2025 Intracranial Hypotension Conference

Amsterdam June 28-29

Surgical ligation vs endovascular embolization vs percutaneous fibrin sealant (titanium vs rubber vs glue)

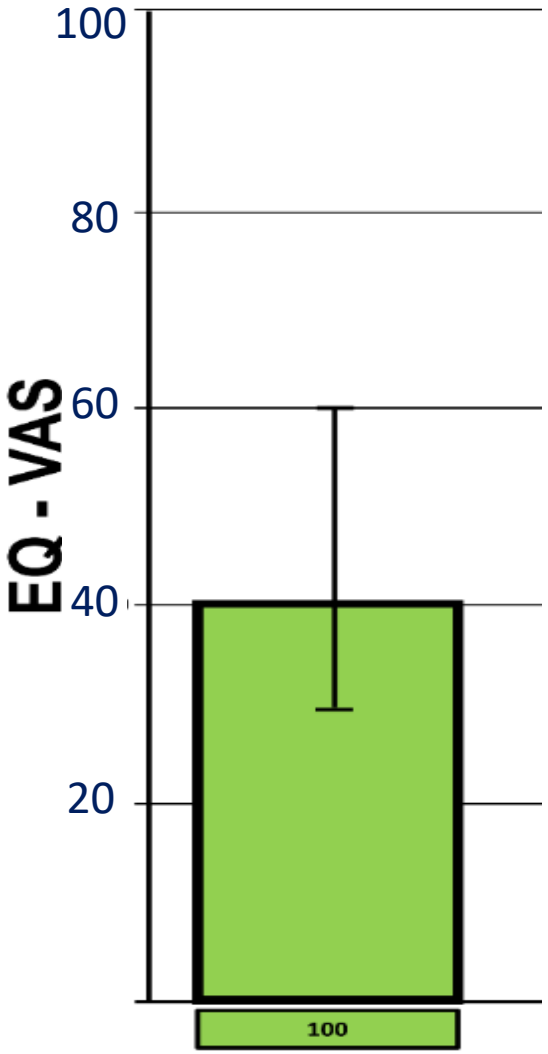
Jürgen Beck

Director Dept. of Neurosurgery

Medical Center – University of Freiburg, Germany

Chair CSF-Section - European Association of Neurosurgical Societies

SIH – Quality of Life



Germany 30-50y

Breast cancer

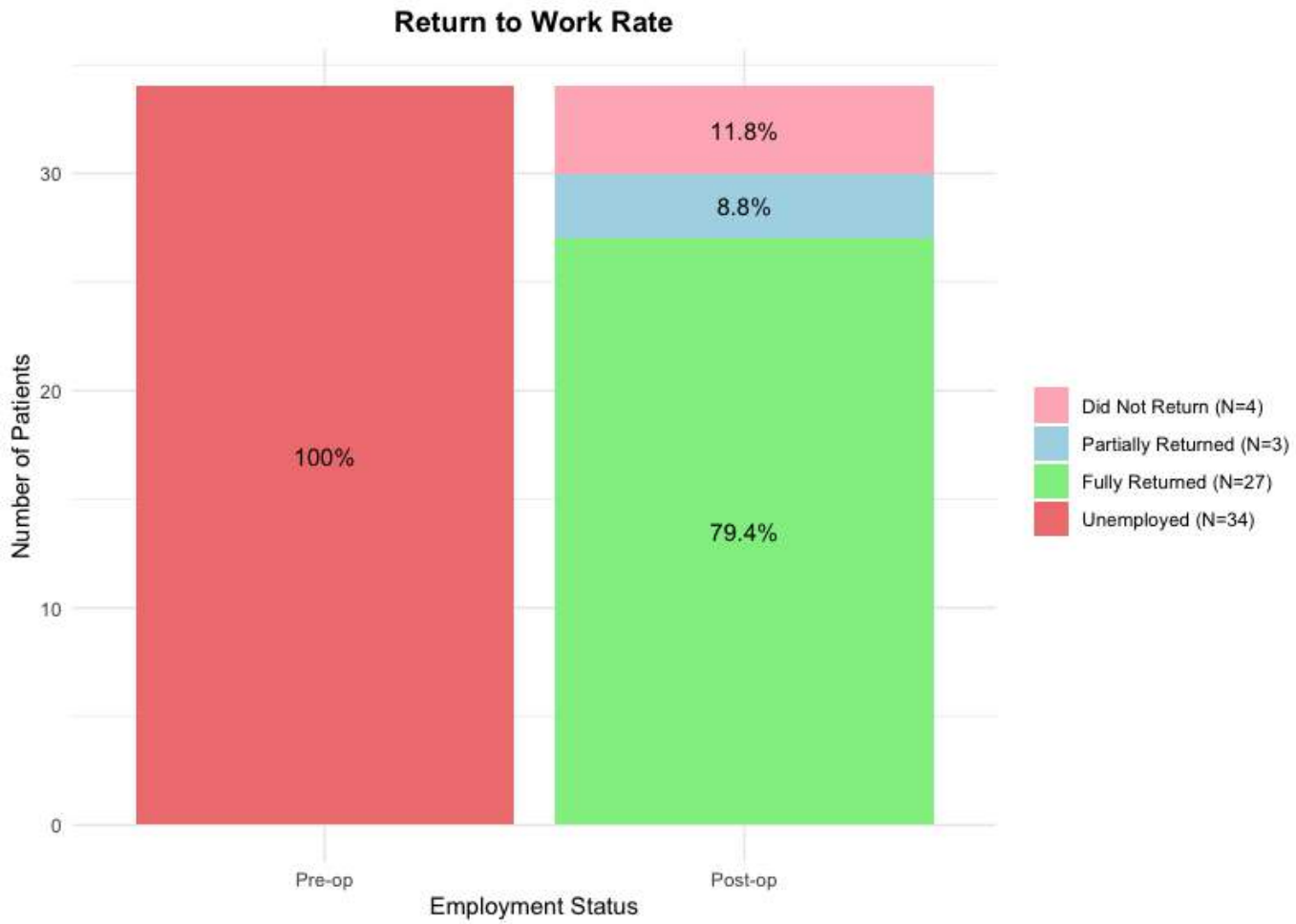
Advanced renal cell carcinoma

Head and neck cancer

SIH

Volz, Wolf, El Rahal et al. 2025

Nerve root clipping for spinal leaks - Return to work rate



Pre op

100% Not able to work

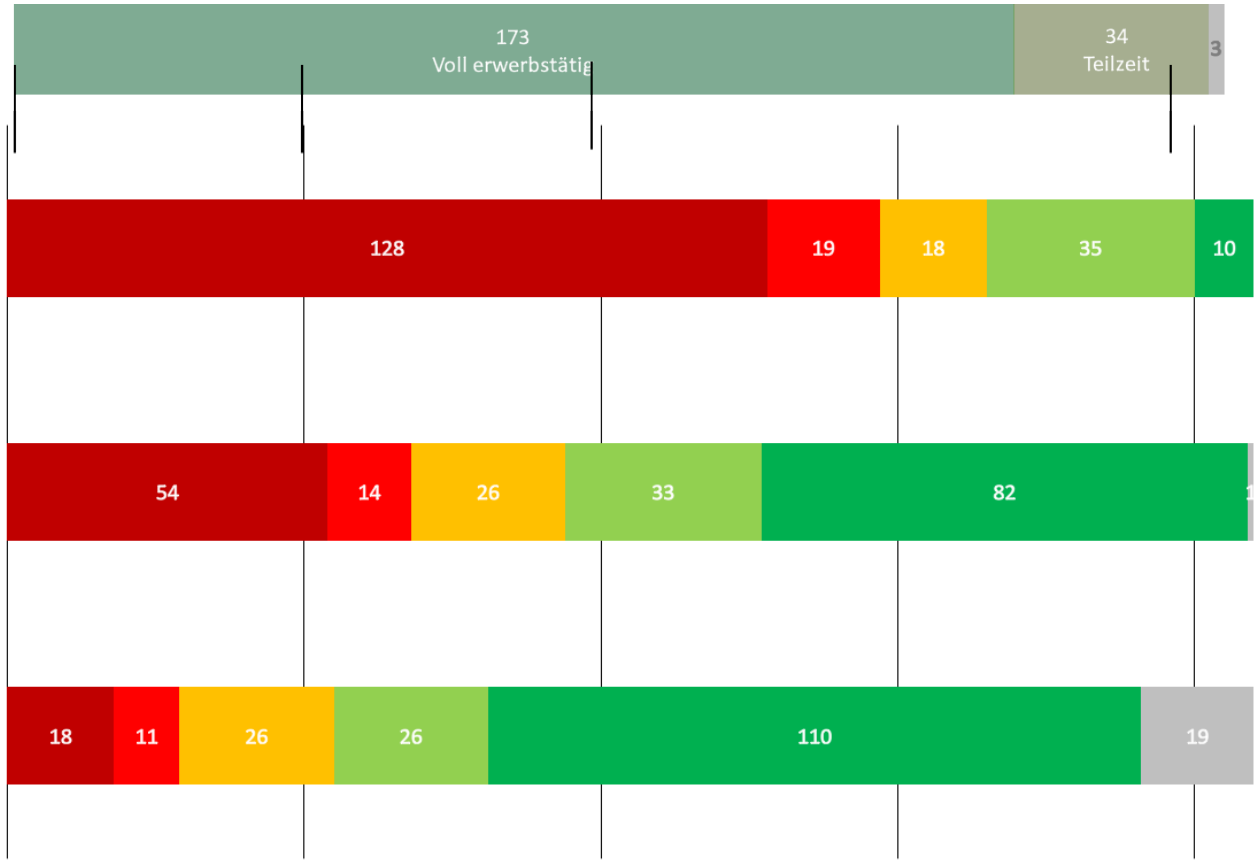
Post op

80% Full employed

El Rahal Beck J, Volz et al. In press 2024

SIH - return to work

SIH



Volz et al.
in preparation

N = 210 patients median age 46 years

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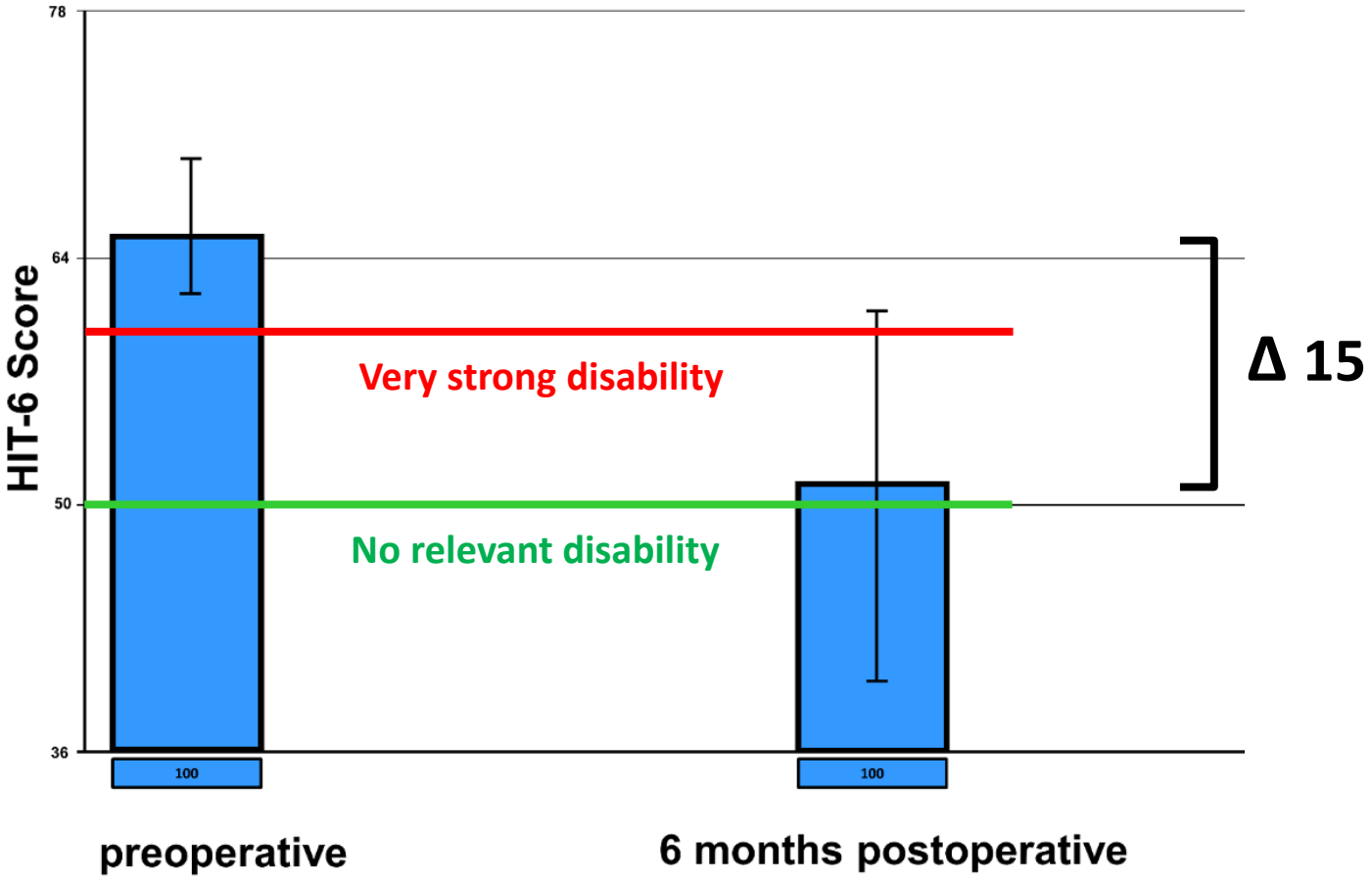
Surgery for SIH

