

Locations and etiologies of extracranial venous lesions in MS

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What is the background rationale that supports an association between MS and venous obstruction?



The Association of Chronic Cerebro-Spinal Venous Insufficiency (CCSVI) and Multiple Sclerosis

Background and Hypothesis

- *MS plaques venocentric*
 - Lesions extend counter-current to normal venous flow direction
 - Distribution of lesions often peri-ventricular where higher vein density
 - Peri-venous cuffs similar to appearance noted in chronic venous disease
- *BBB breakdown*
 - Vessel wall breakdown which leads to micro-bleeds
 - Iron acts as an inflammatory agent (histo and MR SWI show increased iron content in plaques developing in pattern identical to venous counter-current)
 - Ischemic areas associated with shunting of blood volume and vessel atrophy
- *Extracranial venous obstruction*
 - Lesion site is non-specific (dural sinus, jugular, brachiocephalic, azygous veins alone or in combination)
 - Lesion etiology is non-specific (congenital/hereditary, osseous impingement, arterial compression, post-inflammatory, arachnoid granulation, etc., alone or in combination)



Is there evidence that similar narrowing of other venous territories causes symptoms?



MAY- THURNER ANATOMY

LEFT COMMON ILIAC
VEIN COMPRESSION
BY
RIGHT COMMON ILIAC
ARTERY





44 year old male 4 months post lumbar spine surgery with leg pain, swelling and prominent venous collaterals



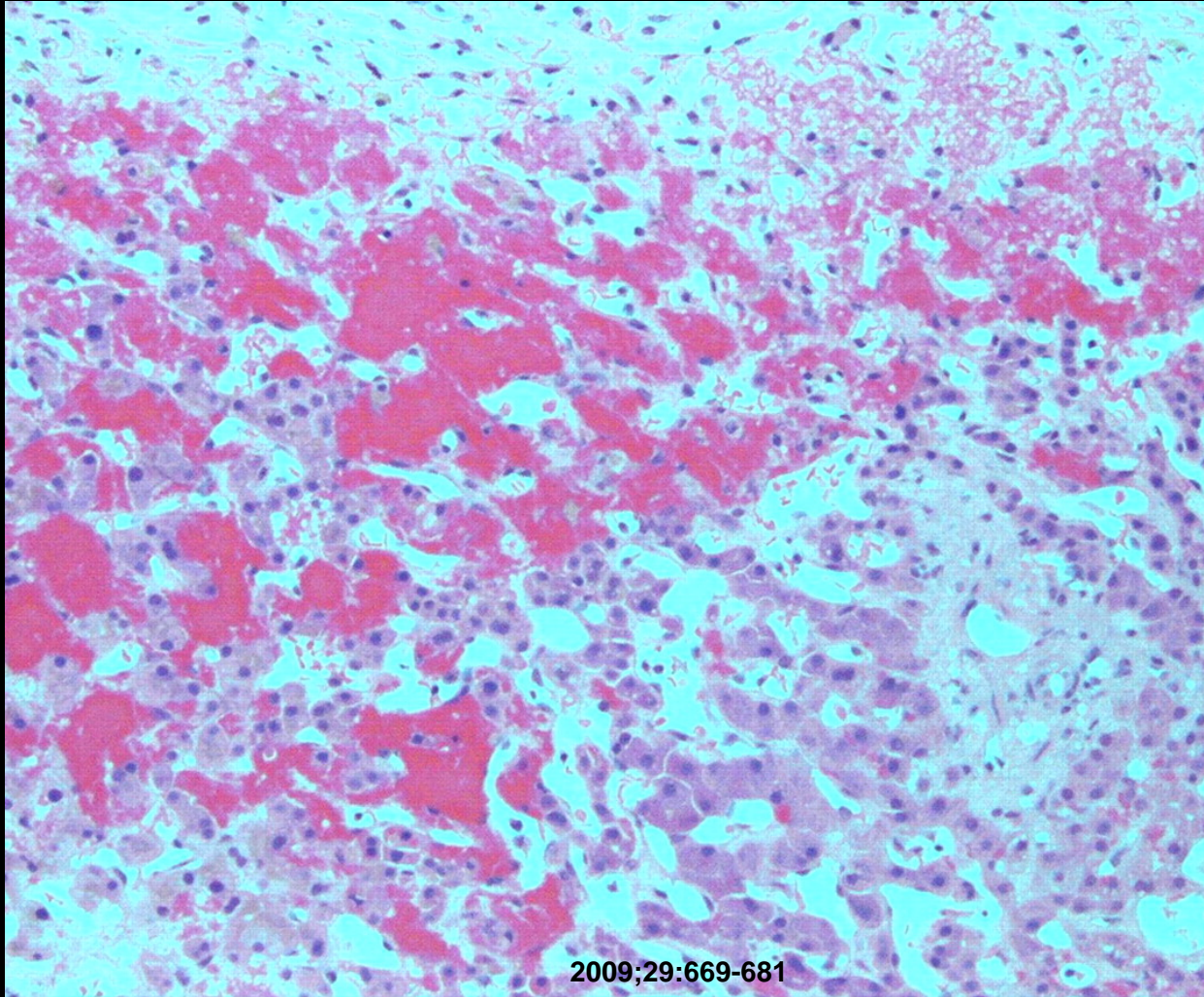
Patient prone



Cavogram in a 24-year-old woman with Budd-Chiari syndrome and a history of oral contraceptive use depicts a narrowed intrahepatic IVC stenosis (*) and collateral vessels (arrows)



Photomicrograph (original magnification, x40; hematoxylin-eosin stain) of a transjugular liver biopsy specimen from a 27-year-old woman with acute Budd-Chiari syndrome shows sinusoidal dilatation and clustering of red blood cells in the sinusoidal spaces around the hepatic vein, findings indicative of congestion in the perivenular zone



2009;29:669-681

Why are stents used in certain situations; what is their role?



Based on prior experience with endovascular management of venous obstruction

- Balloon angioplasty of veins is usually ineffective
- Stents in veins counteract recoil
- Both PTA and stents may be associated with venous re-narrowing; this is especially common in dialysis patients



When POBA?

- **Always first choice -- initial therapy**
- **Valve issues: stuck/stiff leaflet(s)**
- **Membranous lesions**
- **Annular ostial/junctional lesions**
- **Dural sinus lesions**



Why Stents Instead of PTA Only?

- Residual stenosis
- Residual pressure gradient
- Residual collateral network flow
- Residual symptoms



Are any stents FDA-approved
specifically for treatment of
patients with venous
obstruction?



Brief Reports

SVC Syndrome with a Patent SVC: Treatment of Internal Jugular Venous Occlusion after Surgical and Radiation Therapy of Esophageal Cancer

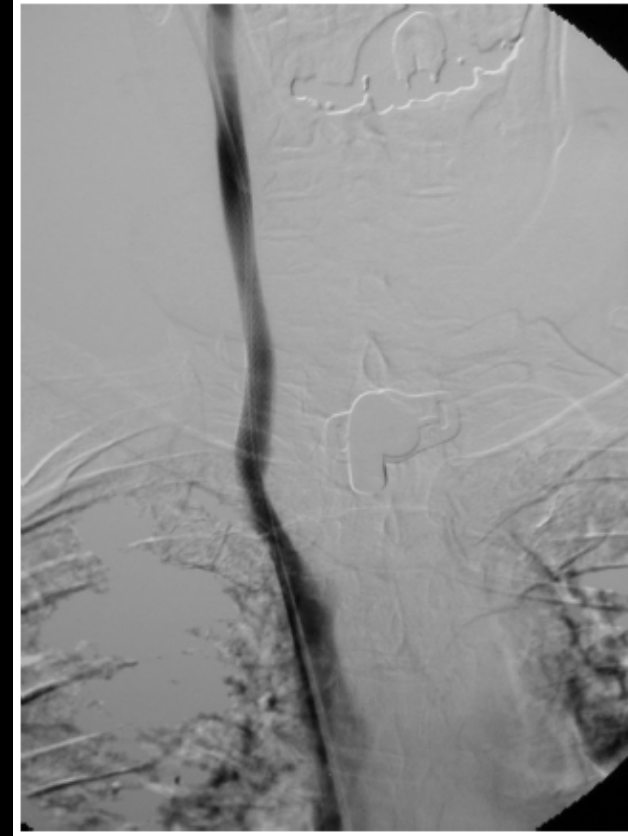
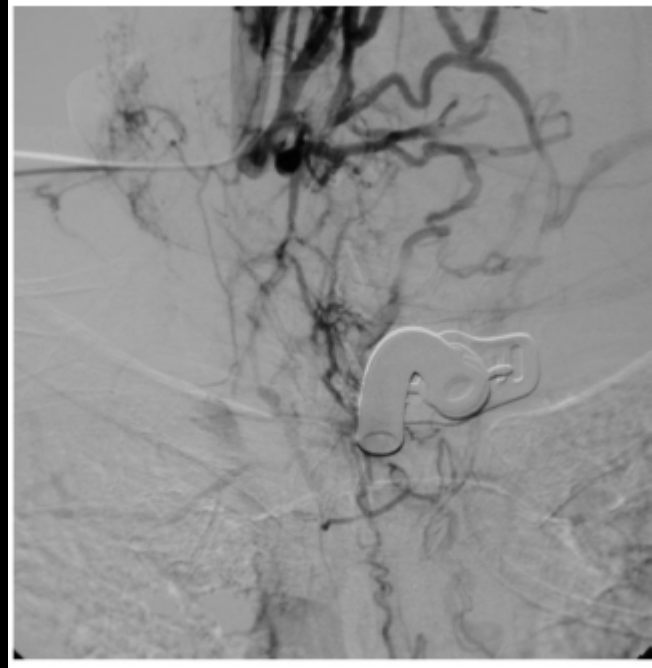
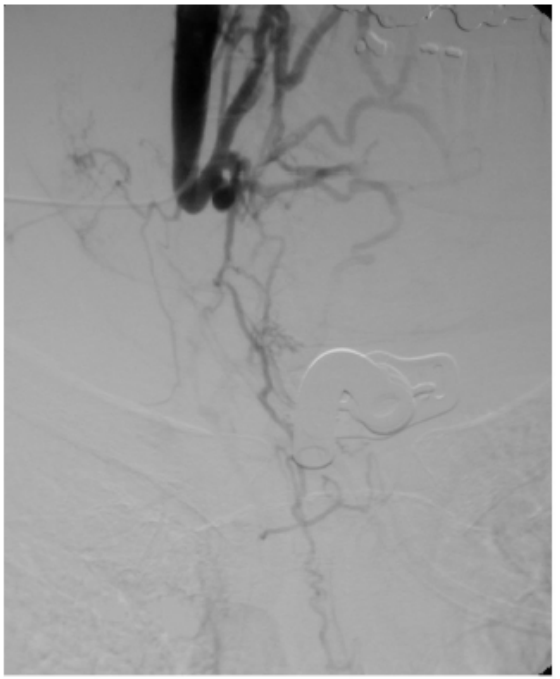
Justin C. Riutta, MD, Andrea L. Cheville, MD, and Scott O. Trerotola, MD

A patient is described in whom recanalization and stent placement in an occluded internal jugular vein was performed for the treatment of refractory facial edema initially thought to be lymphedema. The authors describe the combination of venous obstructions leading to this clinical presentation, which they term "SVC syndrome with a patent SVC."

