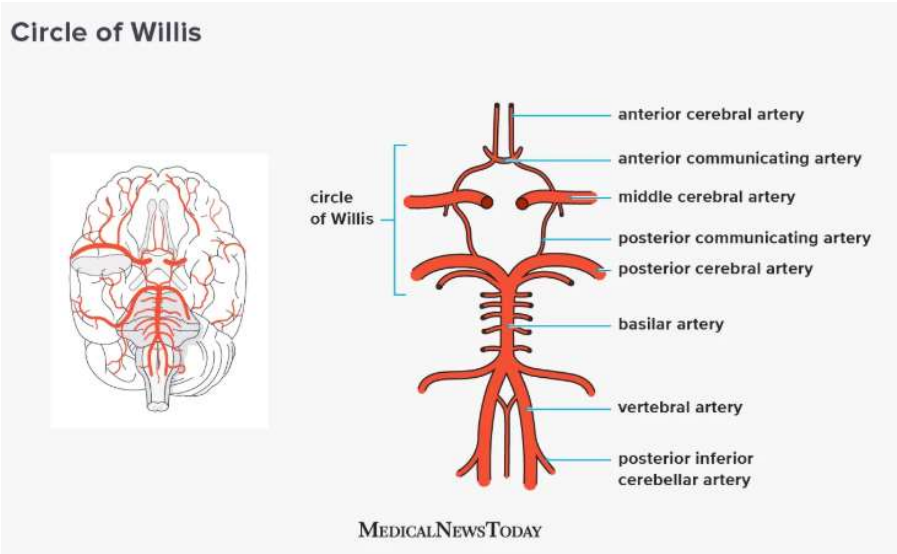
## VAs converge to form the Basilar Artery and Circle of Willis

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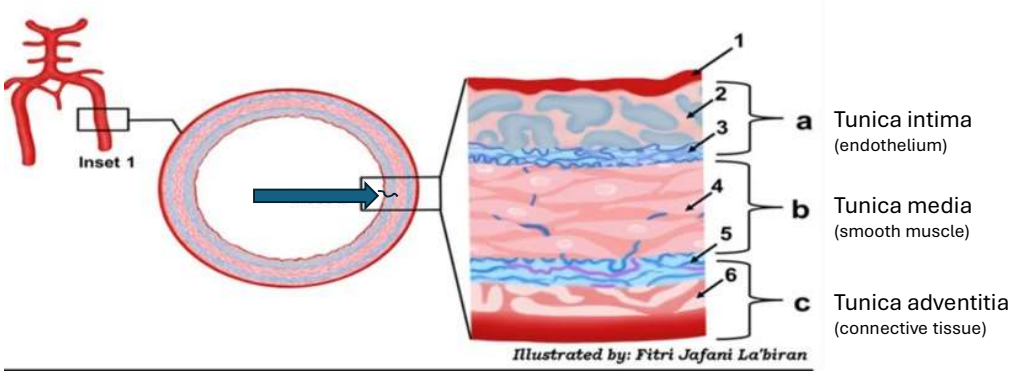
## VAD starts with a tear in the intima

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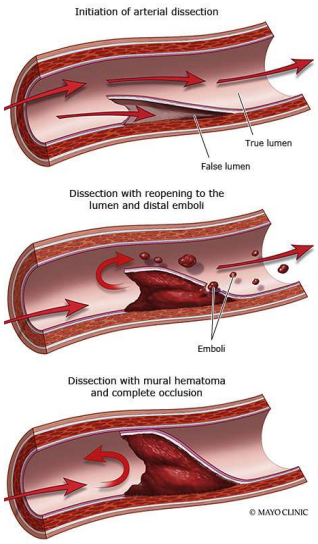
# Tear can lead to emboli and/or occlusion

- **Asymptomatic**
- **Neck pain and/or HA**
- **No neuro signs**




- **TIA**
- **Stroke**
- **Neuro signs**

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# Forces on VA during manipulation

- Measurements of VA tensile load during extension/rotation manipulation
- Slack must be taken up prior to VA experiencing tensile force
  - 33.5% to 1st force occurrence
- Required to cause VA failure
  - 51.3% to failure
- During manipulation
  - 5.1% change in length
- Conclusions
  - During manipulation VA length change was below slack length
  - VA elongated but not stretched to tensile force

Gorrell et al. Vertebral arteries do not experience tensile force during manual cervical spine manipulation applied to human cadavers. 2022.