Headache



Home › Journal of Neurology › Article

Don't delay, but don't despair: symptom duration, comorbidity and outcome after closure of spinal cerebrospinal fluid leaks

Original Communication | Open access | Published: 26 February 2024

(2024) Cite this article

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Florian Volz, Amir El Rahal, Christian Fung, Mukesch Shah, Niklas Lützen, Horst Urbach, Jürgen Beck & Katharina Wolf

Clinically relevant changes:

- **2.3** for chronic daily headache
  Coeytaux et al., J Clin Epidemiol 2014
- **2.5** for migraine
  Smelt et al., Cephalalgia 2014
- **8** for tension-type headache
  Castien et al., Cephalalgia 2012

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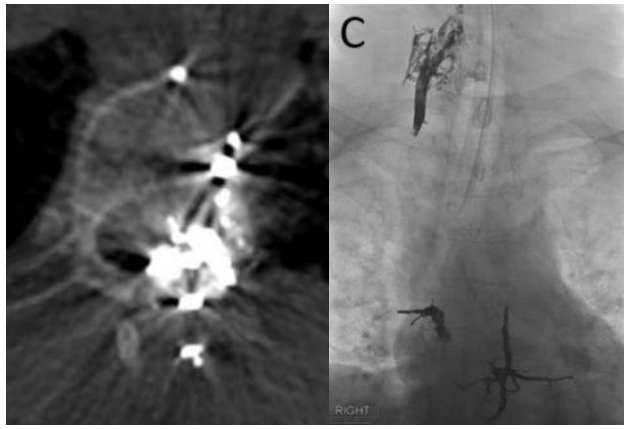
Original research

Clinical and imaging outcomes of 100 patients with cerebrospinal fluid-venous fistulas treated by transvenous embolization

Waleed Brinjikji ,[1,2] Ajay Madhavan,[1] Ivan Garza,[3] Mark Whealy,[3] Narayan Kissoon,[3] Ian Mark ,[1] Pearse P Morris,[1] Jared Verdoorn ,[1] John Benson ,[1] John L D Atkinson,[2] Hassan Kobeissi ,[1] Jeremy K Cutsforth-Gregory [3]



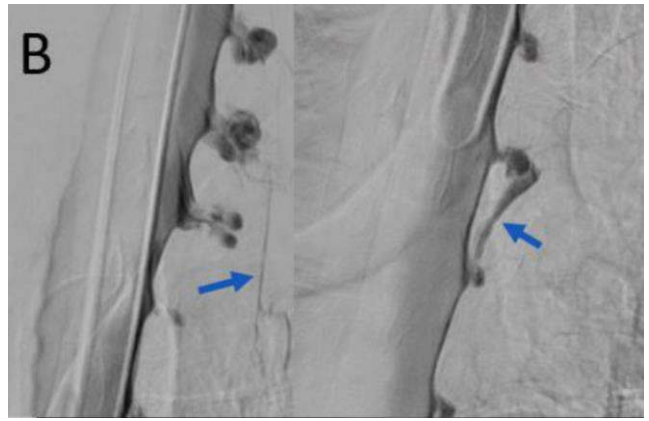
Complete improvement	Partial improvement	No improvement
58	37	5

Brinjikji et al. J NeuroIntervent Surg 2023

Original research

Clinical and imaging outcomes of 100 patients with cerebrospinal fluid-venous fistulas treated by transvenous embolization

Waleed Brinjikji ,[1,2] Ajay Madhavan,[1] Ivan Garza,[3] Mark Whealy,[3] Narayan Kissoon,[3] Ian Mark ,[1] Pearse P Morris,[1] Jared Verdoorn ,[1] John Benson ,[1] John L D Atkinson,[2] Hassan Kobeissi ,[1] Jeremy K Cutsforth-Gregory [3]



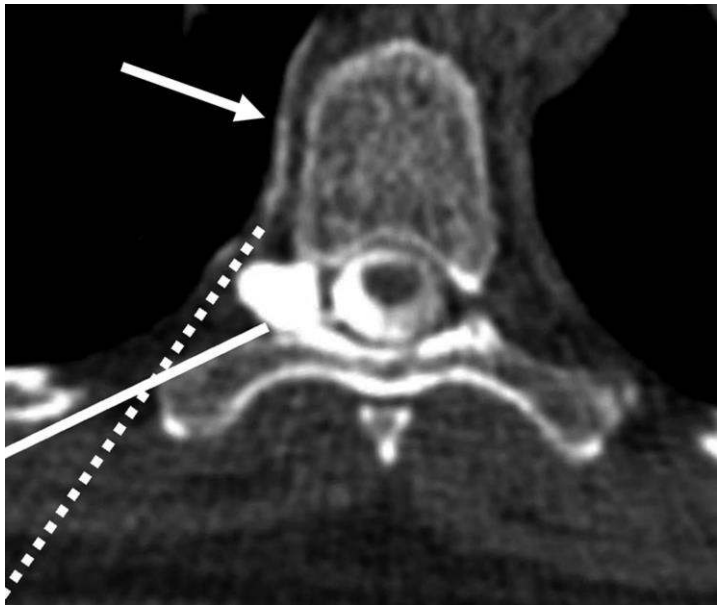
	Complete improvement	Partial improvement	No improvement	P value
N	58	37	5	–
Prior headache history				
None	48 (82.8)	23 (62.2)	2 (40.0)	0.0004
Pachymeningeal enhancement	48 (82.8)	31 (83.8)	0 (0.0)	<0.0001
VS engorgement	44 (75.9)	30 (81.1)	1 (20.0)	0.01
Pre-treatment Bern SIH score	5.9 (3.1)	6.2 (3.2)	2 (2.8)	0.04
Time from symptoms to embolization, months	32.0 (39.4)	49.2 (61.6)	82.6 (81.2)	0.04

Adapted from: Brinjikji et al. J NeuroIntervent Surg 2023

Time to treatment = modifiable

Factors Predictive of Treatment Success in CT-Guided Fibrin Occlusion of CSF-Venous Fistulas: A Multicenter Retrospective Cross-Sectional Study

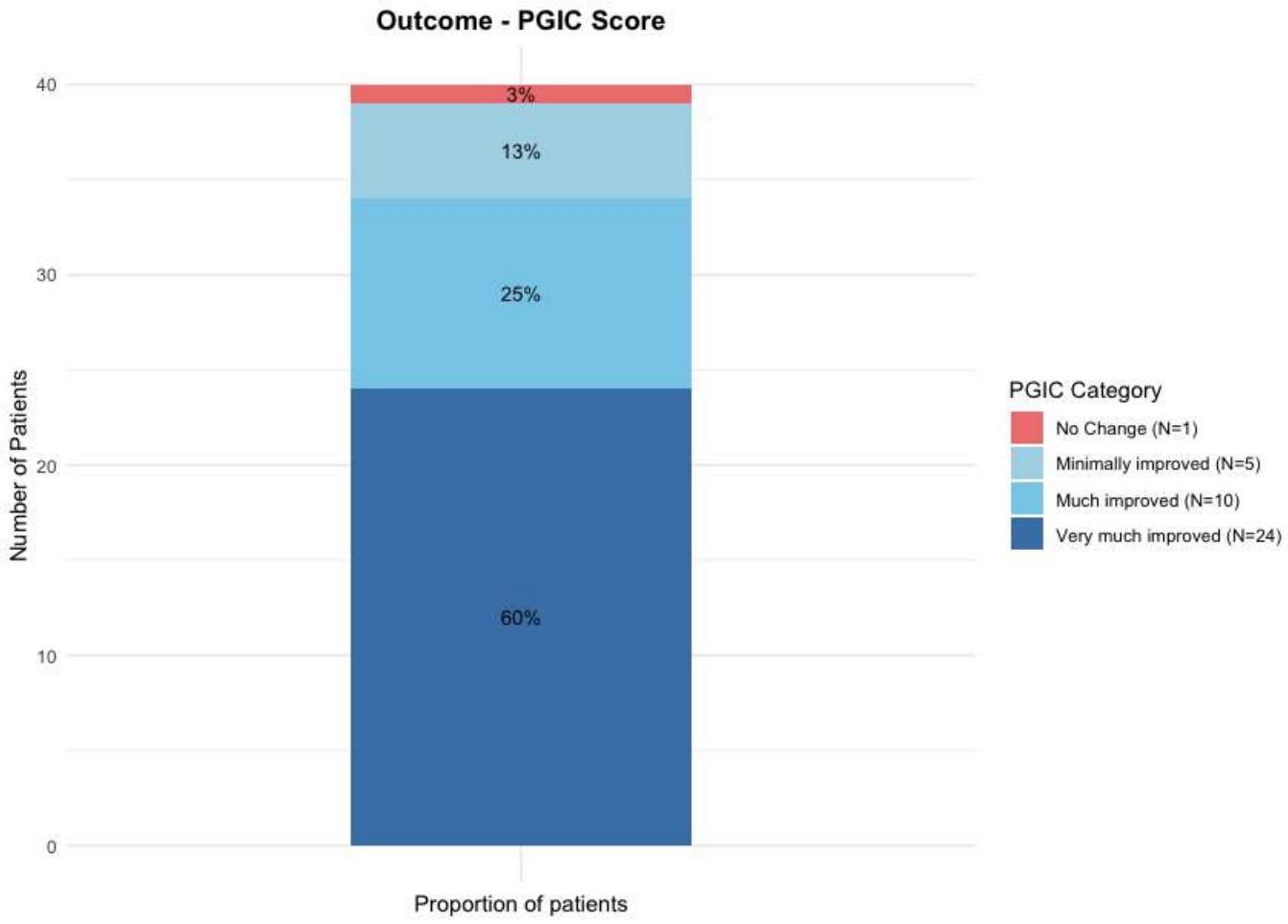
Andrew L. Callen, Lalani Carlton Jones, Vincent M. Timpone, Jack Pattee, Daniel J. Scoffings, David Butteriss, Thien Huynh, Peter Y. Shen, and Mark D. Mamlouk



Clinical improvement	
Complete	71 (59.7%)
None	7 (5.9%)
Partial	41 (34.5%)

Callen et al. AJNR 2023

Nerve root clipping - Patient Global Impression of Change (PGIC)



85% very much/much improved
98% improved

El Rahal Beck J, Volz et al. 2024

Infratentorial Superficial Siderosis and Spontaneous Intracranial Hypotension

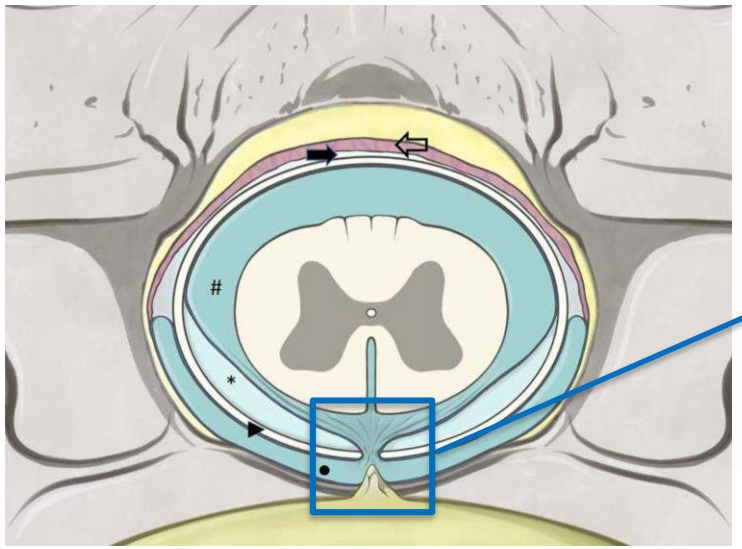
Wouter I. Schievink, MD,[1] M. Marcel Maya, MD,[2] Jennifer Harris, MD,[3]
Javier Galvan, MD,[2] Rachelle B. Taché, NP-C, MSN,[1] and Miriam Nuño, PhD[4]