J Vasc Interv Radiol 2005; 16:727-731

Abbreviations: IJV = internal jugular vein, SVC = superior vena cava





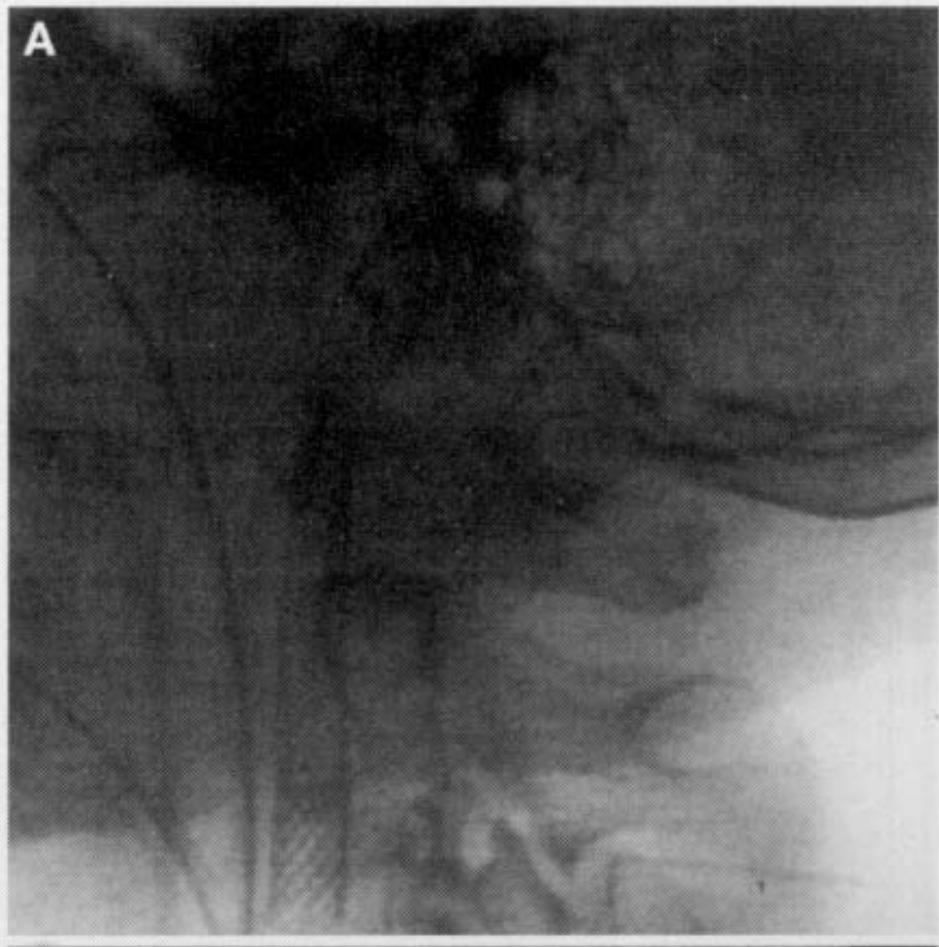
**18-year-old obtunded s/p assault; normal CT of brain, carotids,
but bilateral IJV thrombosis and ICP of 33 mmHg**



**Left IJV occluded at C1 level
With 8 mmHg pressure gradient;
catheter-directed thrombolytic
infusion ineffective**



**S/P stent placement with immediate physiological and clinical improvement;
Coumadin administered for 8 weeks post procedure; stent widely patent on f/u venography**

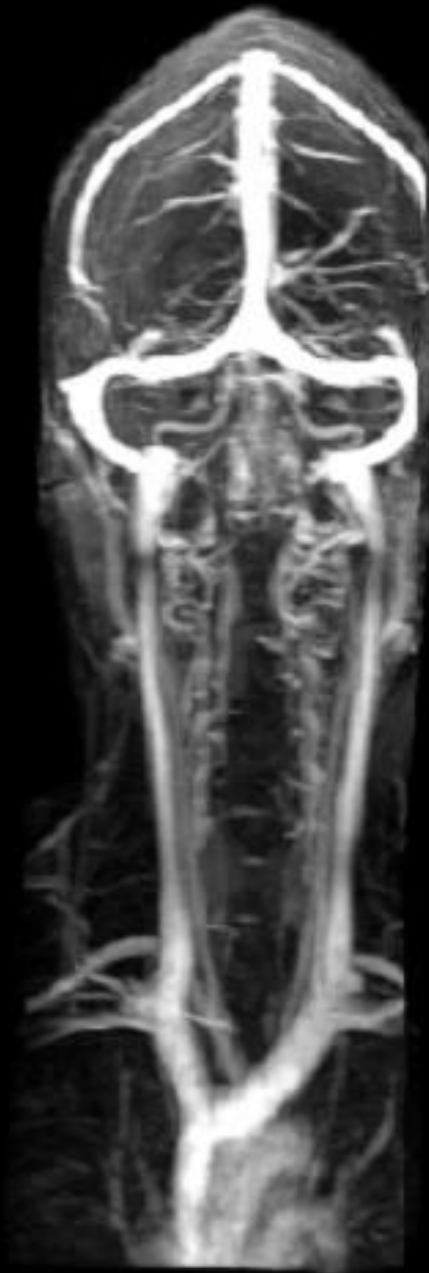


Where does the extra-cranial
venous obstruction occur?



High Jugular Lesions

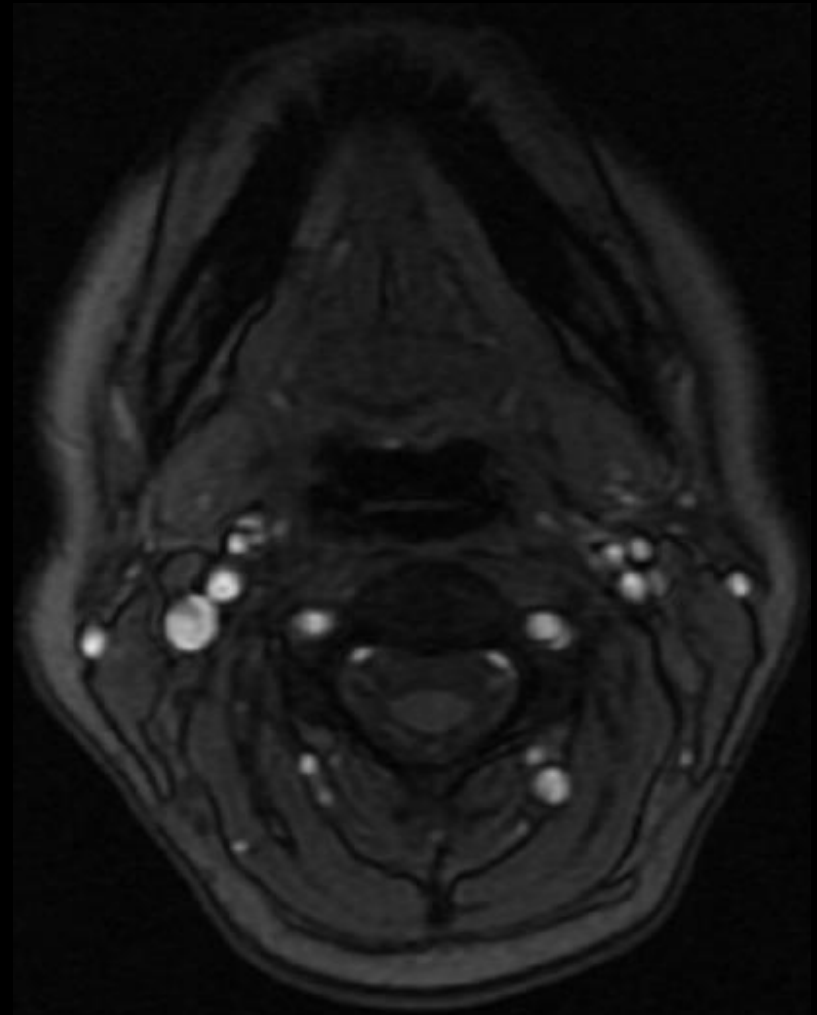
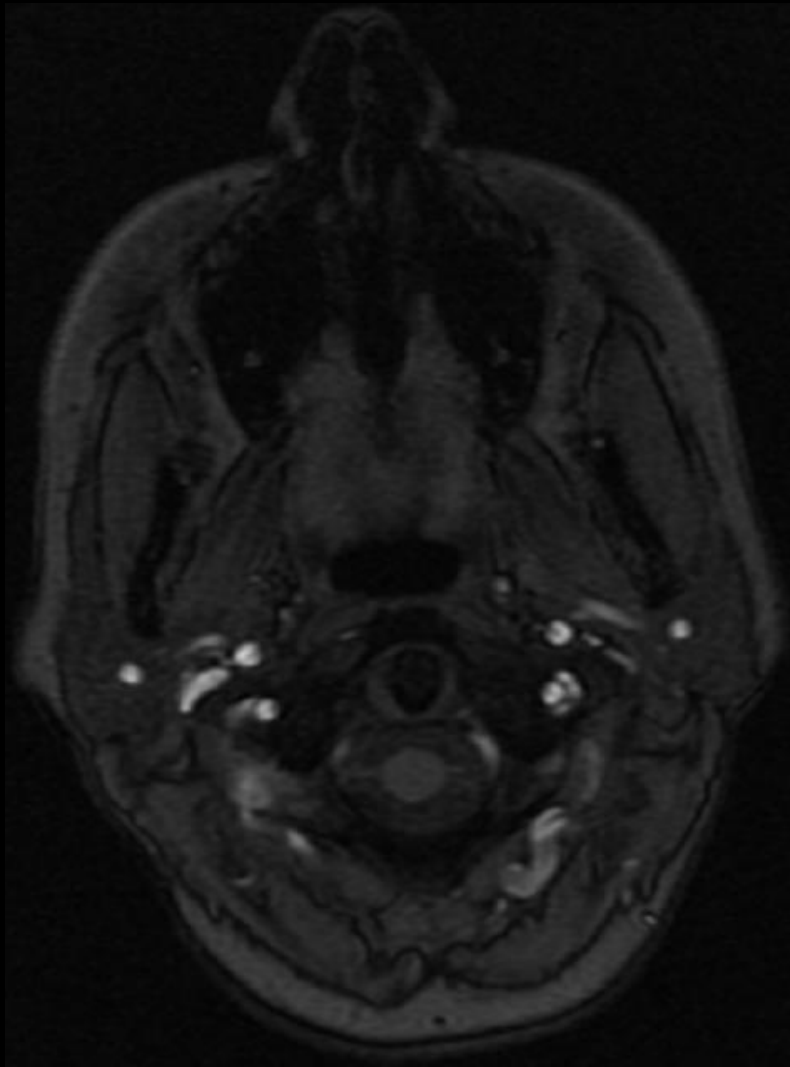