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# Genetics and VAD

- Genetic polymorphisms (SNP)
- Encode for Collagen Type III deficit
- Structural weakness in connective tissues
  - Ligament laxity
  - Arterial fragility
- Associated with several genetic disorders
  - Fibromuscular Dysplasia
  - Marfan Syndrome
  - Vascular Ehlers-Danlos

**VAD Genotype?**

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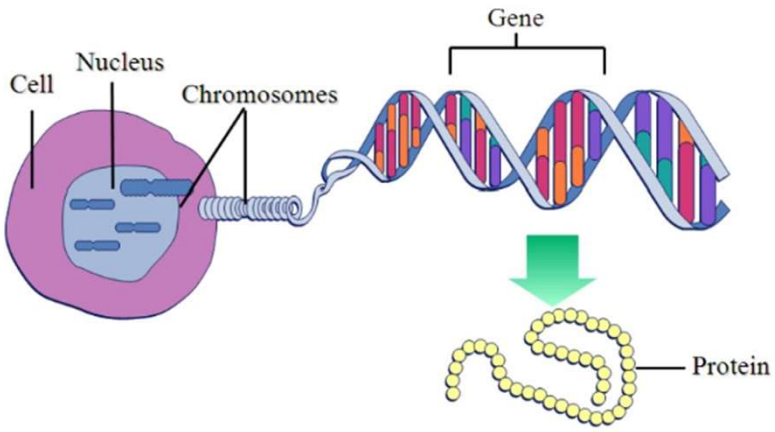
CHROMOSOMES are made of DNA - broken down into specific GENE segments.

A GENE is a stretch of DNA that determines a certain trait.

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# Examples of Genetic Variants


"Normal" protein/enzyme

General Population = "Normal" genotype

Single Nucleotide Polymorphism (SNP)

Genetic Variant B
- Single SNP (allele)


Variant protein/enzyme B

SNP

Genetic Variant C
- Two SNPs (alleles)


SNP

Variant protein/enzyme C

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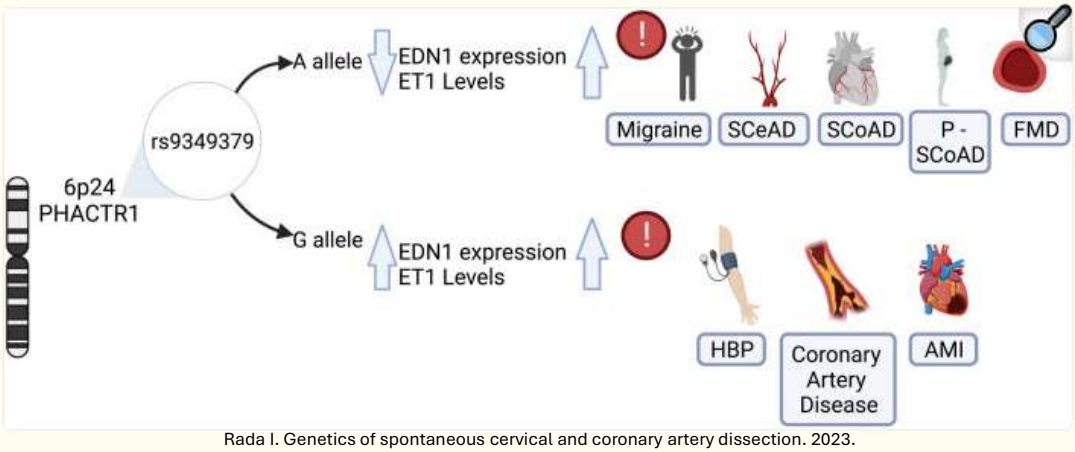
# Best Current Evidence

Suggests a Genetic Predisposition for VAD




Rada I. Genetics of spontaneous cervical and coronary artery dissection. 2023.

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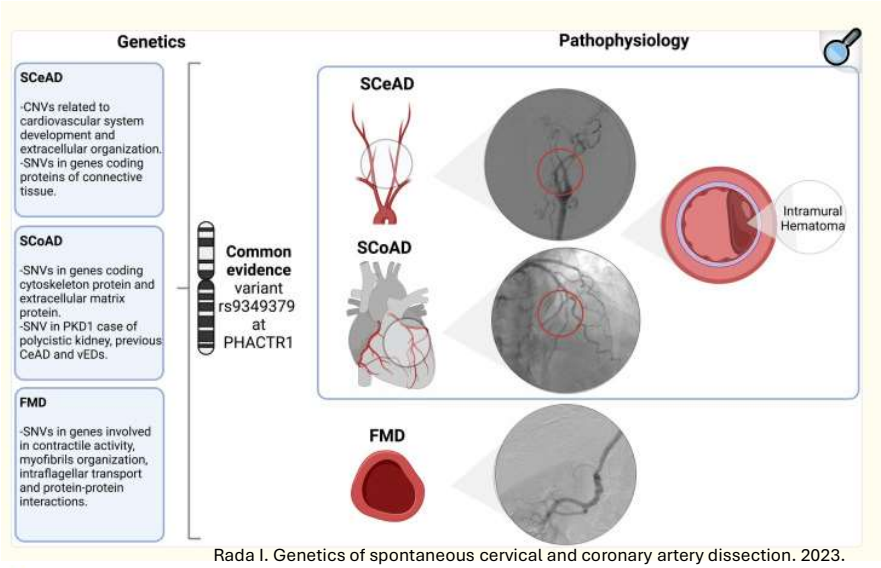
# Genetics and Spontaneous Dissections




Rada I. Genetics of spontaneous cervical and coronary artery dissection. 2023.