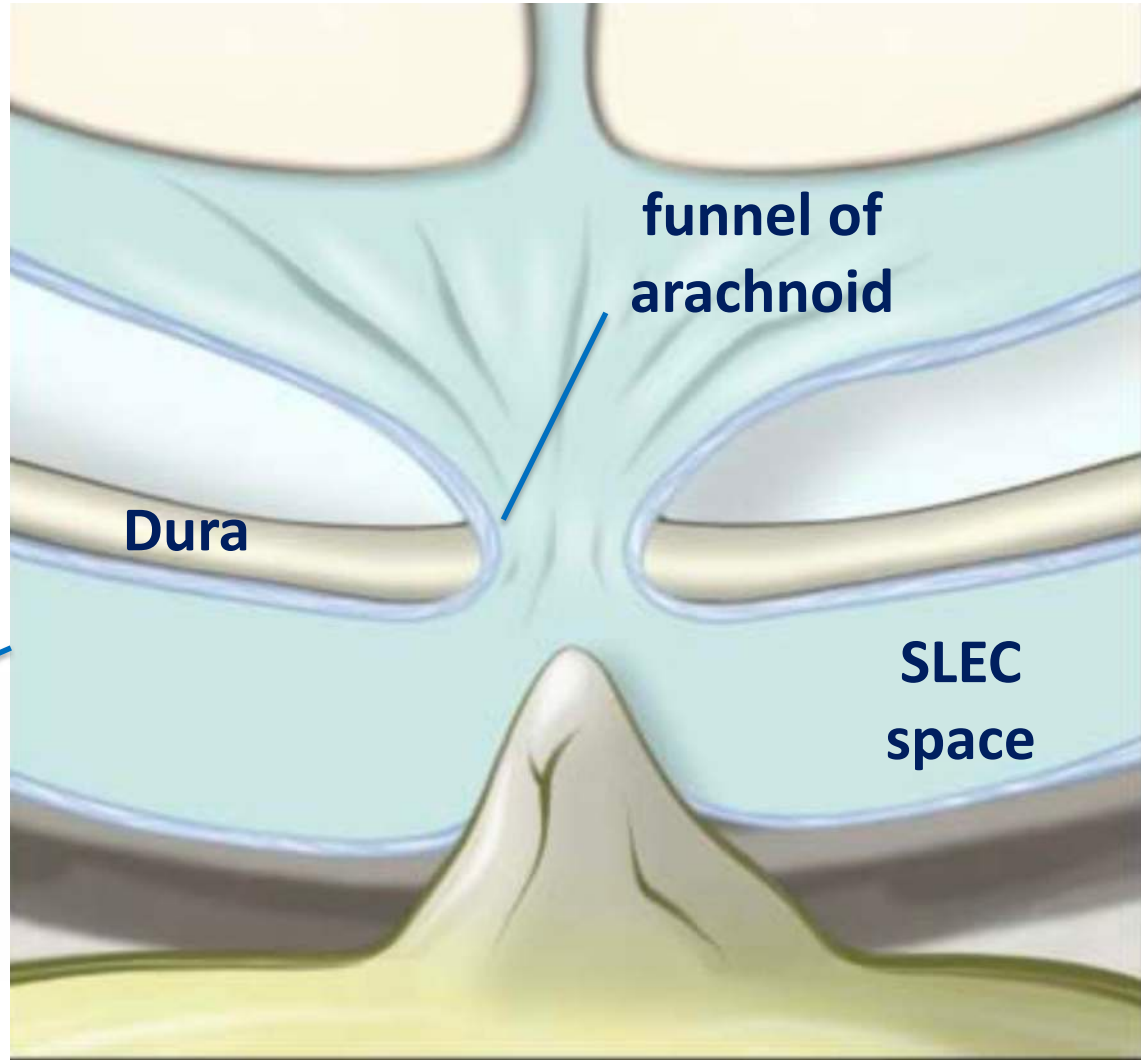
ANN NEUROL 2023

Treatment success

- **ventral CSF leaks could not be eliminated with percutaneous procedures in any patient**
- **surgical repair resulted in resolution of the CSF leak in all patients (know site)**
- **Surgical repair was associated with low risk (<5%)**

Microsurgical anatomy
-
transdural membranes

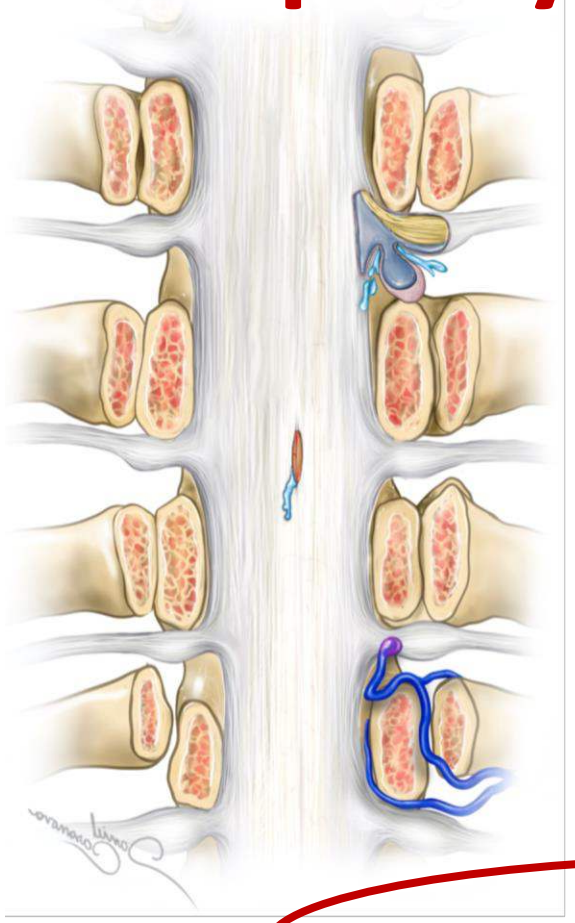




Häni et al. Beck Operative Neurosurgery 2023

Sequelae of a spinal dural leak

„Duropathy“



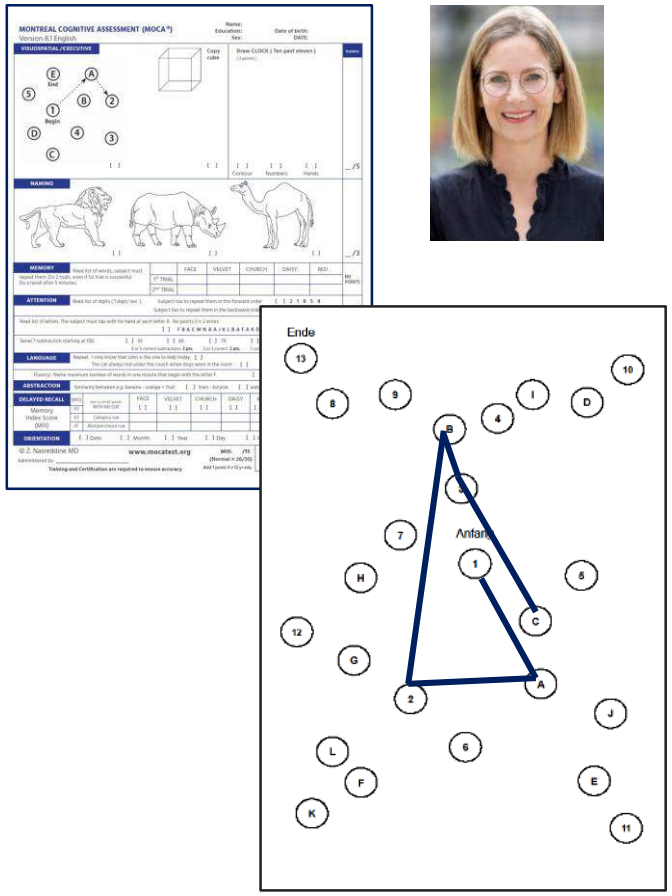
Type 2 → Acute

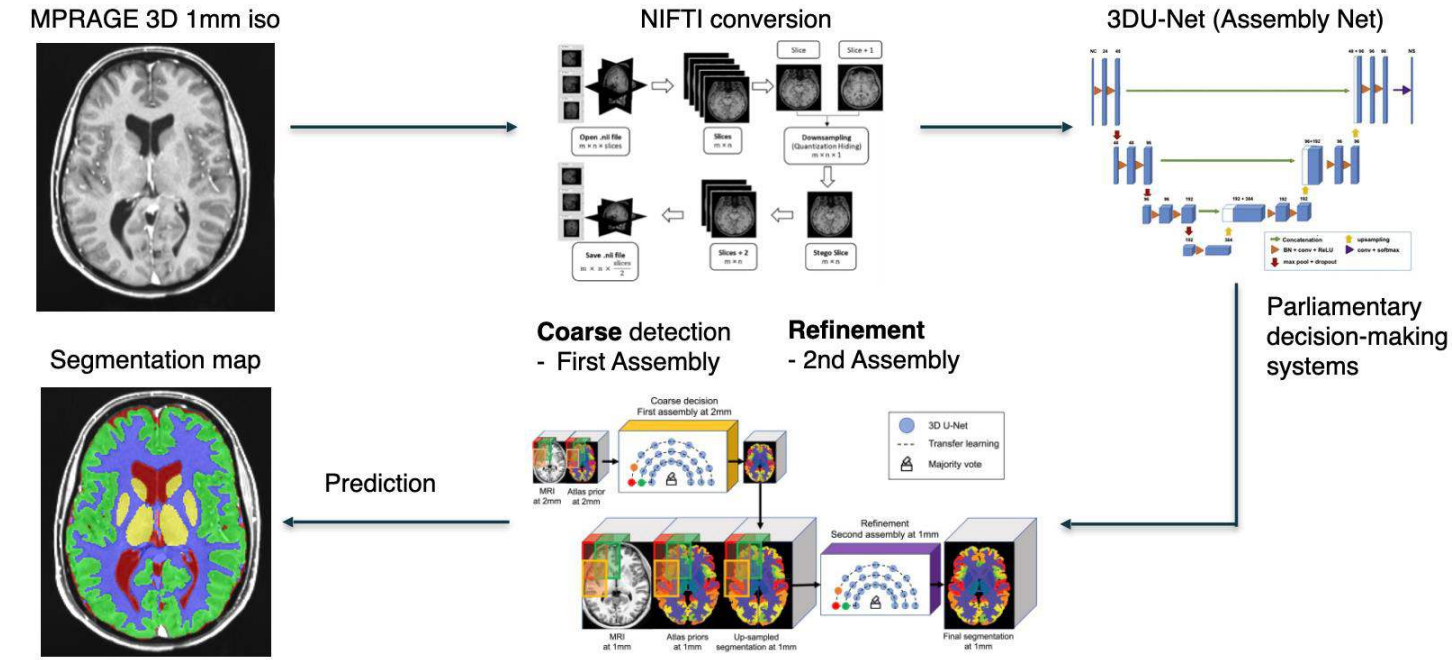
Type 1 → Type ?

Type 3 → Chronic

- **Spontaneous intracranial hypotension**
  - **Subdural hematoma**
  - Venous sinus thrombosis
  - Diffuse nonaneurysmal SAH
  - Bibrachial amyotrophy
  - Brain sagging dementia
  - **Spinal cord herniation**
- **Spinal dementia**
- **Superficial siderosis (iSS)**

Cognitive Impairment and SIH





Standard Clinical Testing

Wolf K, El Rahal A, Beck J et al, Headache 2025

CNN - Volumetry and brain segmentation

El Rahal A, Wolf K, Volz F Beck J et al, under revision

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CSF-Center Freiburg

EANS CEREBROSPINAL FLUID SECTION

International Collaborations

Inselspital Bern, Switzerland

Lindenhofspital Bern, Switzerland

UZH Zuerich, Switzerland

AKH, Vienna, Austria

University College London, UK

King's College, UK

Danish Headache Center, Denmark

Cedars Sinai, CA, USA

Stanford, CA. USA

Nagoya University, Japan

Neurosurgery & Neurology
J. Beck, K. Wolf, F. Volz, A. El Rahal, V. Vieira da Silva
L. Krismer, M. Overstijns, M. Shah

Neuroradiology
H. Urbach, N. Lützen,
C. Zander, T. Demerath

Nuclear Medicine
P.T. Meyer & Team

Anesthesiology
H. Bürkle & Team

Neuroophthalmology
W. Lagrèze & Team

Neuromedical AI Lab
T. Ball & Team

Medical Physics
M. Reisert & Team

Freiburg CSF Center
Prof. Dr. Jürgen Beck

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CSF CENTER FREIBURG

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Baden-Württemberg

@JrgenBeck
@Niklas_Luetzen
@KathaDCwolf
@ZanderCharlotte

Thank you

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EDITORIAL

"Sinking into a coma" from spontaneous intracranial hypotension

Gordon R. Kelley, MD, and Joseph D. Burns, MD

Neurology 2018

PAPER

Subdural haematoma: a potentially serious consequence of spontaneous intracranial hypotension

R J de Noronha, B Sharrack, M Hadjivassiliou, C A J Romanowski

Spontaneous intracranial hypotension with deep brain swelling

Mario Savoiardo,[1] Ludovico Minati,[1,3] Laura Farina,[1] Tiziana De Simone,[1] Domenico Aquino,[1] Eliana Mea,[2] Graziella Filippini,[2] Gennaro Bussone[2] and Luisa Chiapparini[1]

Brain 2007

Spontaneous occult intracranial hypotension precipitating life-threatening cerebral venous thrombosis: case report

Avital Perry, MD,[1] Christopher S. Graffeo, MD,[1] Waleed Brinjikji, MD,[2] William R. Copeland III, MD,[3] Alejandro A. Rabinstein, MD,[4] and Michael J. Link, MD[1,5]

J Neurosurg Spine 2018

Coma

A serious complication of spontaneous intracranial hypotension

Wouter I. Schievink, MD, M. Marcel Maya, MD, Franklin G. Moser, MD, MMM, Stacey Jean-Pierre, PA-C, and Miriam Nuño, PhD

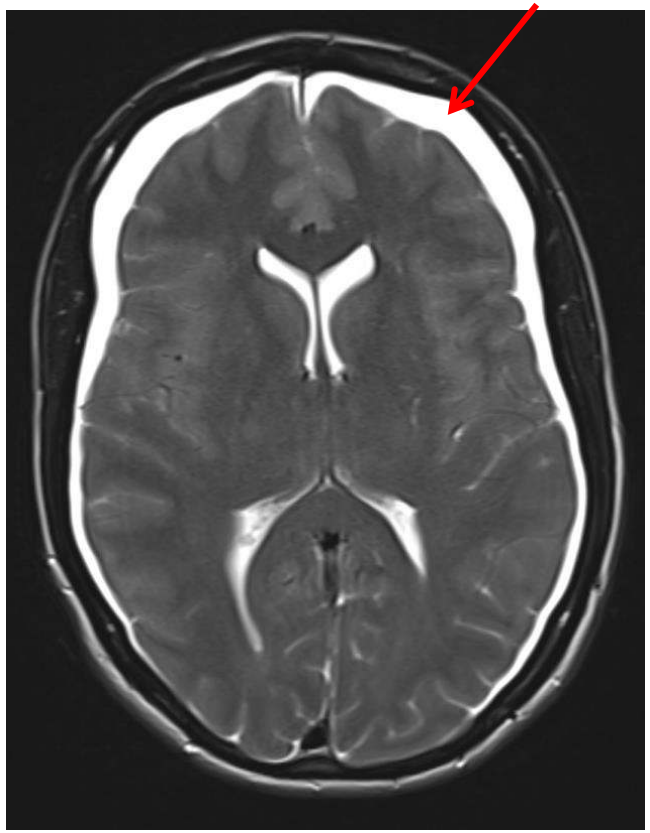
Correspondence
Dr. Schievink
schievinkw@cshs.org