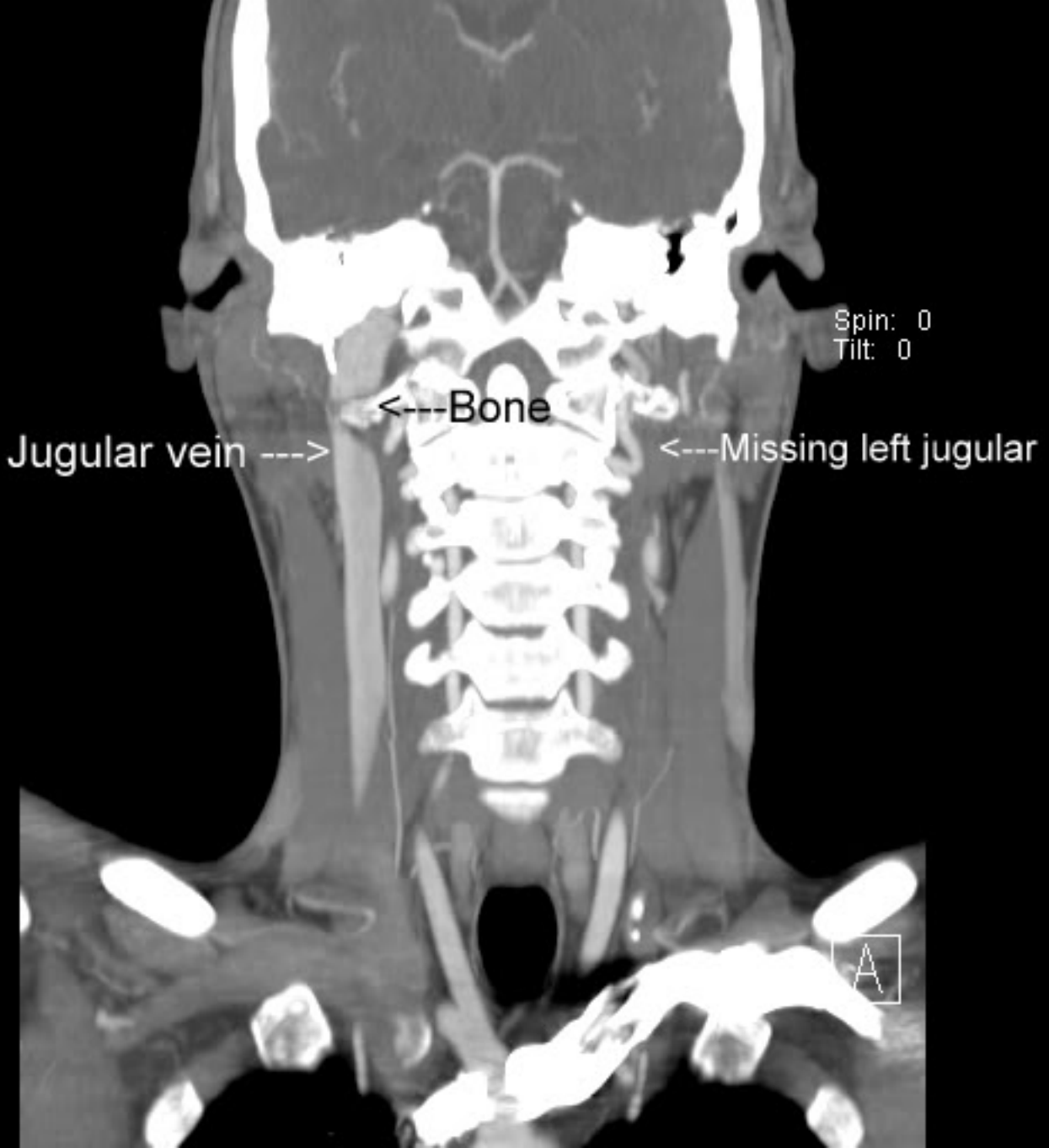


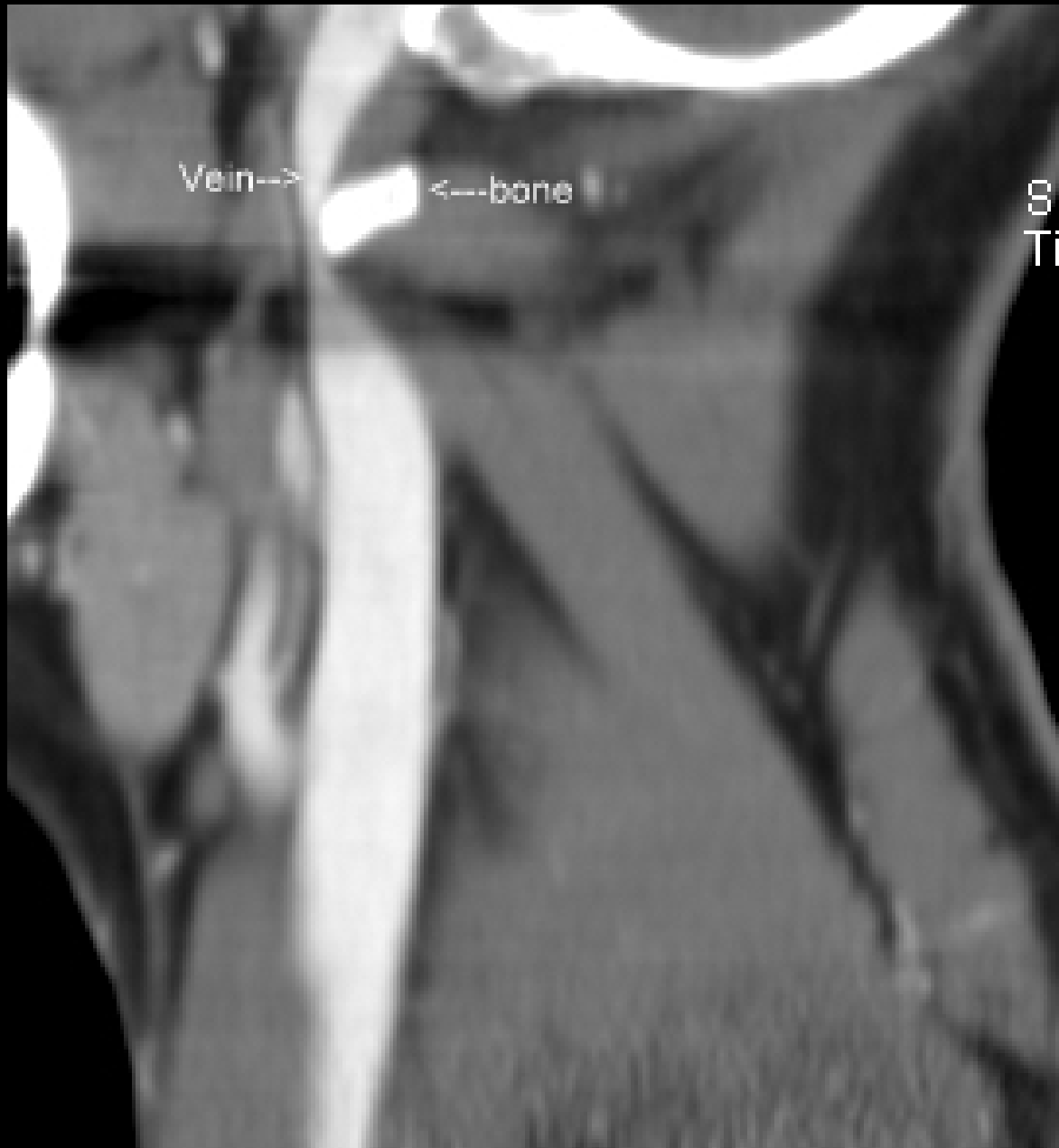
Asymmetric compression of non-dominant left IJ by C1 lateral mass