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# Dissection vs Stroke/TIA

## Different Symptoms

- Dissection symptoms
  - Occipital Headache
  - Neck pain
- Stroke or TIA symptoms
  - 5 D's and 3 N's

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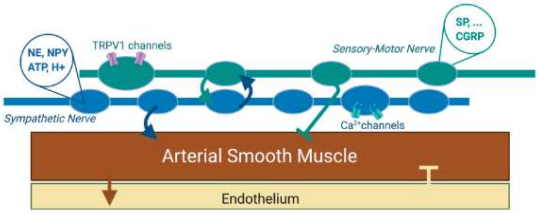
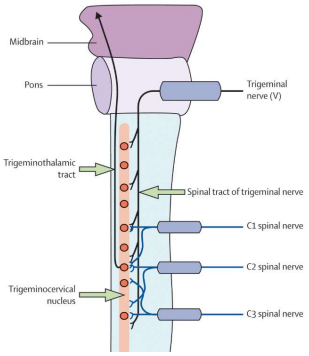
# Innervation of the VA




- Sympathetic nerves from cervical ganglion
- Sensory and motor nerves from C1, 2, 3

Aalkjaer C, et al. Sympathetic and sensory-motor nerves in peripheral small arteries. (2021)

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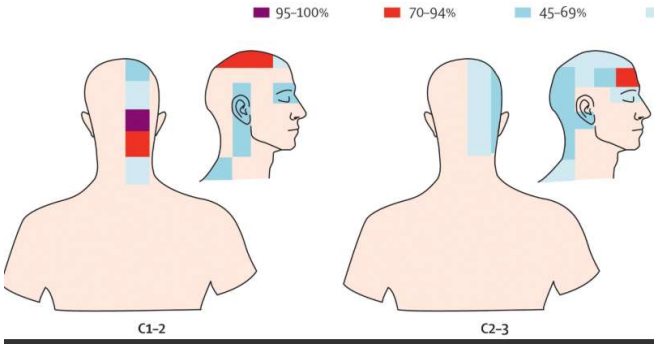
# VAD Symptoms




**Cardinal Symptoms of VAD**

1. **Unilateral occipital headache**
   - "A terrible headache… nothing like I've ever had…not a migraine"
2. **Ipsilateral neck pain**
   - Average interval between onset of neck pain and headache/other symptoms is 2 weeks

Bogduk N, et al. Cervicogenic headache: an assessment of the evidence on clinical diagnosis, invasive tests, and treatment. (2009)

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# Stroke/TIA

## The "5D's and 3 N's"

- 5D's
  - Dizziness
  - Diplopia, blurred vision or transient hemianopia
  - Drop attacks (loss of power or consciousness)
  - Dysphagia (problems swallowing)
  - Dysarthria (problems speaking)
- 3 N's
  - Nystagmus
  - Nausea or vomitting
  - Other neurological symptoms


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https://www.raynersmale.com/blog/2014/5/25/red-flags

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# The Proverbial Chicken or Egg Argument:

Does C spine manipulation "cause" a VAD and/or stroke…

or is there just an "association" between the two?

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# Genotype ➡ Phenotype with minor trauma

**Minor trauma and other triggers** — Observational data suggest that trauma, typically mild or trivial in nature, or other mechanical events are triggers for cervical artery dissection in up to 40 percent of cases [20]. The list of physical activities associated with dissection is long and includes the following:

- Basketball [21]
- Childbirth [22]
- Cervical manipulation therapy [23-28]
- Coughing or sneezing [29]
- Dancing [30,31]
- Minor sports injuries [32,33]
- Roller coaster or amusement park rides [34-39]
- Scuba diving [40,41]
- Sexual intercourse [42]
- Skating [43]
- Swimming [44]
- Tennis [45,46]
- Trampoline use [47]
- Vigorous exercise [29]
- Volleyball [48]
- Weightlifting [49]
- Yoga [29]

★ While cervical manipulation therapy may trigger dissection, causality is difficult to establish, and the absolute incidence of dissection caused by spinal manipulation is unknown [28,50-52].