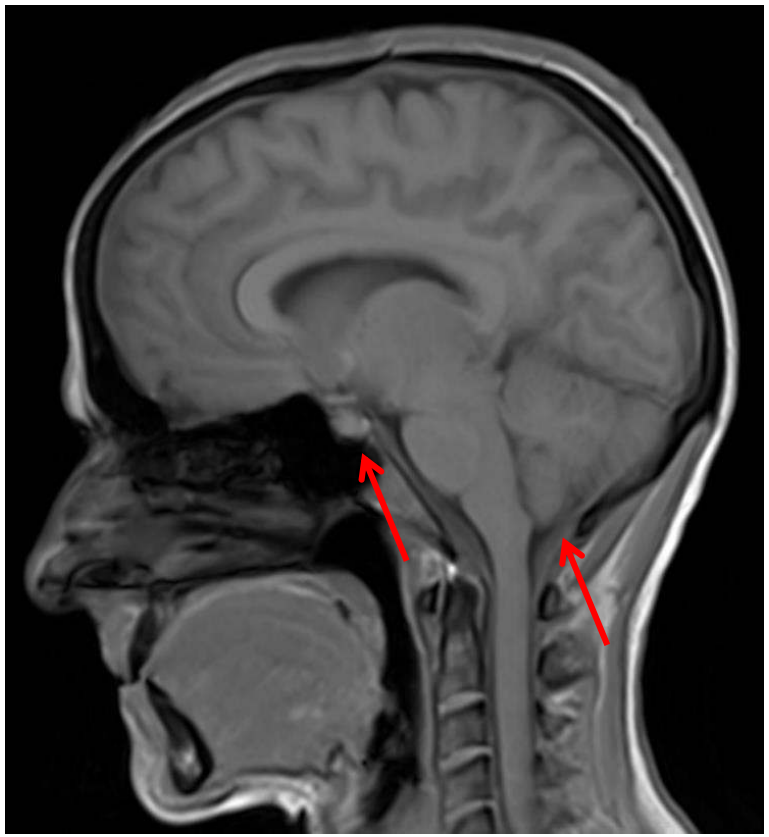
Neurology® 2018;90:e1638-e1645. doi:10.1212/WNL.0000000000005477

Teaching Neuro*Images*: A dangerous complication of spontaneous intracranial hypotension

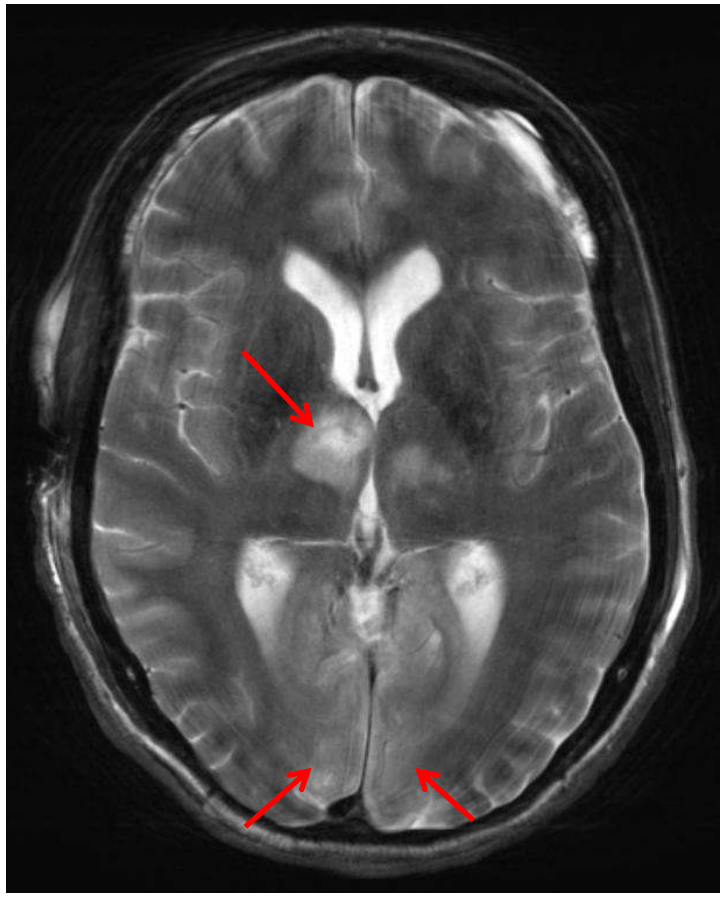
Neurology 2014

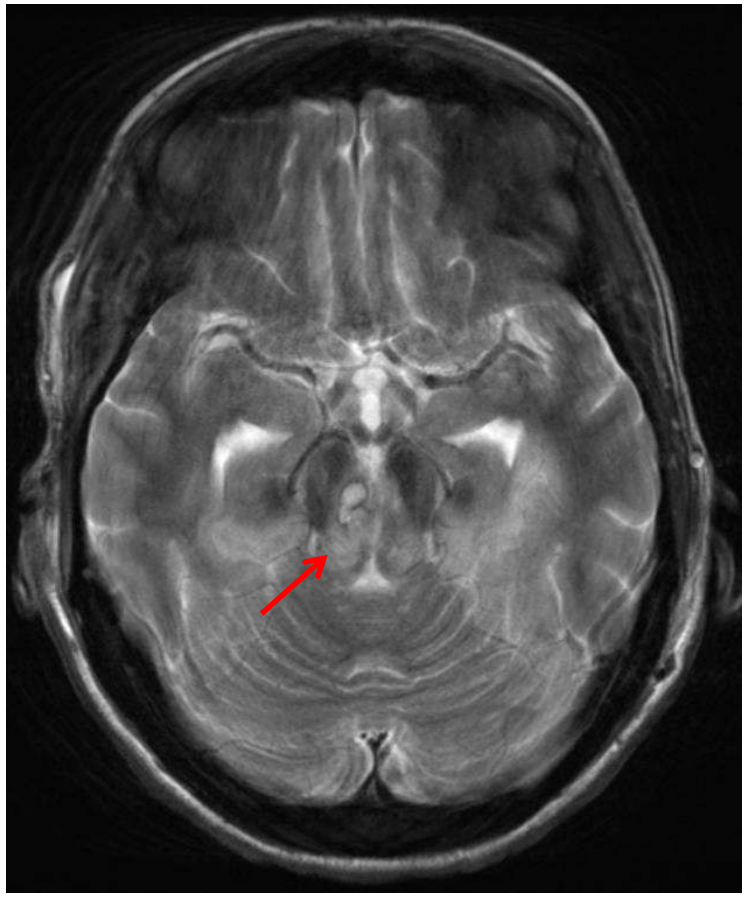
Case: E.B, 52y (F)

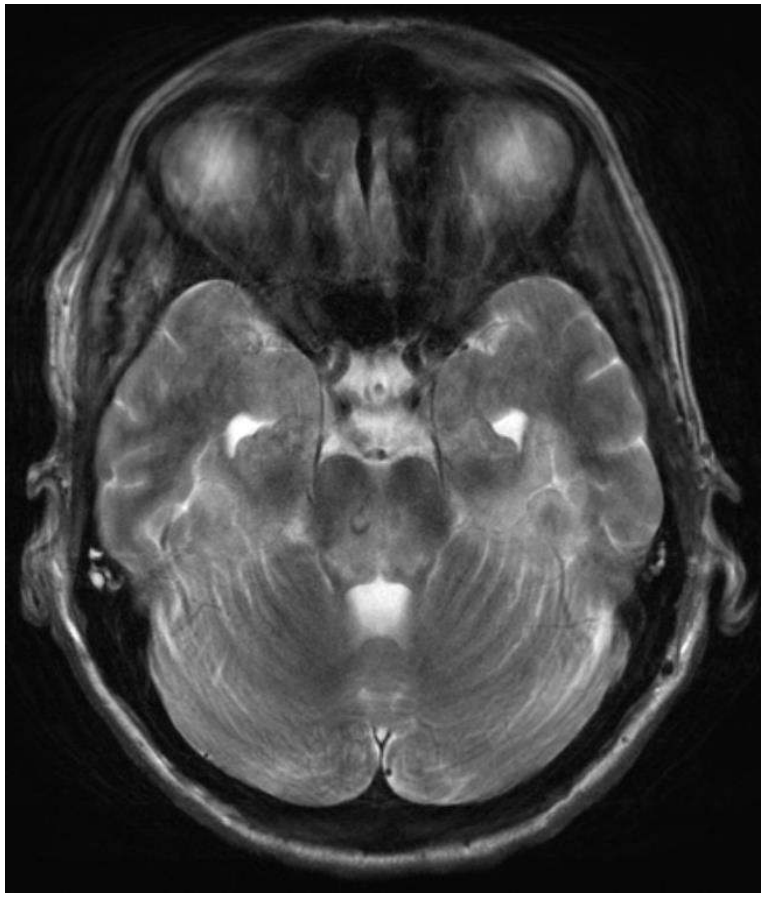




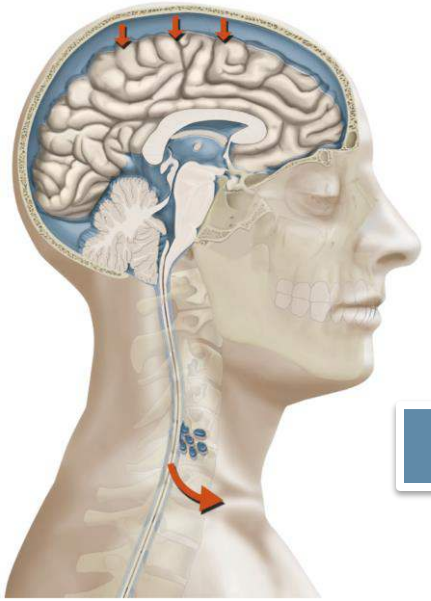
Case: E.B, 52y (F)







Spontaneous Intracranial Hypotension



† Death

- Subdural hematoma
- Venous sinus thrombosis
- Fatigue
- Loss of S-QoL
- Depression

• spinal dementia

- **Superficial siderosis**
- **Bibrachial amyotrophy**
- **Fronto-temporal dementia**
- **Spinal cord herniation**

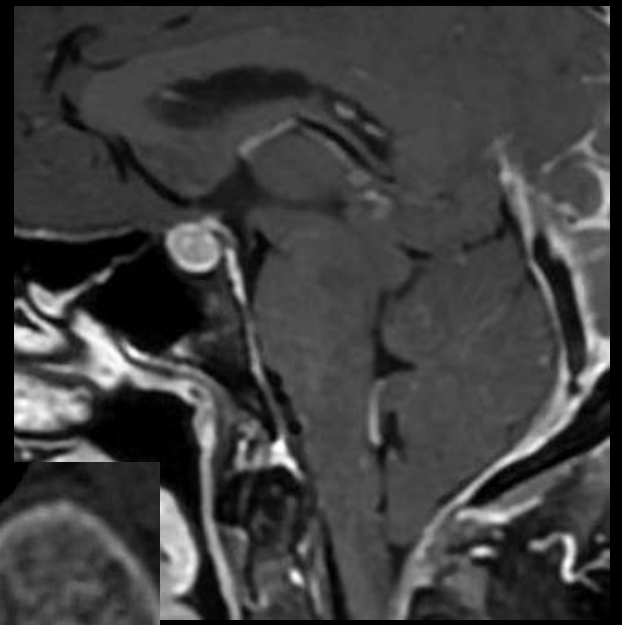
Acute | **Chronic** | **Long Term**

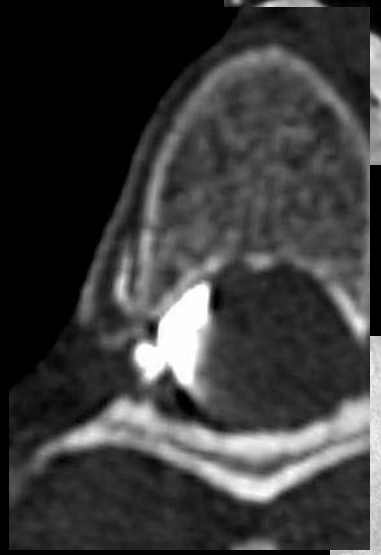
Spinal CSF leak

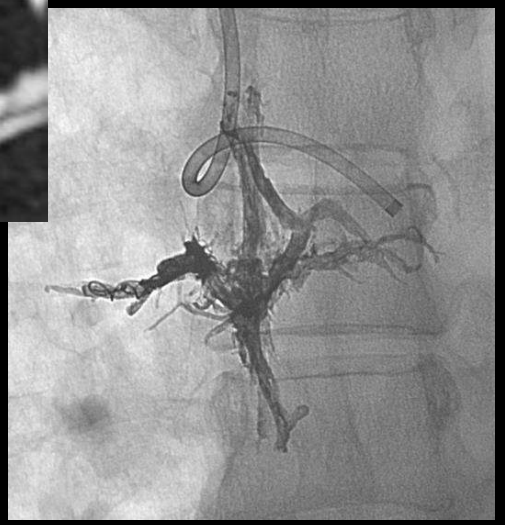
MAYO CLINIC

TRANSVENOUS EMBOLIZATION OF CSF-VENOUS FISTULAE: FIRST-LINE TREATMENT

Thien Huynh, MD MSc FRCPC
Assistant Professor, Consultant
Diagnostic and Interventional Neuroradiology
Mayo Clinic, Florida