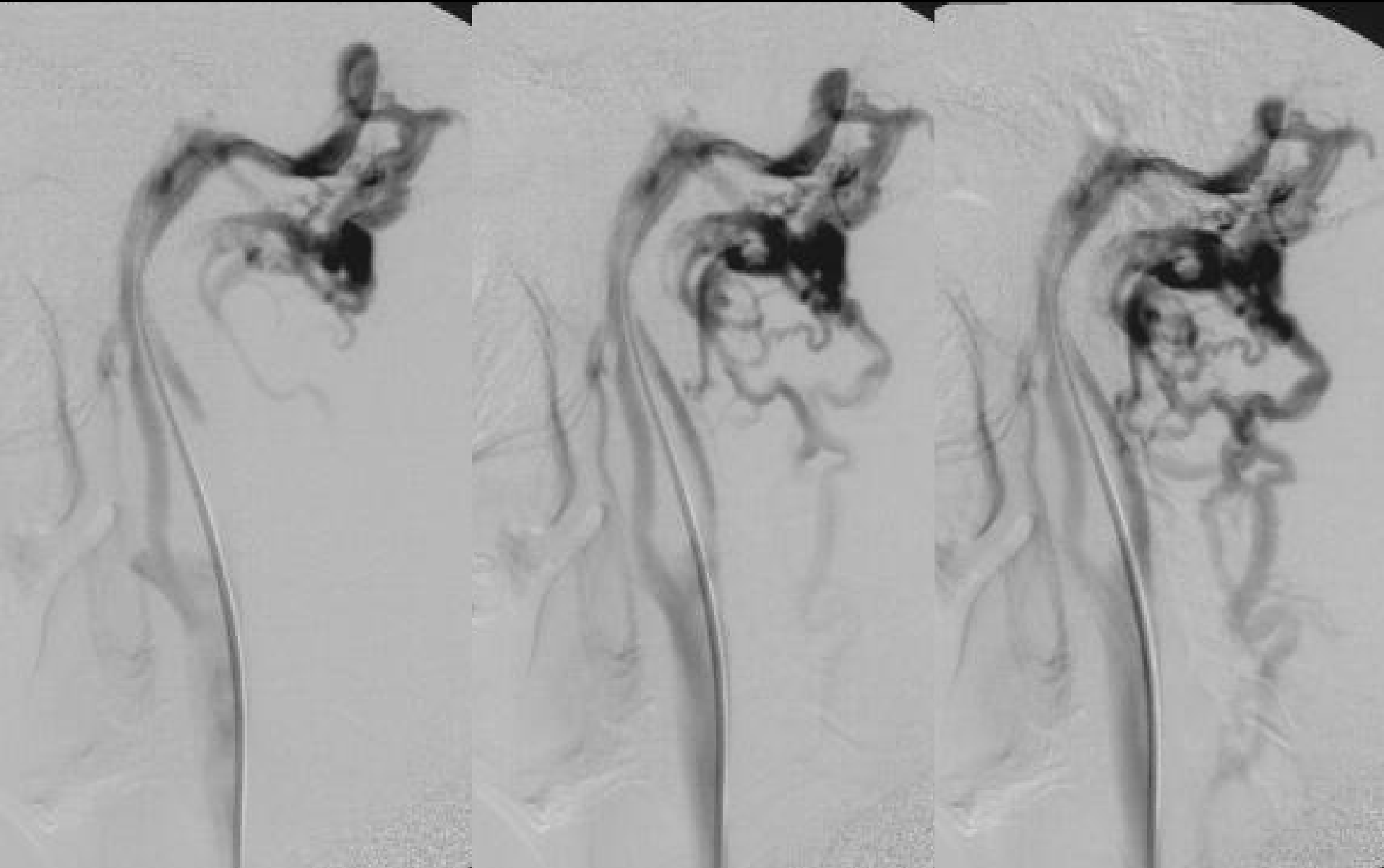
SW



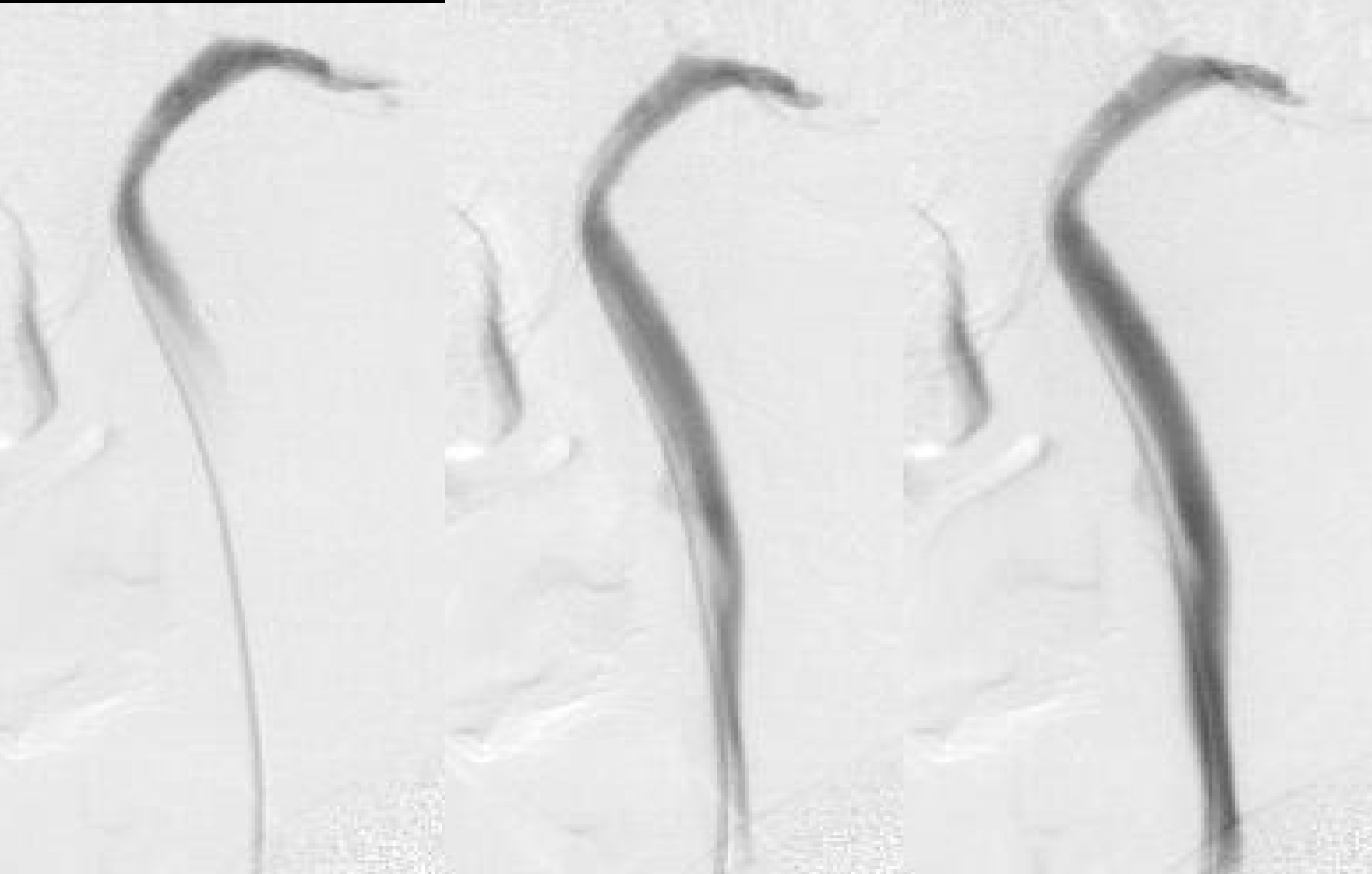




Collaterals Associated with Mid RIJ Stenosis



RIJ Post Stent Placement



Mid Jugular Lesions



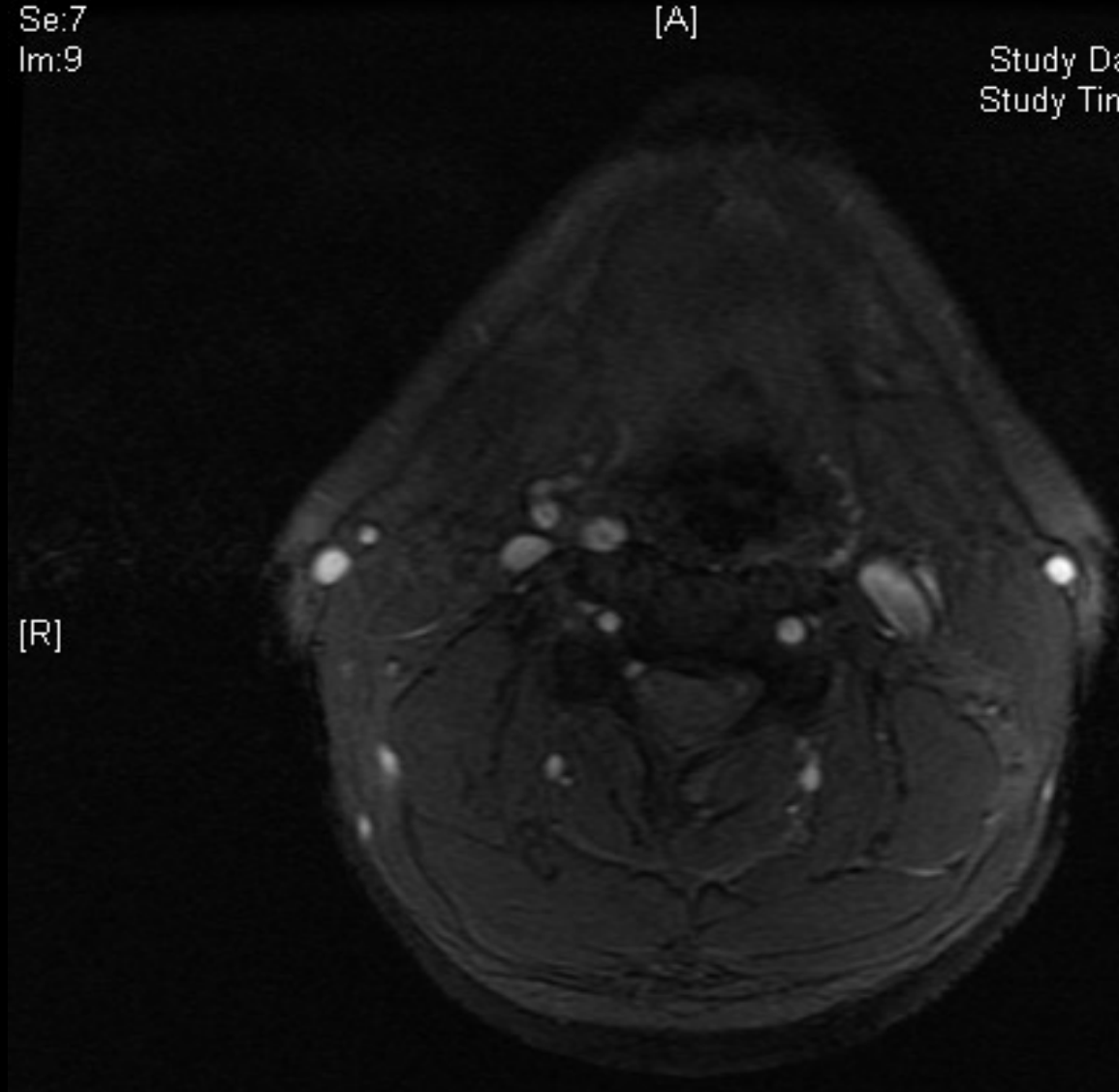
Axial MR with mid jugular compression by ectatic carotid

Se:7
Im:9

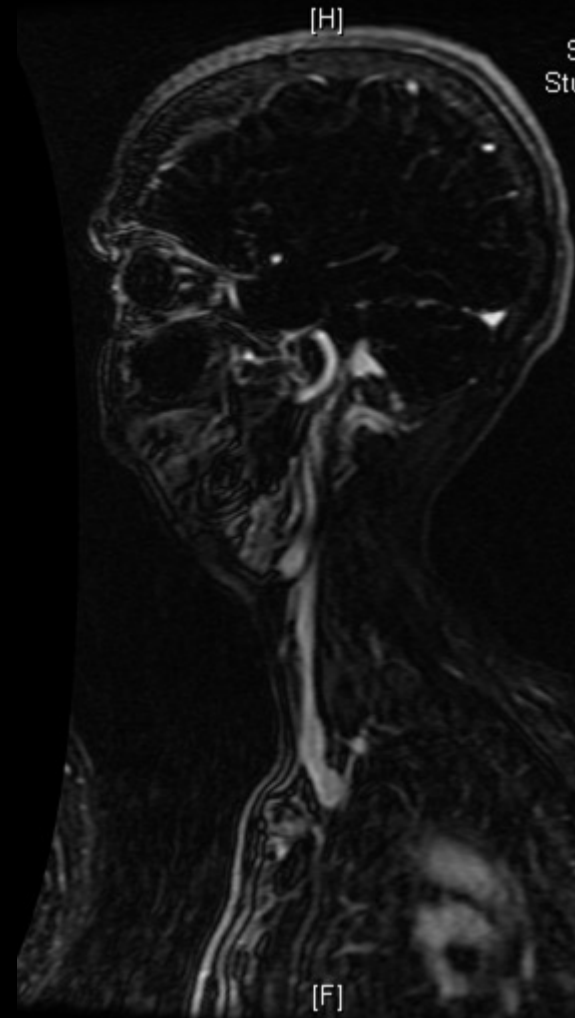
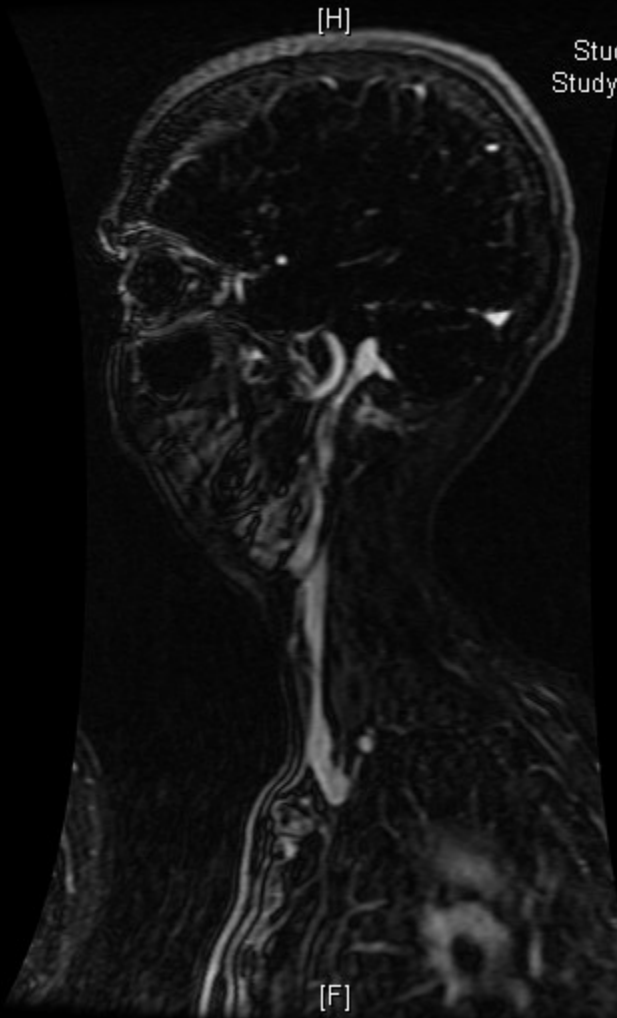
[A]

Study Da
Study Tim

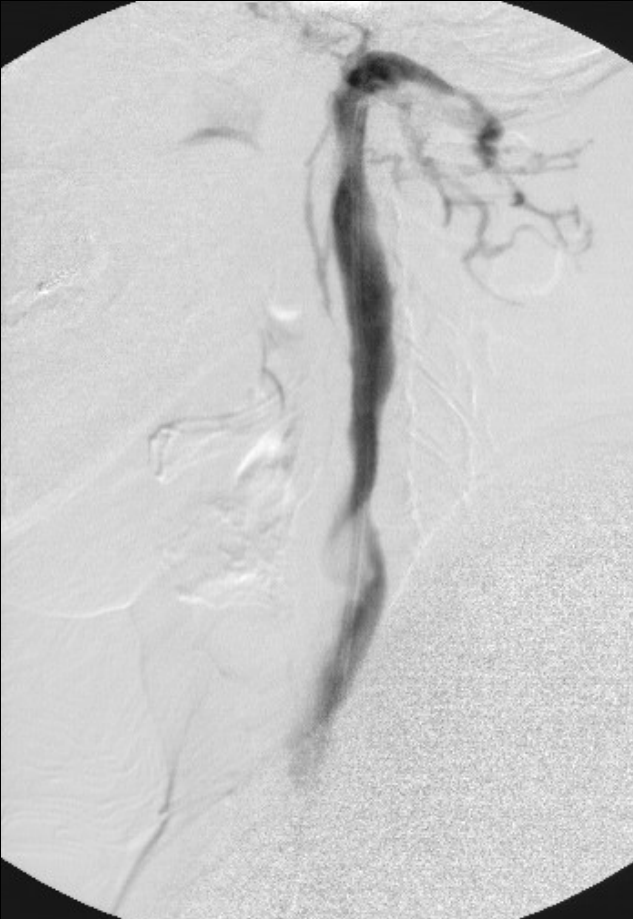
[R]