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Clinical Neurology and Neurosurgery 209 (2021) 106941

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

## Spinal manipulative therapy and cervical artery dissection: A retrospective comparison with spontaneous, traumatic, and iatrogenic etiologies at a single academic medical center

Sarah J. Plachinski[a], Jordan A. Gliedt[a], Raphael Sacho[c], Michael J. Schneider[b], Jeffrey A. King[a,*]

[a] Department of Neurosurgery, Medical College of Wisconsin, 8701 Watertown Plank Rd, Milwaukee, WI 53226, USA
[b] Department of Physical Therapy and Clinical and Translational Science Institute, University of Pittsburgh, 100 Technology Dr, Suite 210, Pittsburgh, PA 15219, USA
[c] Department of Neurosurgery, Zucker School of Medicine, 501 Seaview Avenue, Staten Island, NY 10305, USA

N=307 VAD cases from 2010 to 2020

47% were spontaneous and 44% were traumatic (auto accident, etc)

6% (N=23) were associated with a visit to a DC w/in 30 days

Cases associated with visits to DCs:
- Female 61%
- Average age: 42 years
- Average BMI: 29%
- Non-smokers (1/3 previously smoked)
- No contraceptive: 71%
- No Diabetes: 96%
- No Hypertension: 61%

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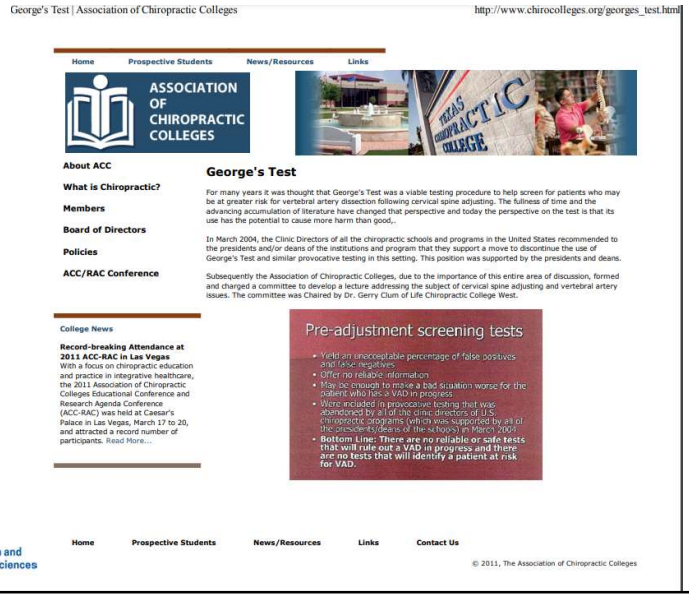
# Bottom Line

## There's no reliable or valid screening test for VAD

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J Orthop Sports Phys Ther. 2023 Jan;53(1):7-22. doi: 10.2519/jospt.2022.11147. Epub 2022 Sep 13.

### International Framework for Examination of the Cervical Region for Potential of Vascular Pathologies of the Neck Prior to Musculoskeletal Intervention: International IFOMPT Cervical Framework

Alison Rushton, Lisa C Carlesso, Timothy Flynn, Wayne A Hing, Sidney M Rubinstein, Steven Vogel, Roger Kerry

PMID: 36099171 DOI: 10.2519/jospt.2022.11147

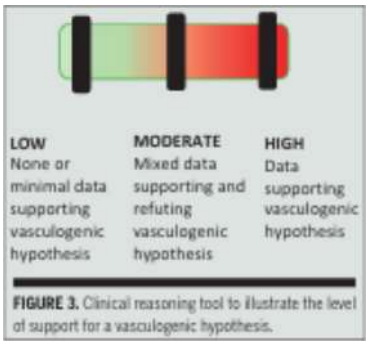


FIGURE 3. Clinical reasoning tool to illustrate the level of support for a vasculogenic hypothesis.

- Physical exam "screening tests" are unreliable
  - False positives and False negatives
  - May be contraindicated!
  - Blood pressure (to rule out)
- Clinical Case History
  - Headache
  - Neck Pain
  - Non-MSK behavior
- Neuro exam
  - Negative – not a green light
  - Positive – a red light

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# Medico-Legal Issues

- What is the 'standard of care' when examining a new patient?
  - 1º complaint is Neck pain without headache
  - 1º complaint is Headache with or without neck pain
  - Presence/absence of neuro signs
- Choice of manipulative technique: thrust vs. non-thrust?
- Immediate or delayed onset of post-treatment symptoms?
- What is role of informed consent?

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# Media Issues

What is the 'correct' response to these questions:

- "Does C spine manipulation cause stroke"?
- If response is "evidence shows association but not causation" … how do you explain cases of immediate symptoms?
- "Considering the risk of VAD/stroke… why would you ever perform C spine manipulation"?
- "What is the chiropractic profession doing about this issue"?

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# Thank you!

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