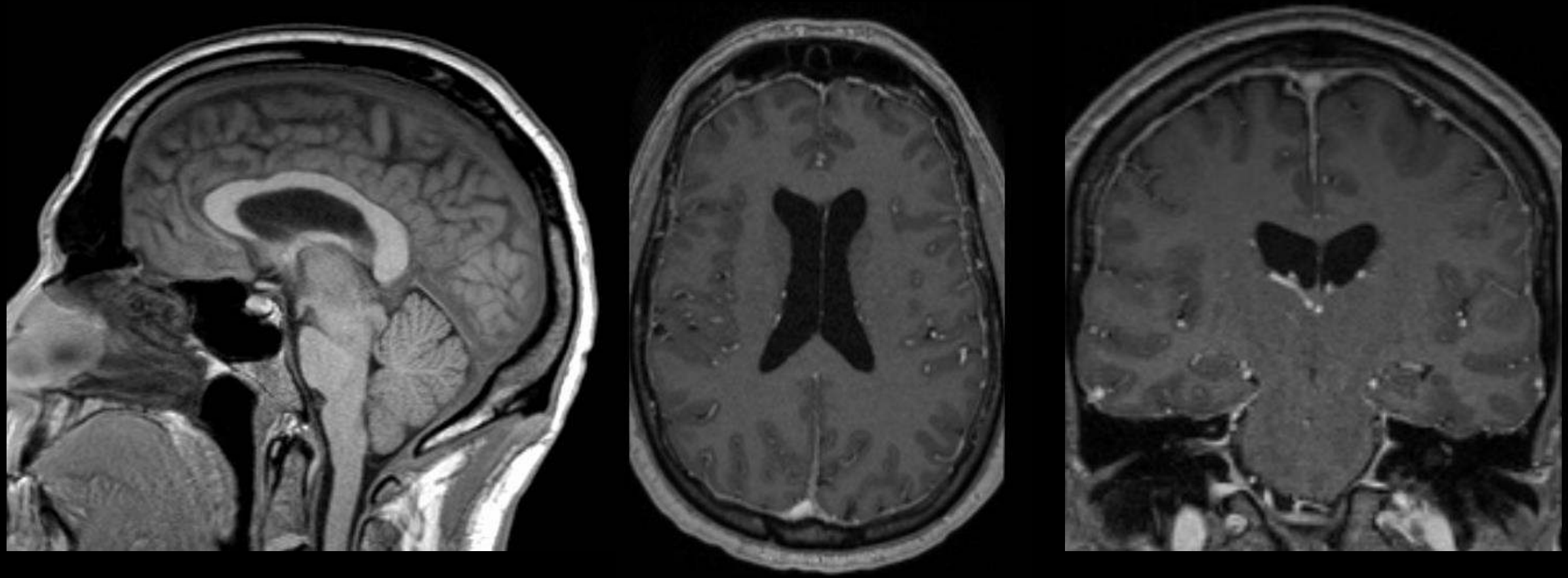




DISCLOSURES

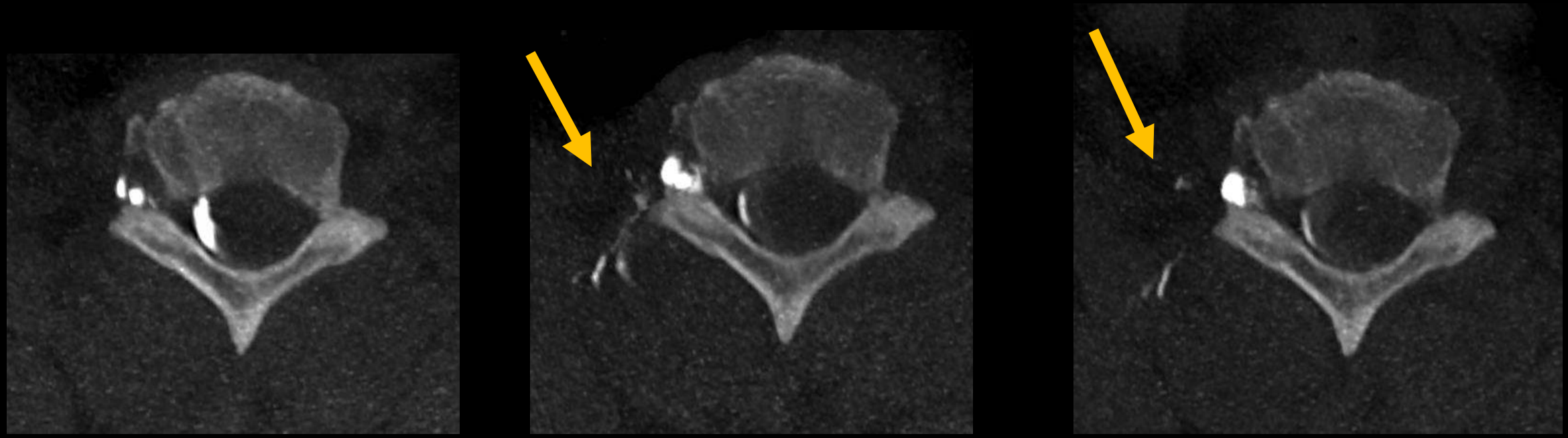
- No financial disclosures

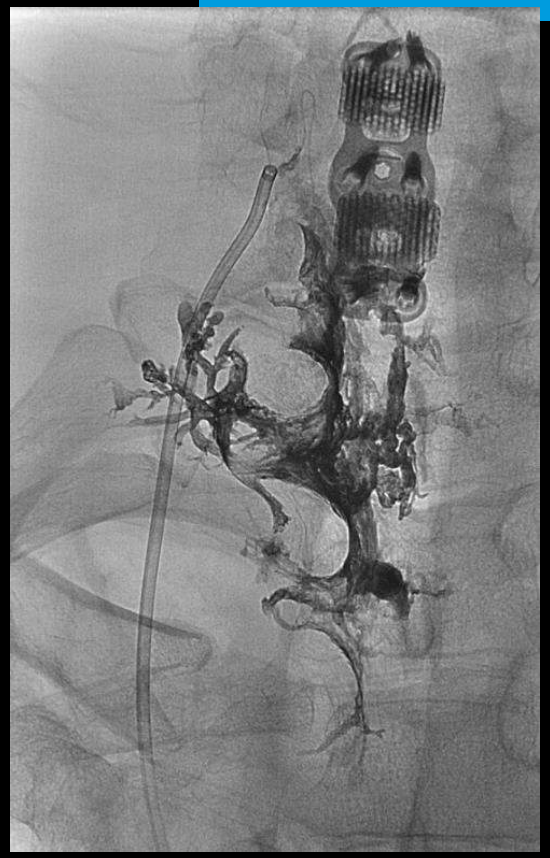
60 year old male, 5+ years headache, brain fog, frontotemporal dementia syndrome

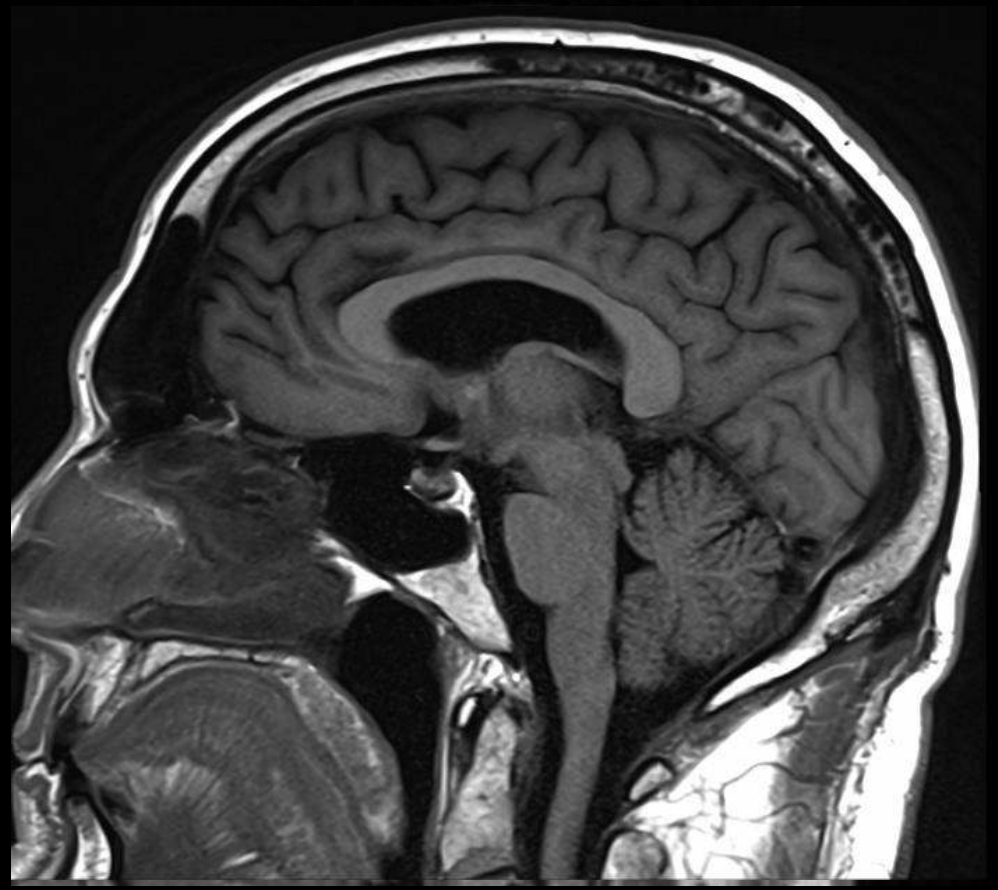


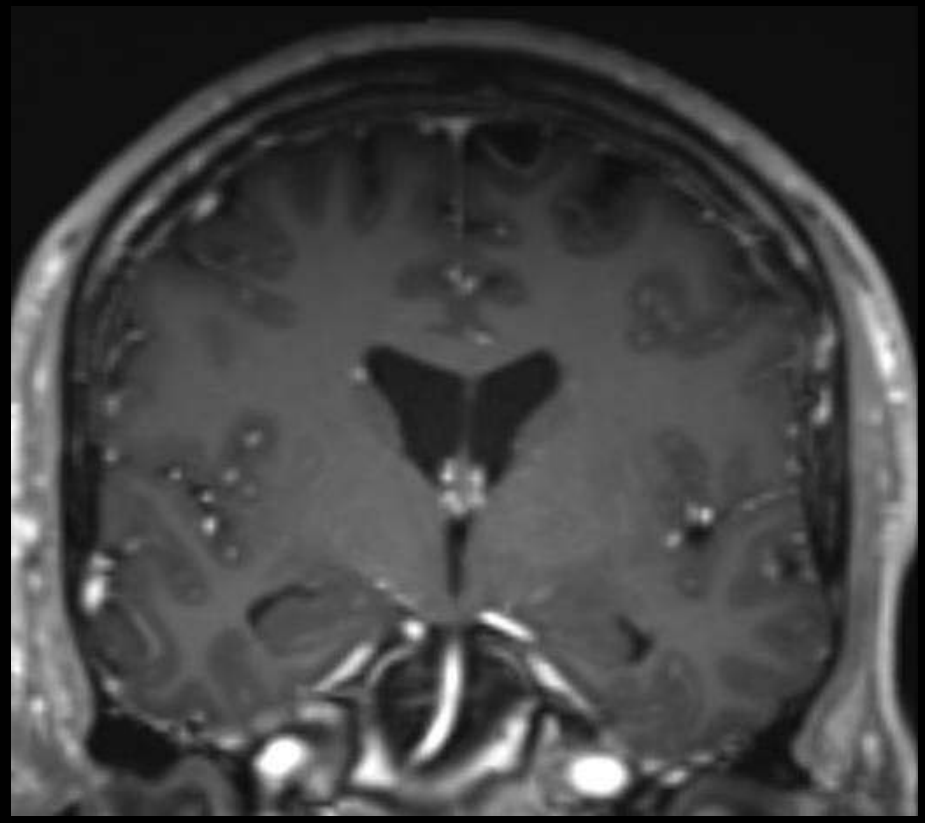
DYNAMIC LATERAL DECUBITUS CT MYELOGRAM WITH BOLUS TRACKING

CSF-VENOUS FISTULA RIGHT T1









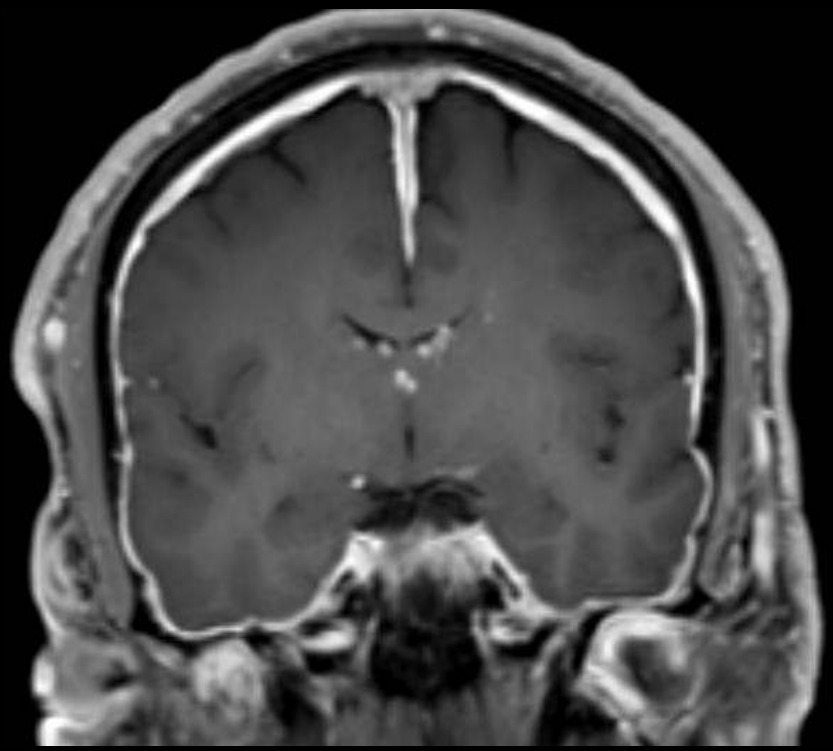
Right T1 CSF-venous fistula embolization