Carotid impression upon mid-jugular



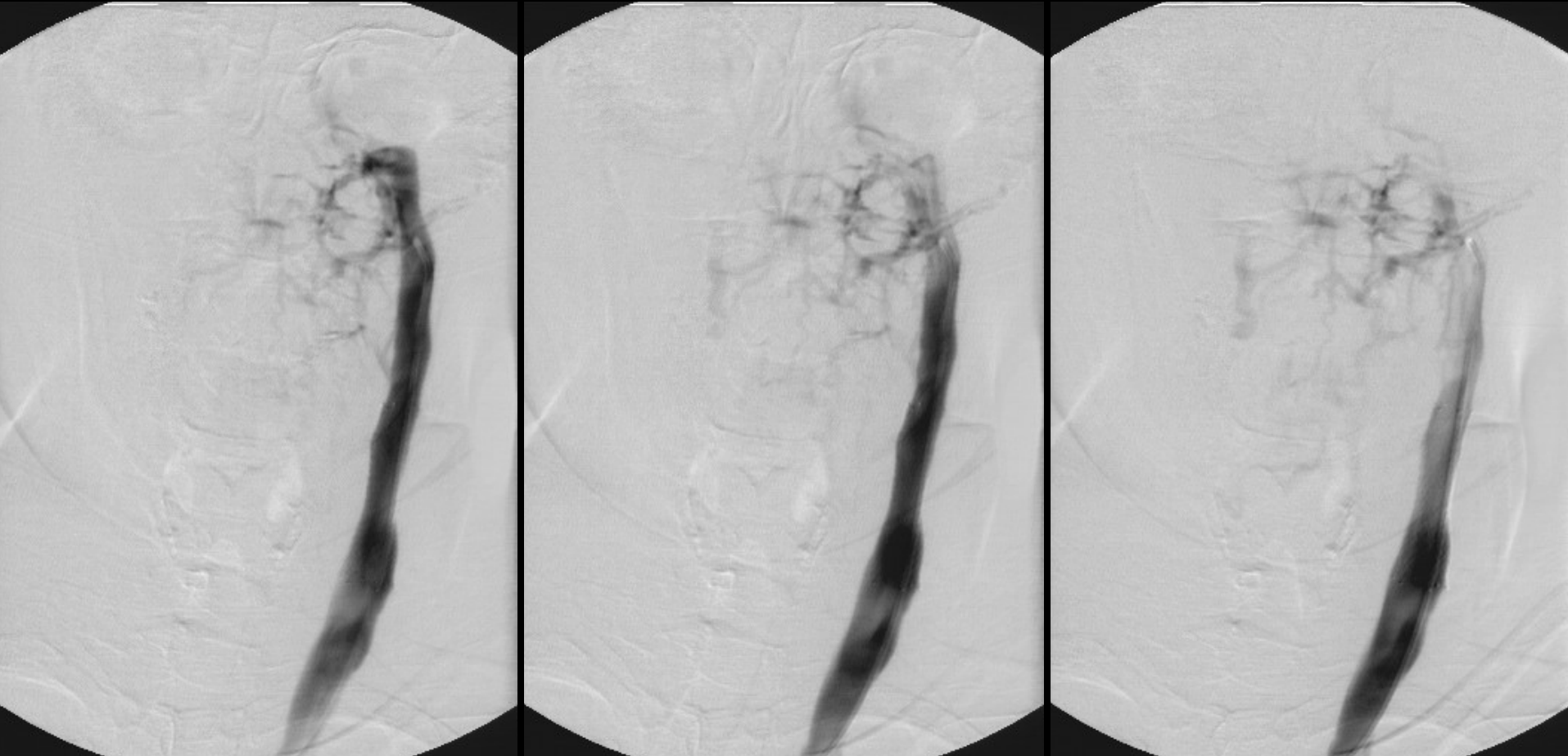
Lateral view of left mid-jugular narrowing



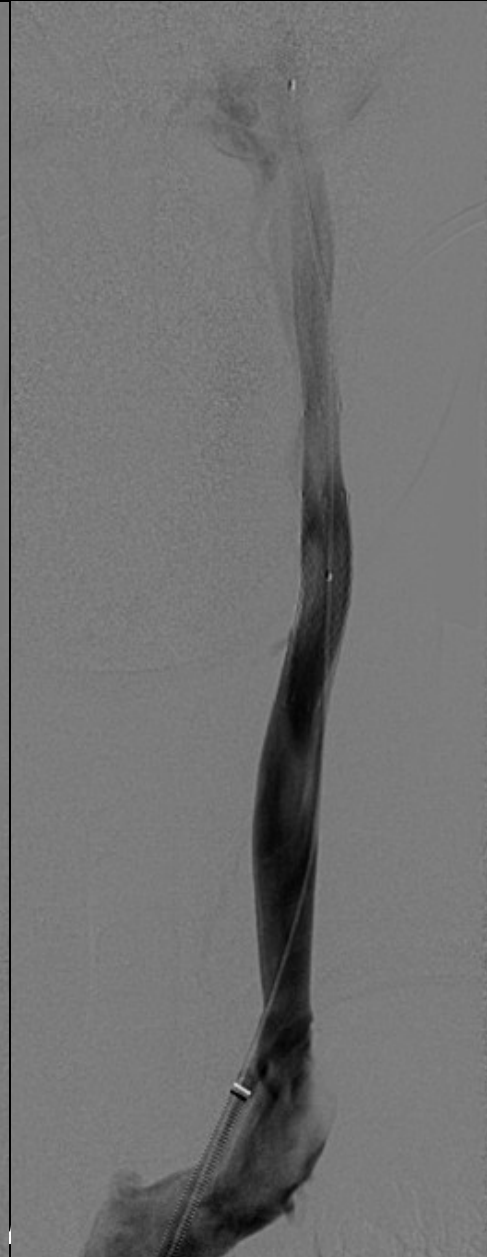
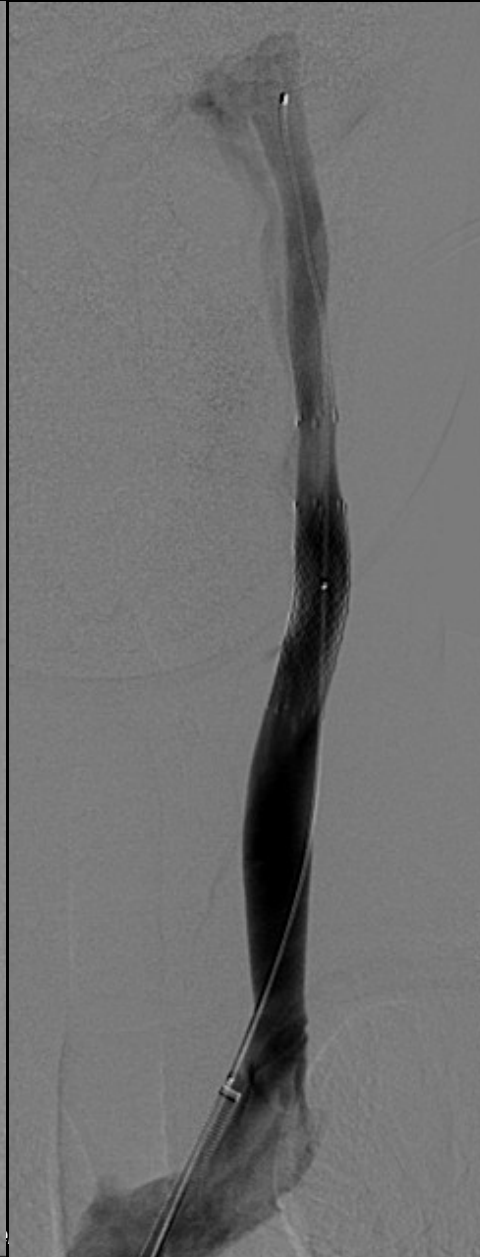
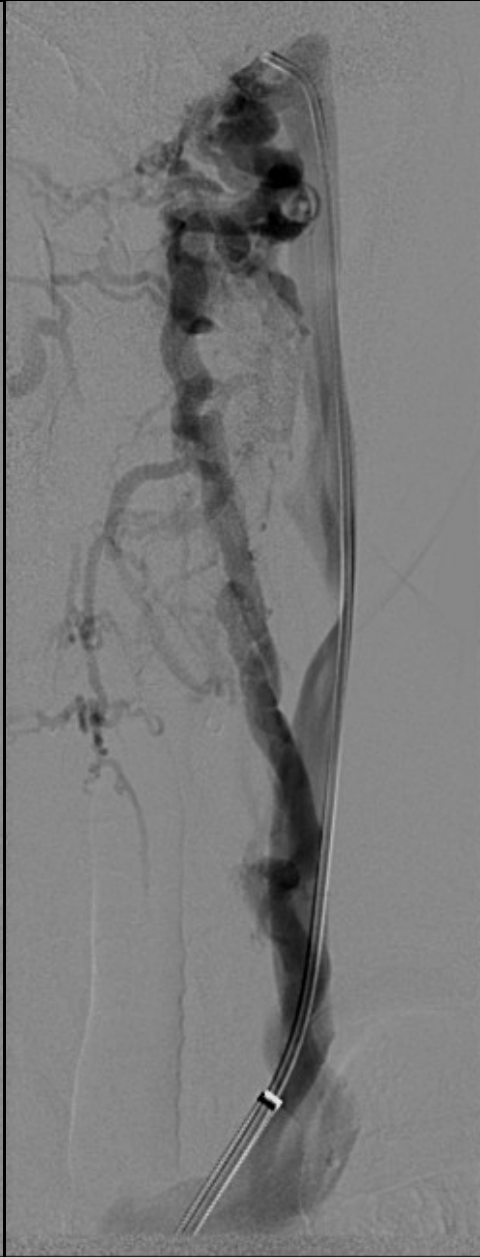
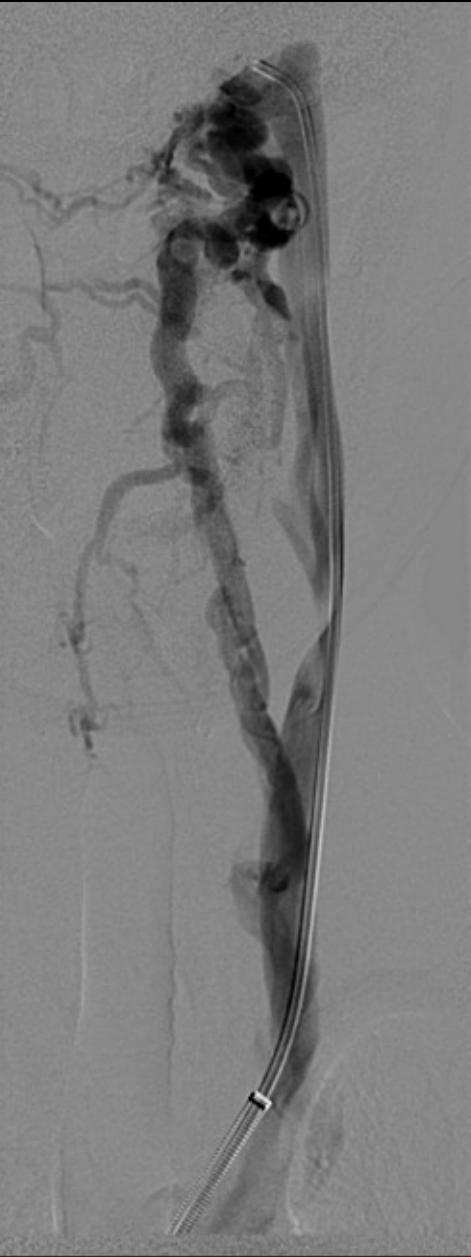
Mid-jugular carotid compression



Post-stent placement in mid-jugular



Venography Pre/Post stent



Low Jugular Lesions



2159759-6
St: 9441 Se: 203
2009/06/02
09:46:45

MR
MIP Mag: 1.16
HFS

SIGNA HD
shmrtr
3/16

Right jugular narrowing

**No flow seen in this
Segment on the left**



10.00mm/div

TR: 7.20 ms
TE: 2.45 ms
TI: 0.00 ms
FOV: 390.00
Thickness: 3.80 mm
Scan Opt: FAST_GEMS\MIP_GEMS\PFF

10.00mm/div

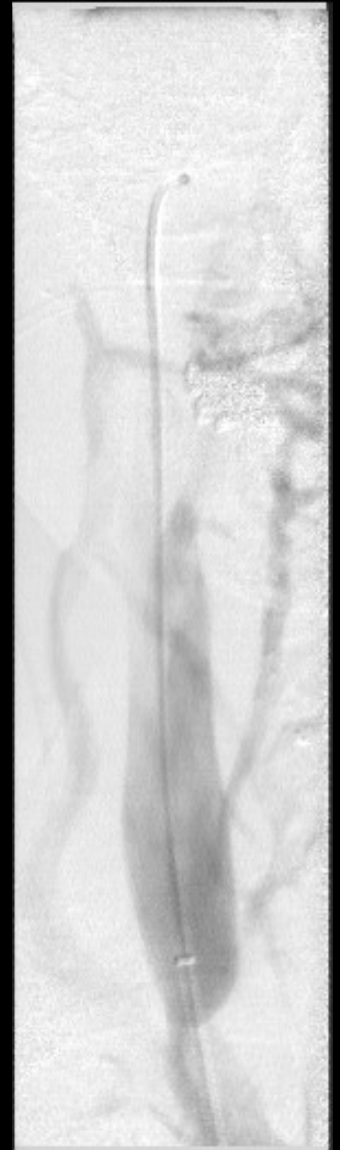
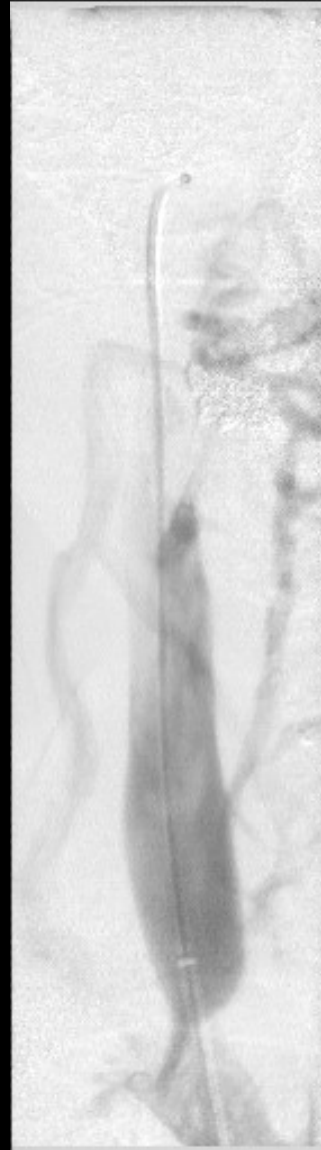
W: 1066 L: 625
LeftButton: Rotate



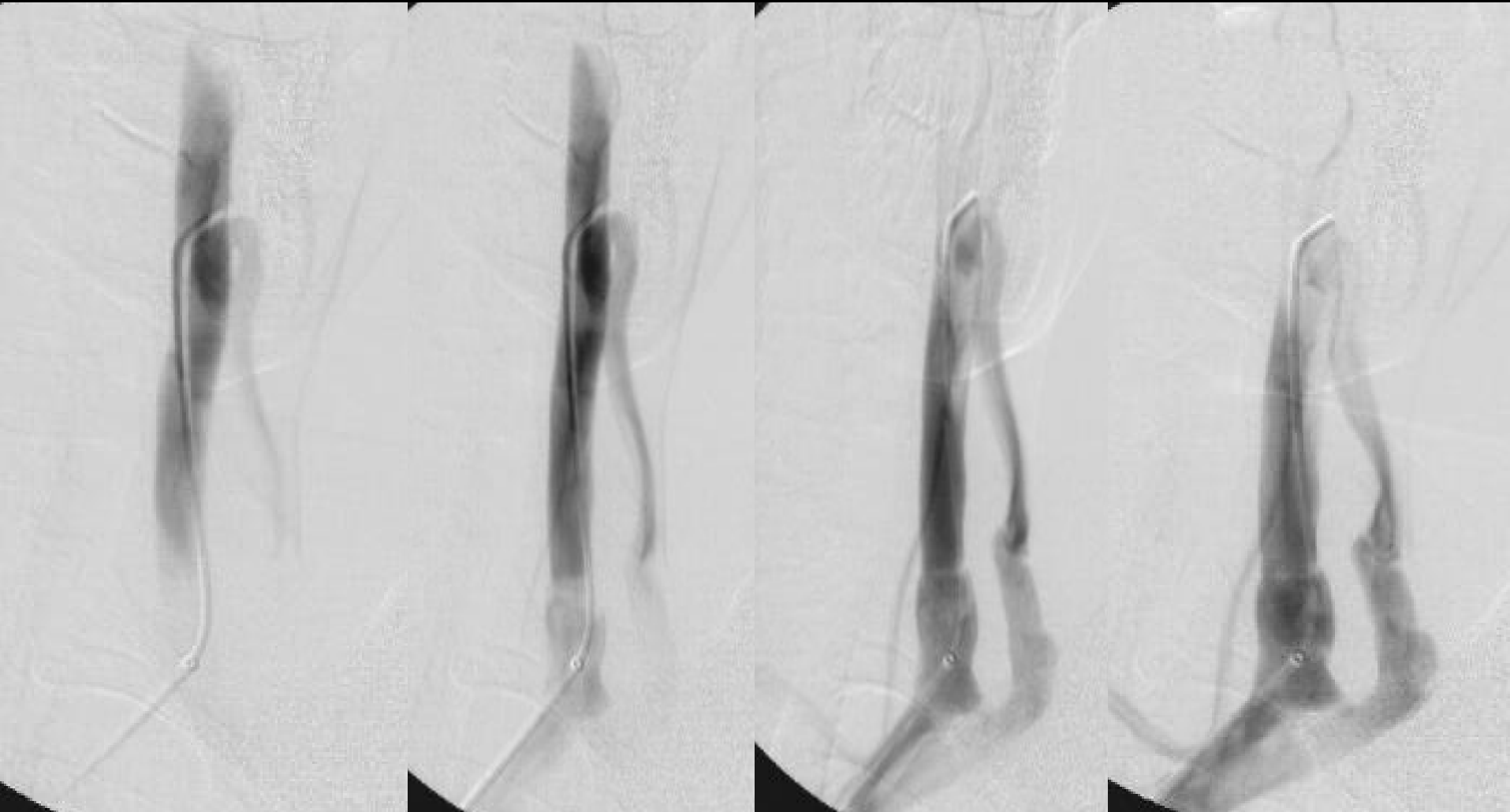
Jugular Valves



Narrowed valve orifice



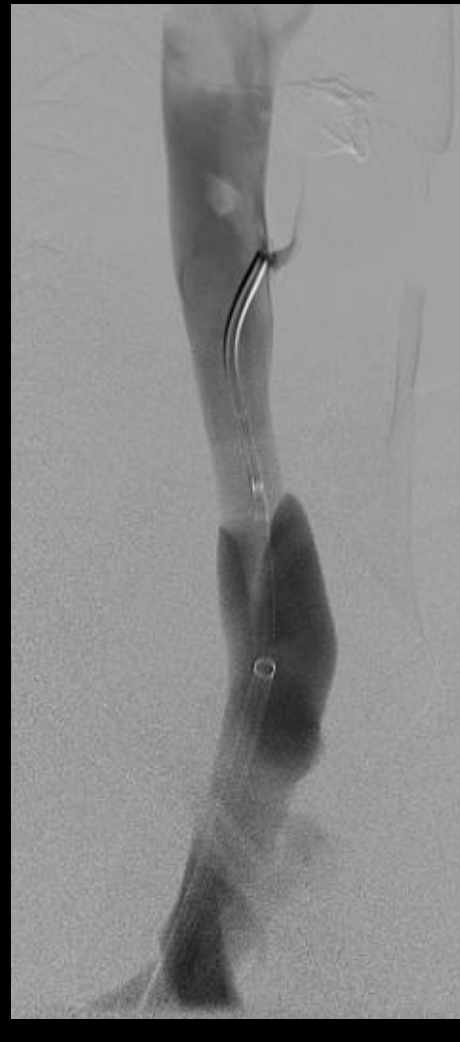
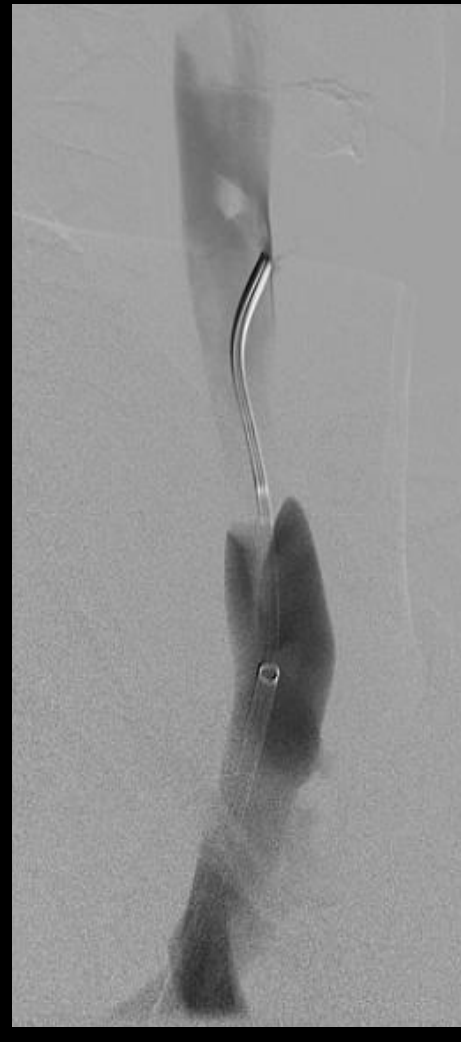
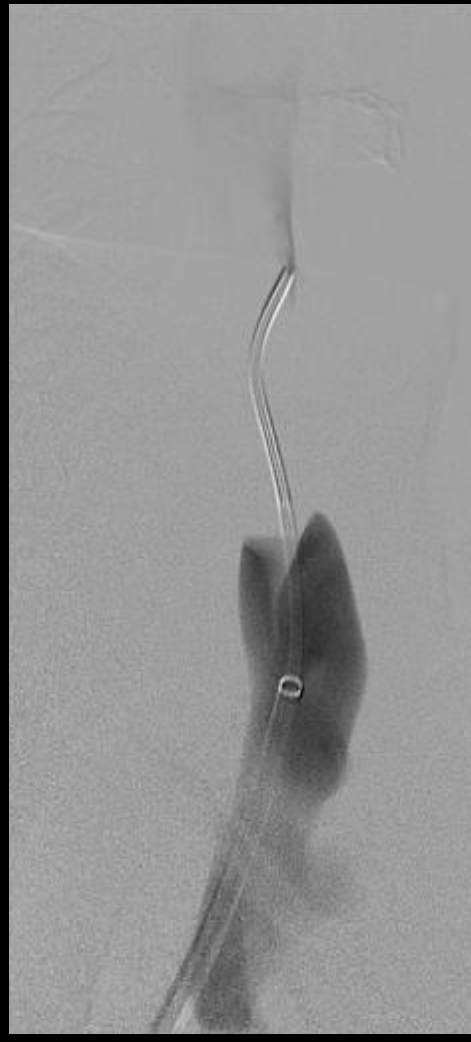
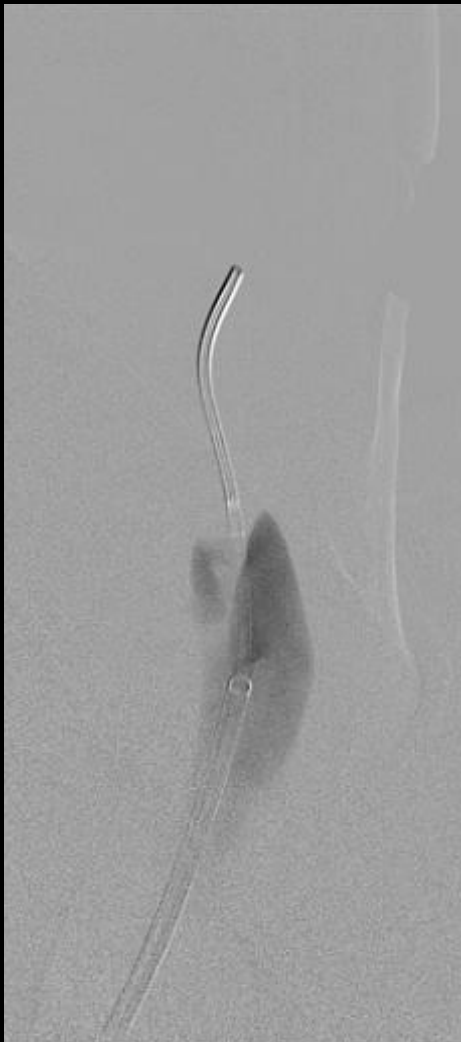
LIJ Venogram with Large Collateral