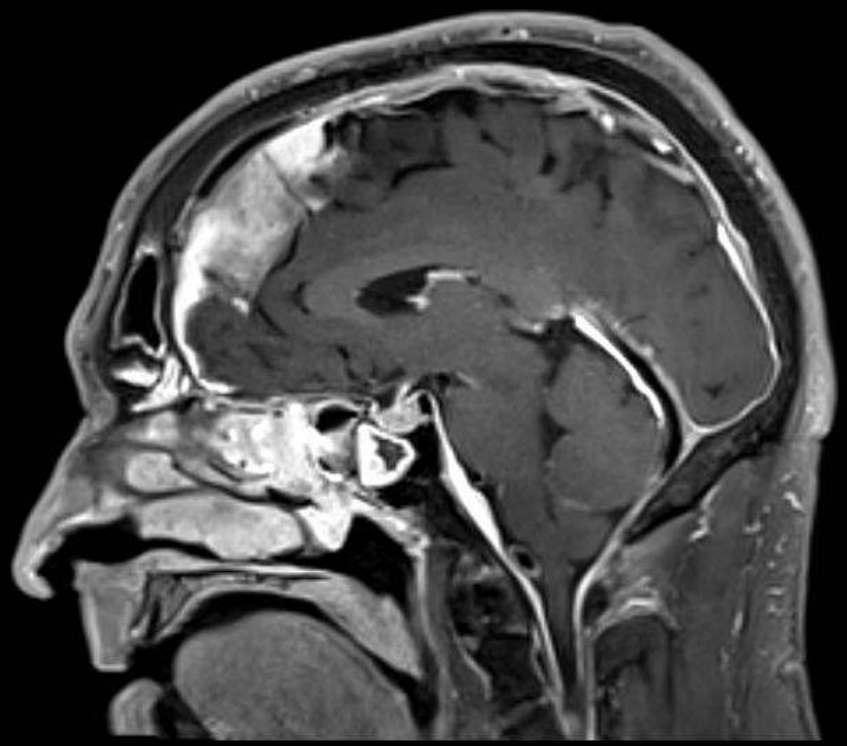
Complete resolution of dementia and headache <1 month

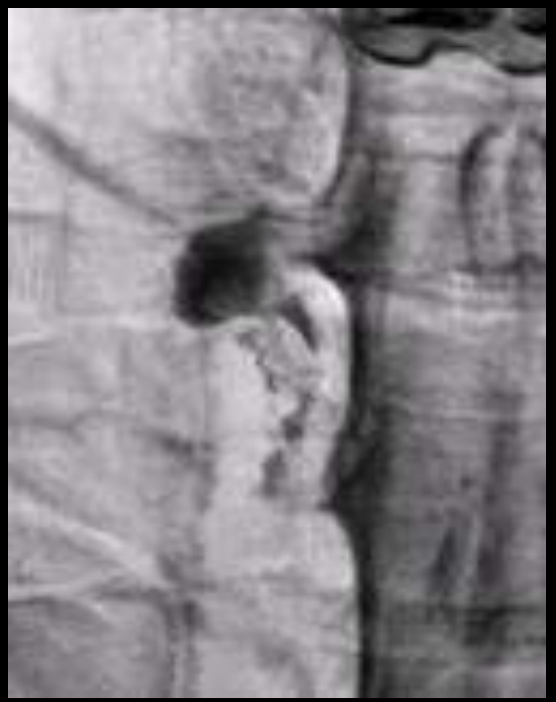
Why do we treat endovascularly?
(vs. fibrin glue or surgery)

MCF First CVF Embolization Patient Nov 2020

- 60M, 8 years progressive gait instability and brain fog, trigeminal neuralgia
- CVF at C7
- Recurrence of symptoms <1-2 months after x2 fibrin patching
  (despite initial rebound headache and partial resolution of symptoms)

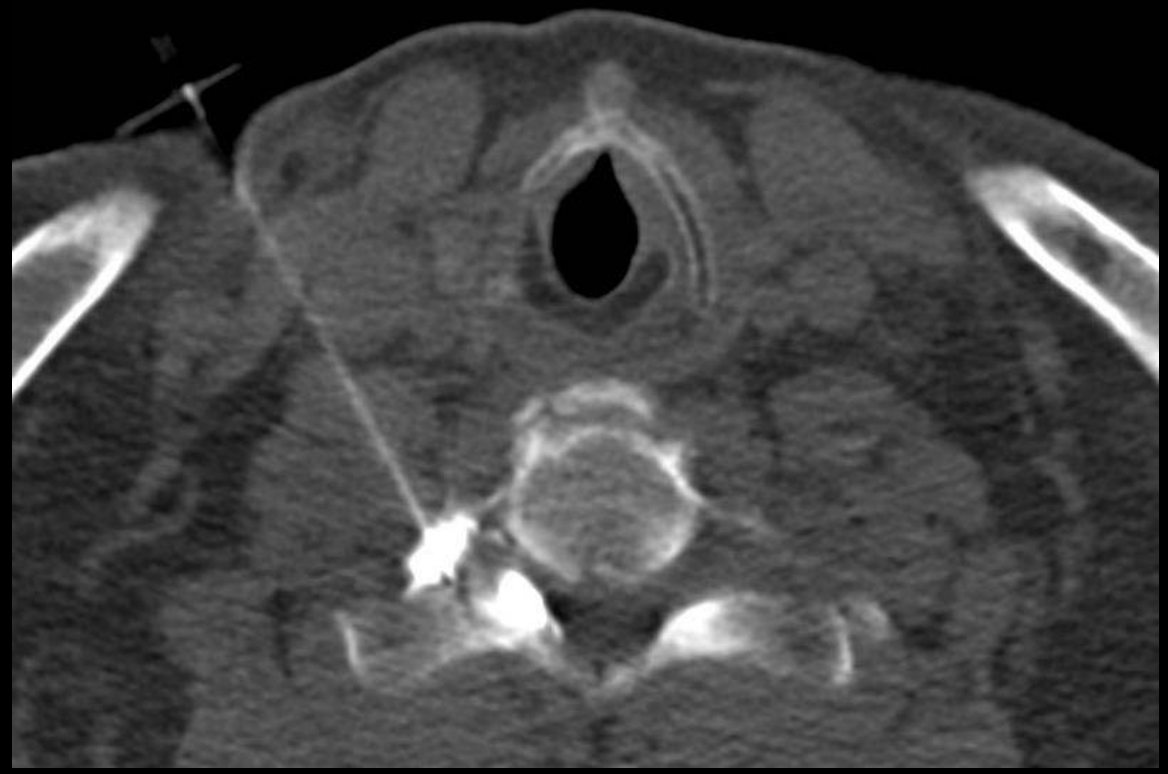


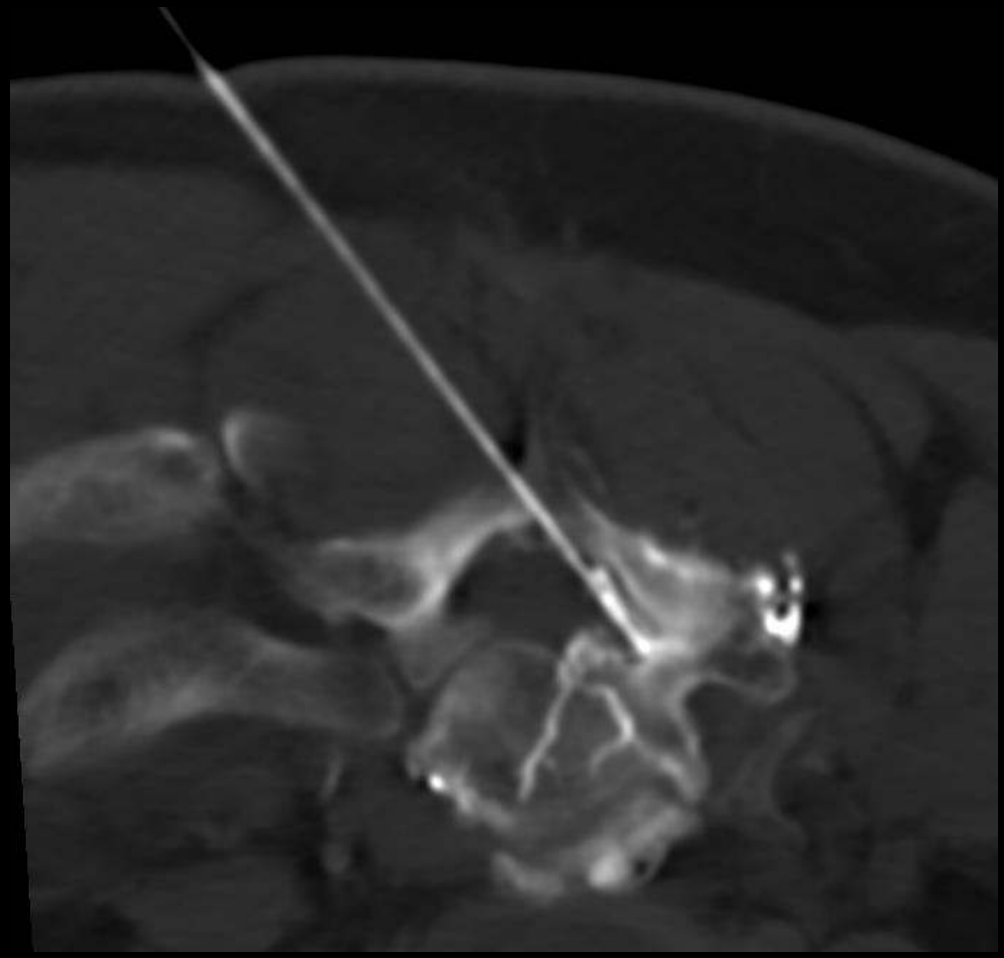




C7 CT Targeted Fibrin Patch x2:
HARD WORK: Treatment failure – UNPREDICTABLE results

Surgery at functional level?





RE: Confidential Next Frontier of CSF Leak Treatment

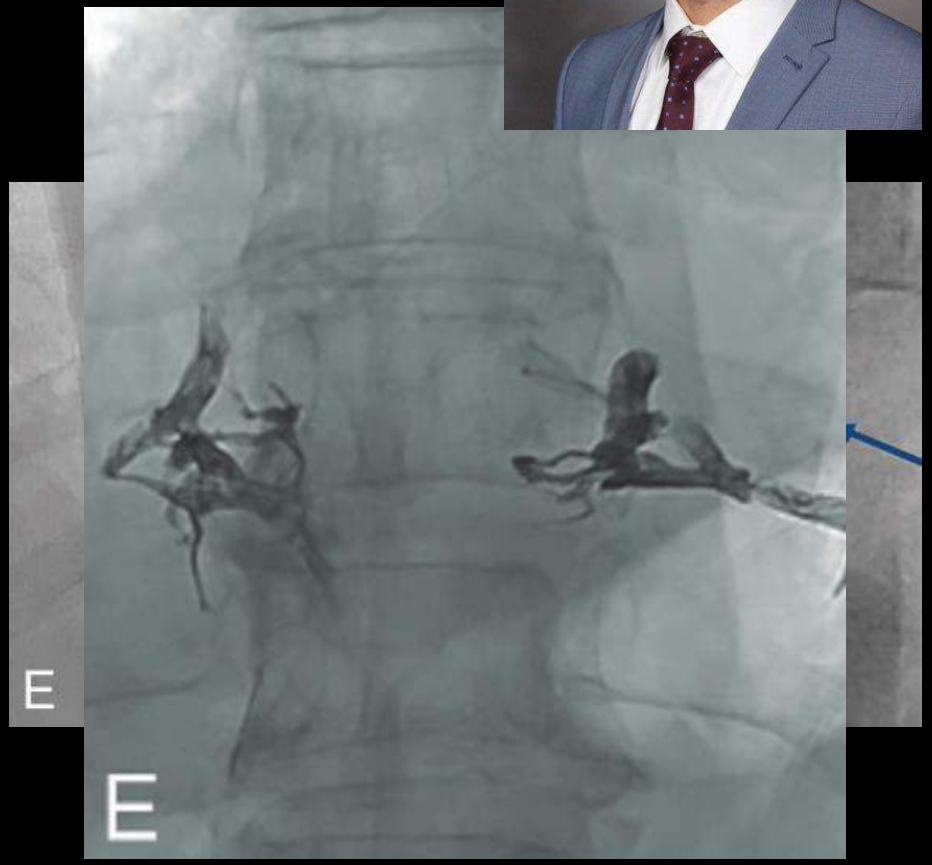
Brinjikji, Waleed, M.D.

You forwarded this message on 11/11/2020 10:34 AM.

Sent: Wed 11/11/2020 10:12 AM

CVF TRANSVENOUS EMBOLIZATION

- First described by Brinjikji 2021
- CVF venous embolization highly attractive:
  - Targeted permanent venous occlusion compared to epidural fibrin/blood patch
  - Minimally invasive compared to open surgery – preserves nerve at eloquent levels
  - Safety of venous endovascular procedure



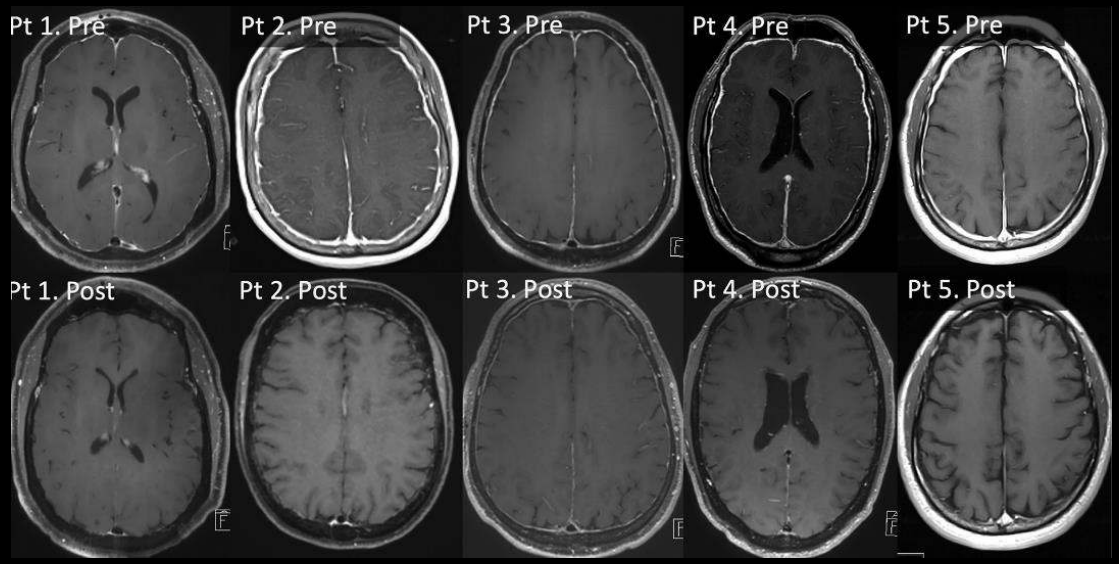
Brinjikji AJNR 2021

A Novel Endovascular Therapy for CSF Hypotension Secondary to CSF-Venous Fistulas

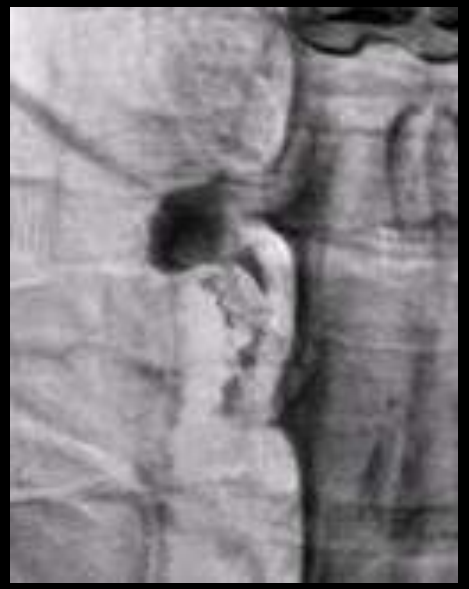
W. Brinjikji, L.E. Savastano, J.L.D. Atkinson, I. Garza, R. Farb, and J.K. Cutsforth-Gregory

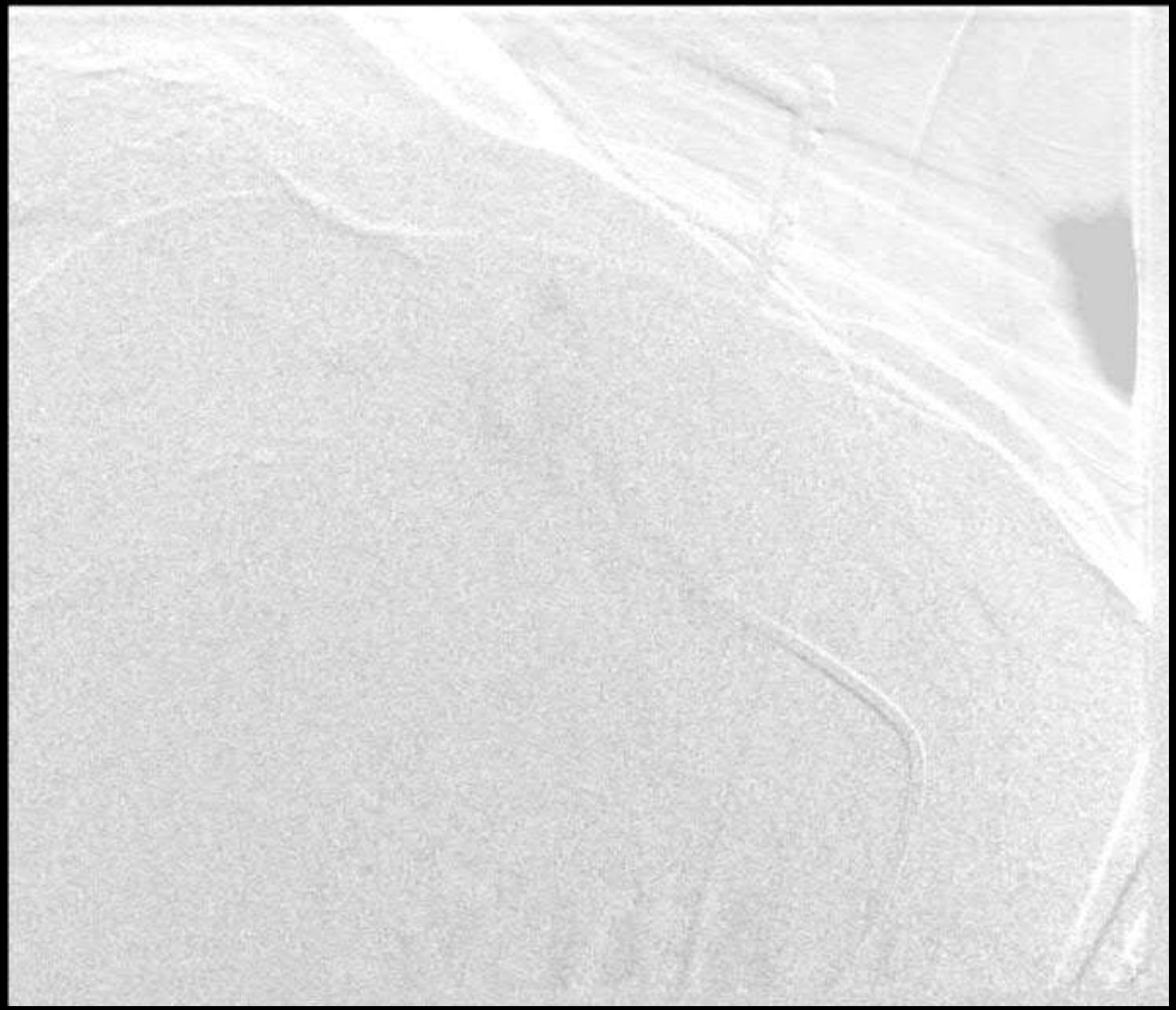
Brinjikji May 2021 www.ajnr.org

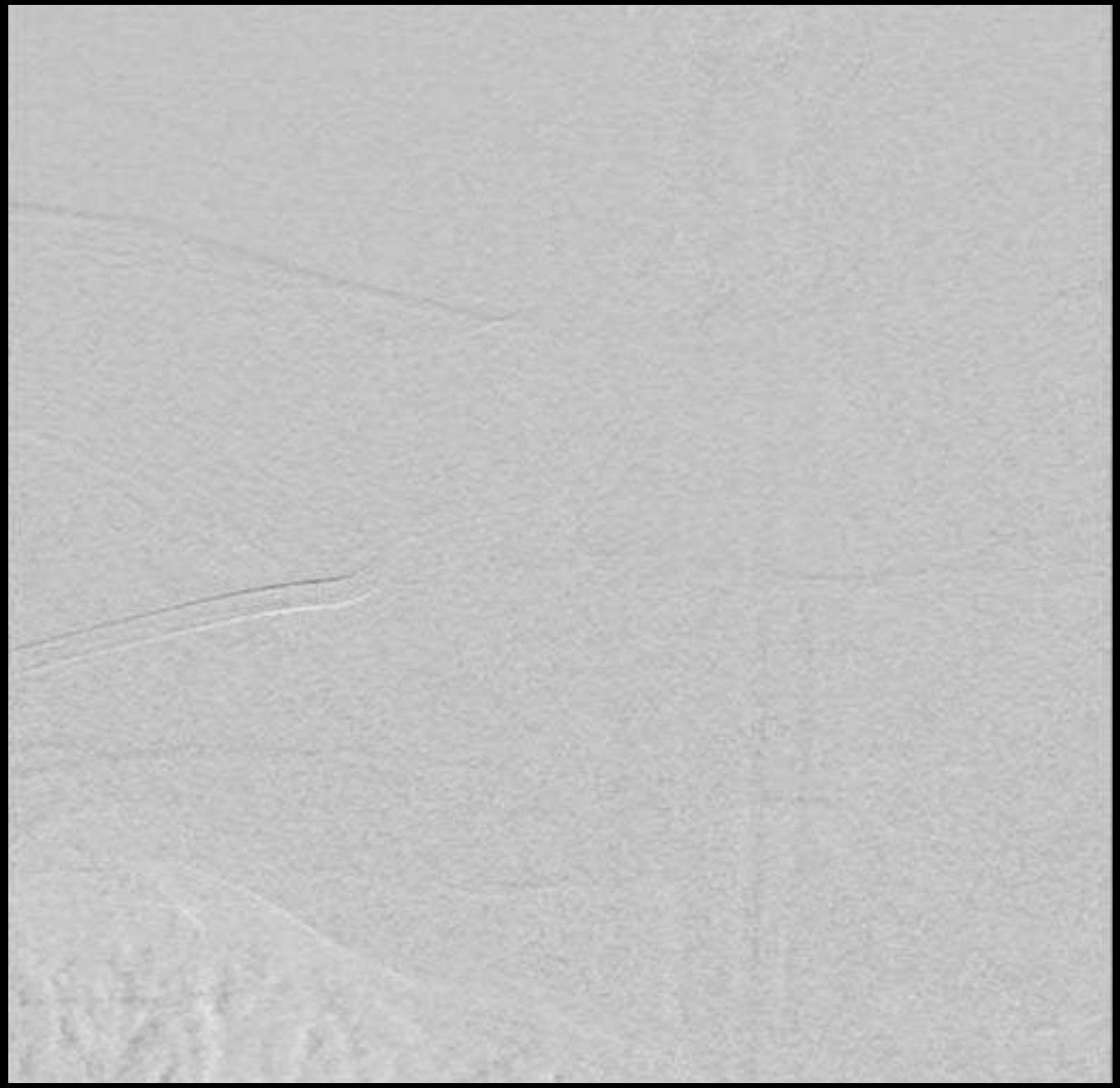
- 5 patients with CVF embolization
- 5/5 (100%) symptom improvement;
  - 4/5 complete, 1/5 partial
- 5/5 (100%) had improvement in MRI Brain SIH findings:
  - 3/5 complete resolution, 2/5 partial