Prominent valve cusps more conspicuous on left



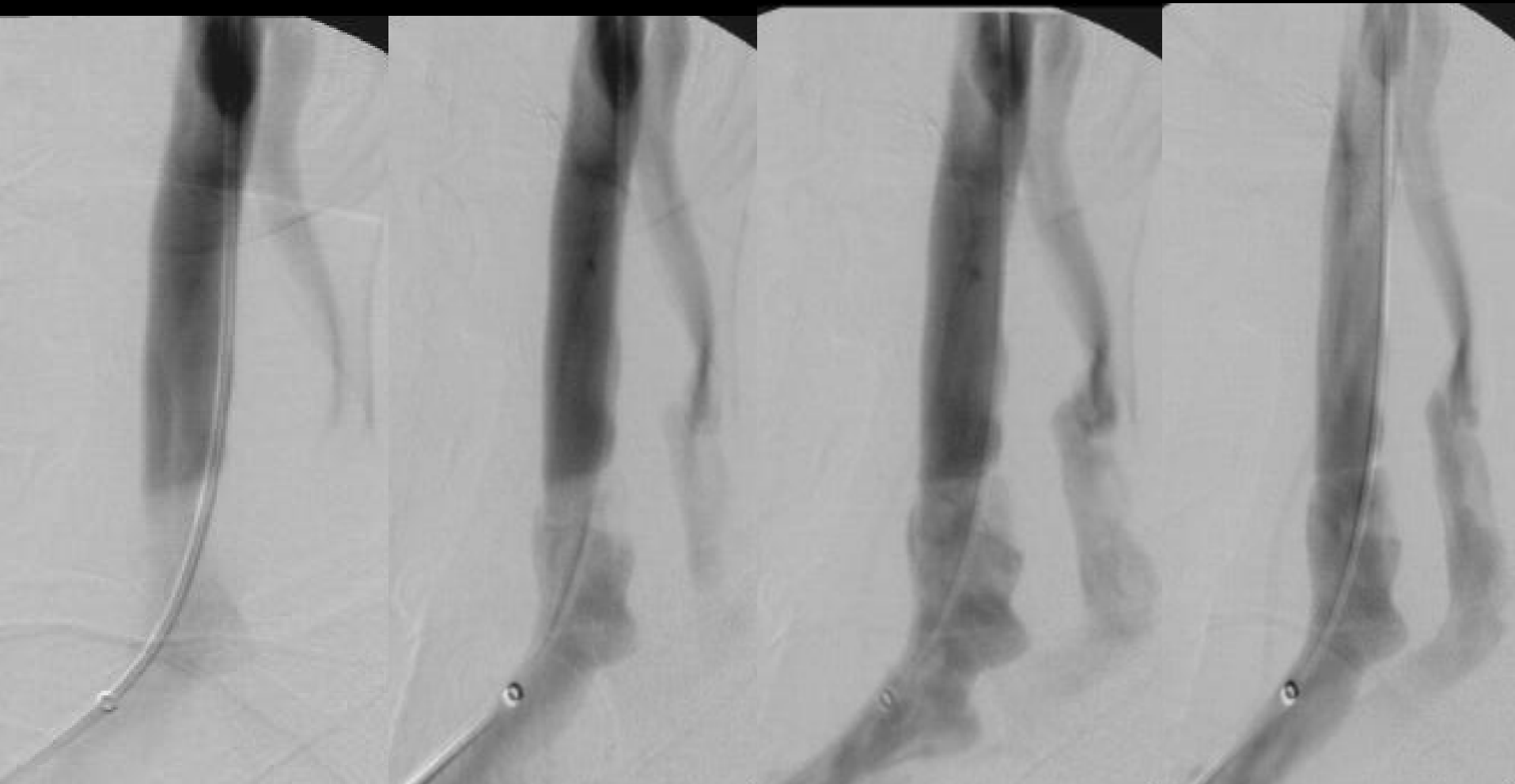
Too Competent...Stuck Leaflet?



12 mm PTA of LIJ Valve



Post-PTA LIJ Venogram



Post-Stent LIJ Venogram



Azygous



Pre/Post stenting of twisted descending azygous vein



What causes the venous
narrowing?



Constellations of locations and etiologies of venous obstruction in patients with MS

- *High Internal Jugular (C1-3 vertebral level)*
 - Often at C1 associated with impingement from anterior aspect of broad-based transverse process
 - May be a dynamic obstruction related to position (vein stretched when supine with neck extended)
 - PTA ineffective; stent commonly improves, but outward force may cause pressure injury to CN XI (accessory nerve) which runs in jugular sheath
- *Mid Internal Jugular (middle third between upper and lower segments, C4-6)*
 - Usually secondary to arterial compression from ectatic carotid located medial to vein (side by side) as opposed to anterior/posterior relationship
 - PTA ineffective; stent placement relieves compression
- *Low Internal Jugular (lower third, including valvular segment, C7-T2)*
 - Pancake flattening subjacent to sternocleidomastoid muscles has a dynamic character of unknown etiology or physiological import
 - 2nd loci related to abnormal valve function (stuck or inverted leaflets, stiff/stenosed valve, etc.)
 - These sites may exist in combination or alone. Valve abnormalities frequently respond to PTA, with stent placement reserved for persistent obstruction

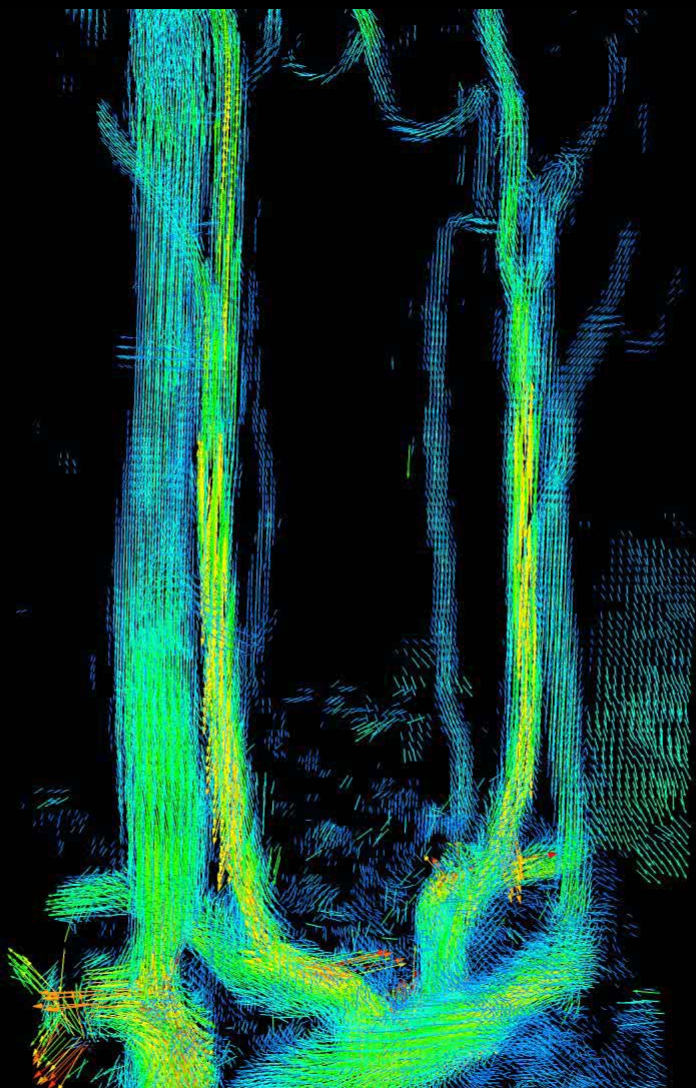
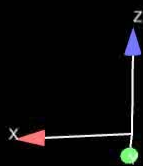


How do we know if the venous lesion is significant?



Collaterals Pressure Gradients Flow Patterns



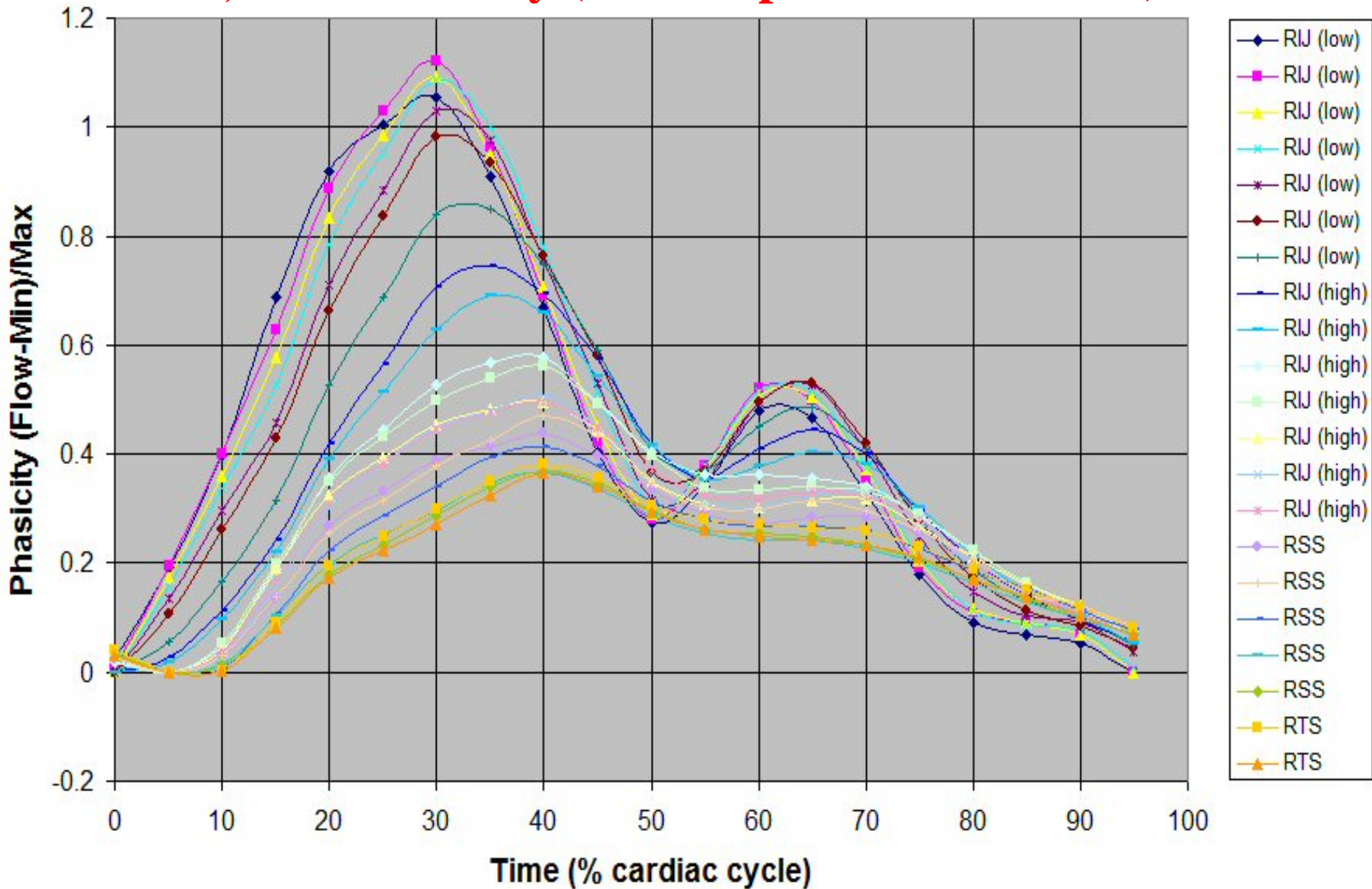


velocity

500
375
250
125
0

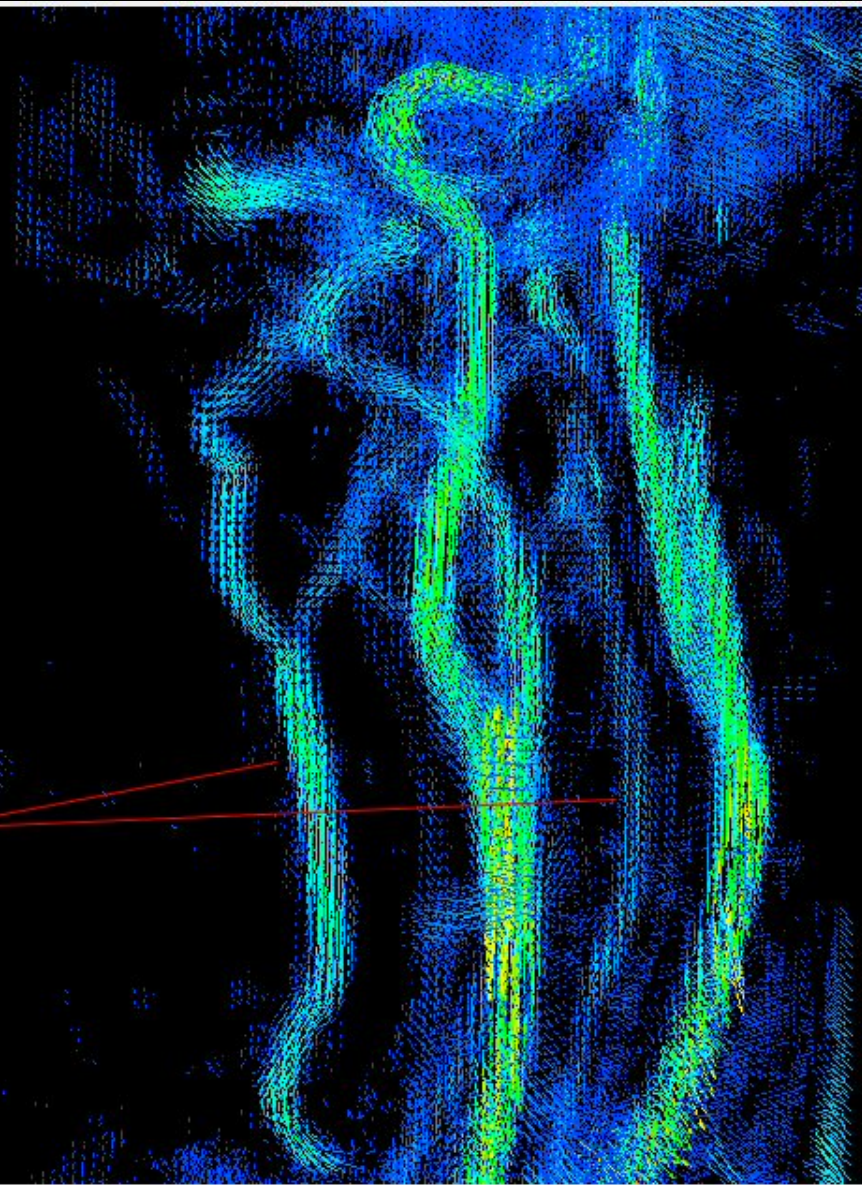
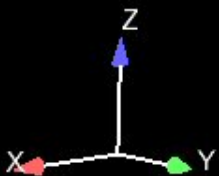


RIJ, RSS Phasicity (cardiac phase re-centered)

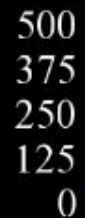


Time = 28.0

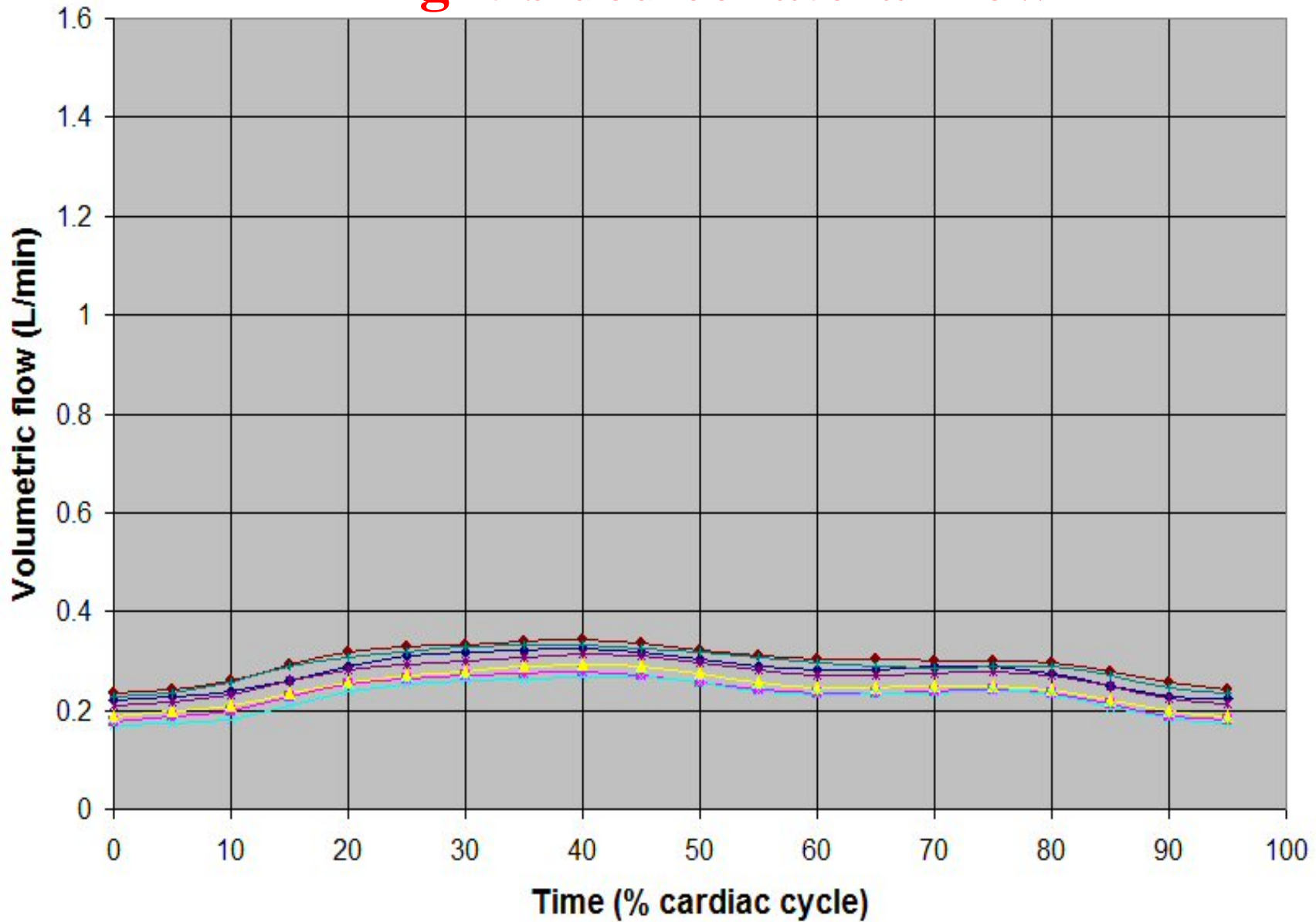
collaterals?



velocity



Right-sided collateral flow



What are the anticipated short and long-term outcomes of endovascular management of extra-cranial venous insufficiency?



Venous Obstruction (CCSVI) and MS

- *Initial Observations Recorded after Endovascular Treatment of Venous Stenotic Lesions*
 - Global symptoms attributable to MS, but not referable to a specific neuro-anatomic loci (ie., fatigue, headache, heat sensitivity, “brain fog“, urinary urgency, etc.), show short-term improvement and in some cases (low EDSS) completely resolve. This suggests that these particular “MS“ symptoms may be more accurately categorized as related to venous obstruction.
 - Early-term follow-up of functional mobility (high EDSS) is not conspicuously changed from pre-procedure.



What are the procedural complications of endovascular intervention (PTA, stent placement, etc.) for venous obstruction?



Complications and Untoward Effects

- **Bleeding: groin hematoma, excessive bruising, intra-cranial hemorrhage/death**
- **Stent migration**
- **Headache, nausea, ear plugging, neck/throat discomfort**
- **Trapezius pain, shoulder weakness and decreased ROM due to CN XI (accessory) pressure “injury”**
- **Re-narrowing or obstruction of treated segment**
- **No stroke, MI, worsening of existing symptoms**



The Association of Chronic Cerebro-Spinal Venous Insufficiency (CCSVI) and Multiple Sclerosis

Summary Analysis

- *Extracranial venous obstruction*
 - Lesion site is non-specific (dural sinus, jugular, brachiocephalic, azygous veins alone or in combination)
 - Lesion etiology is non-specific (congenital/hereditary, osseous impingement, arterial compression, post-inflammatory, arachnoid granulation, etc., alone or in combination)