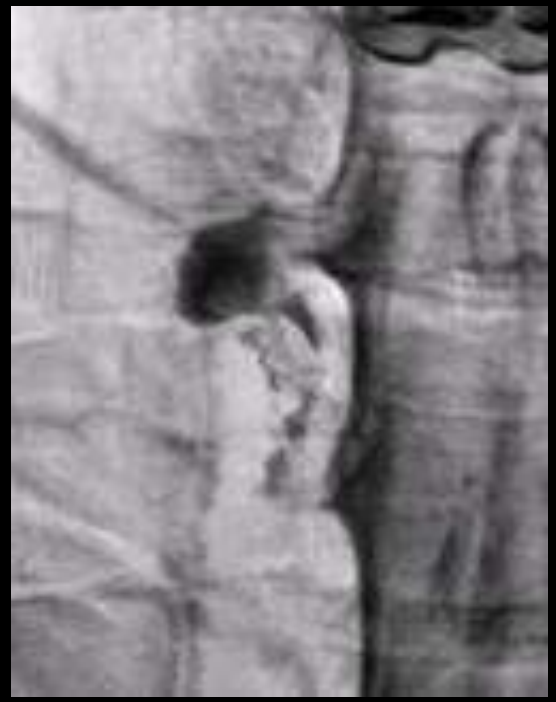


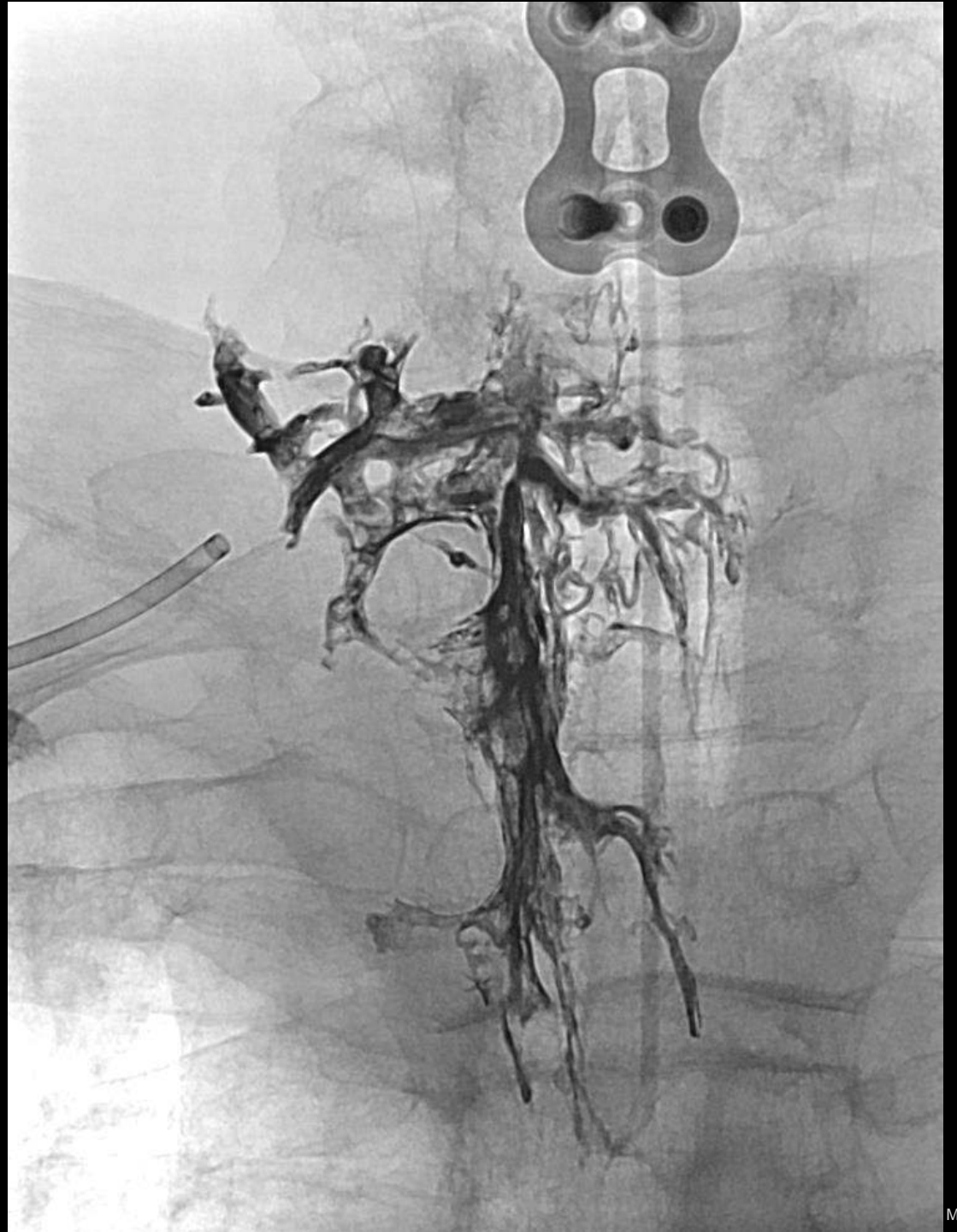
Case 1: CVF Right C7

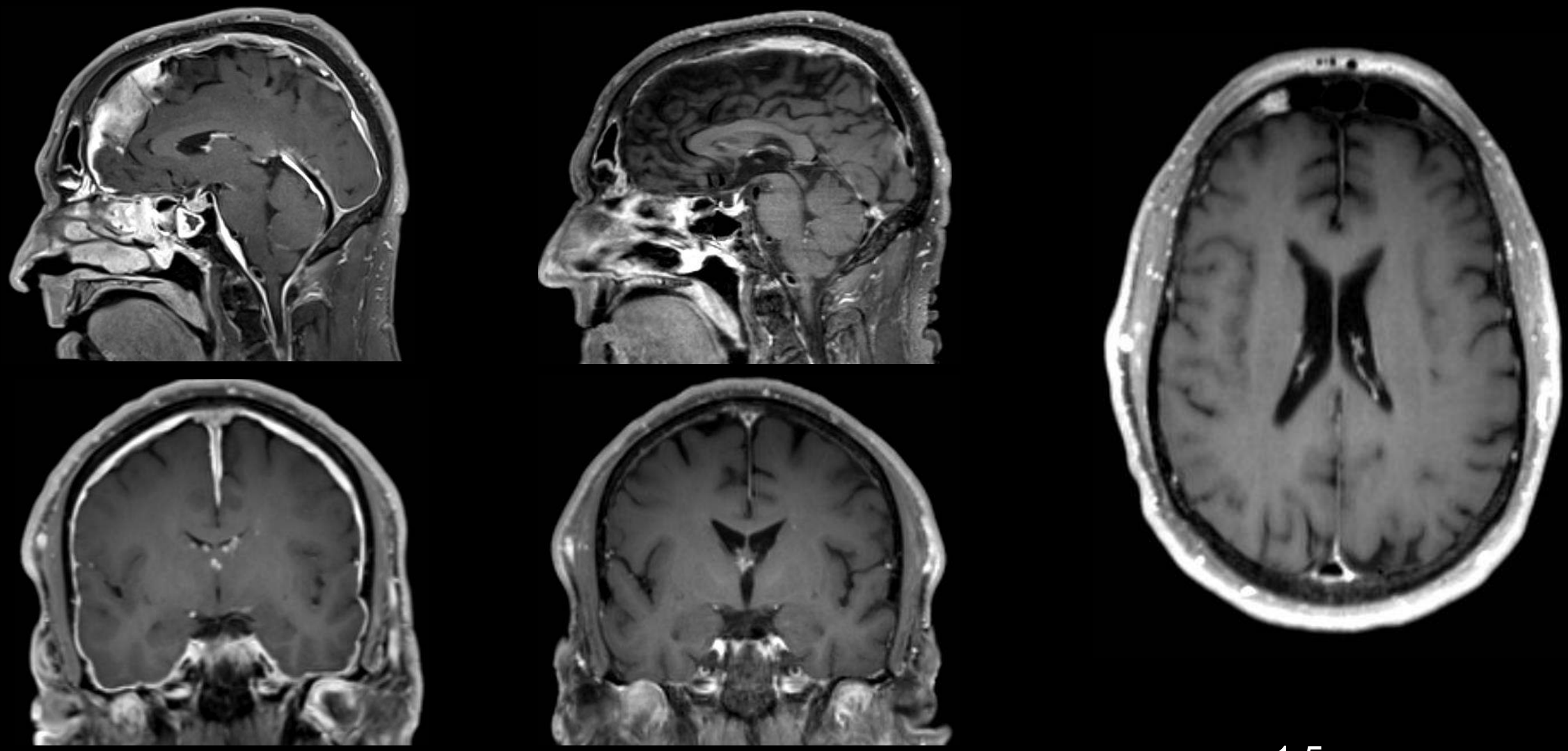












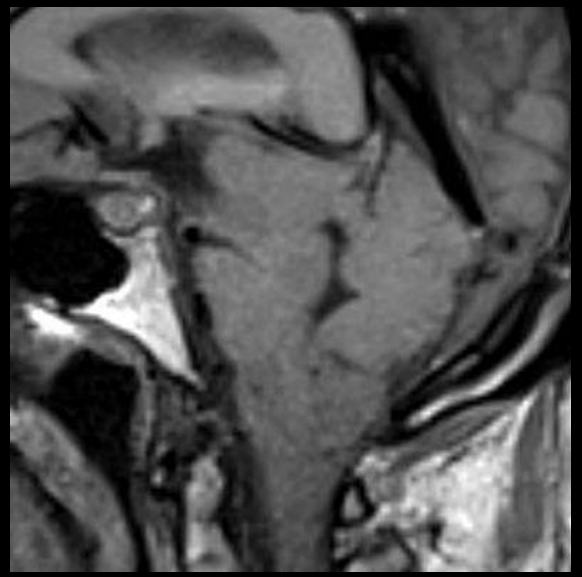
Baseline

6 months

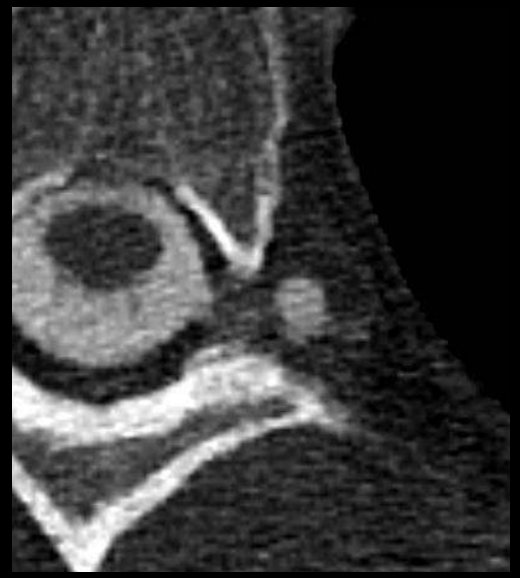
1.5 years

Case 2: 60F, 10 years+ headaches, gait imbalance, syncope

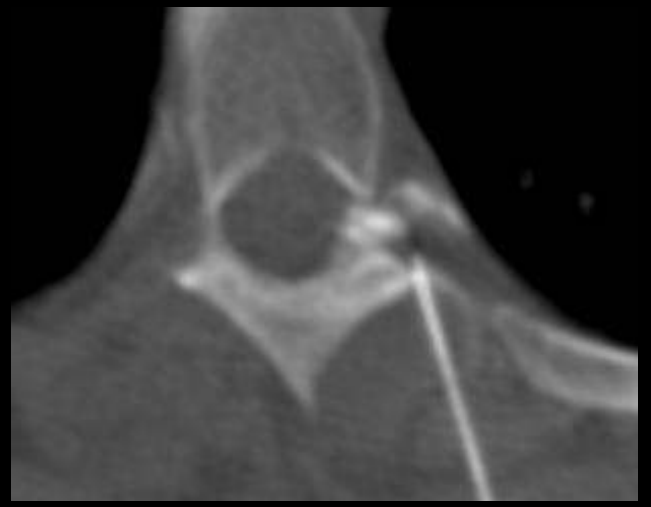
CT Fibrin patch, Left T4 x 2



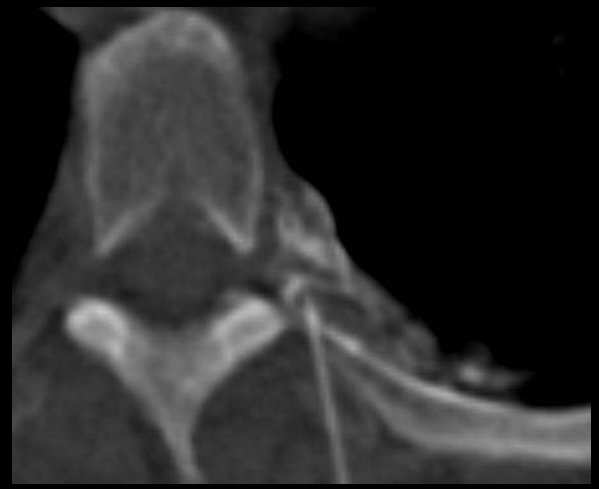
Dec 2016



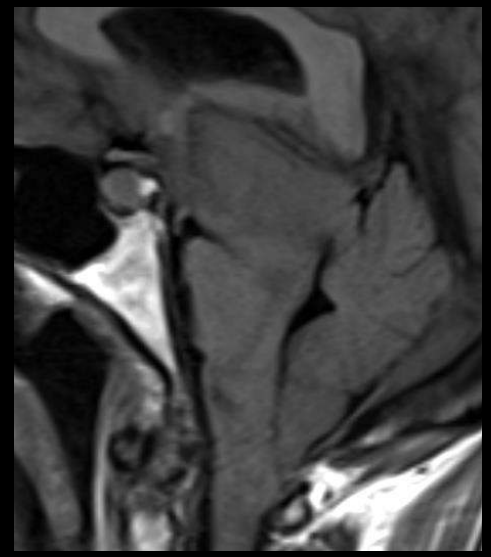
CVF Left T4?
Oct 2018



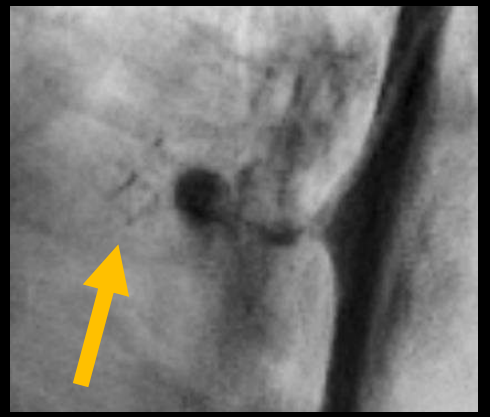
Oct 2018



Sept 2020

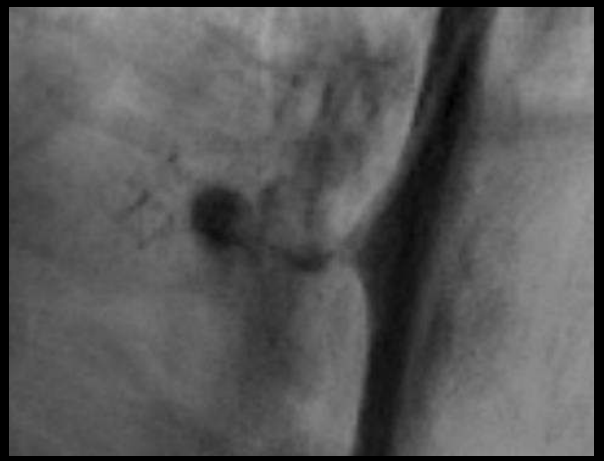


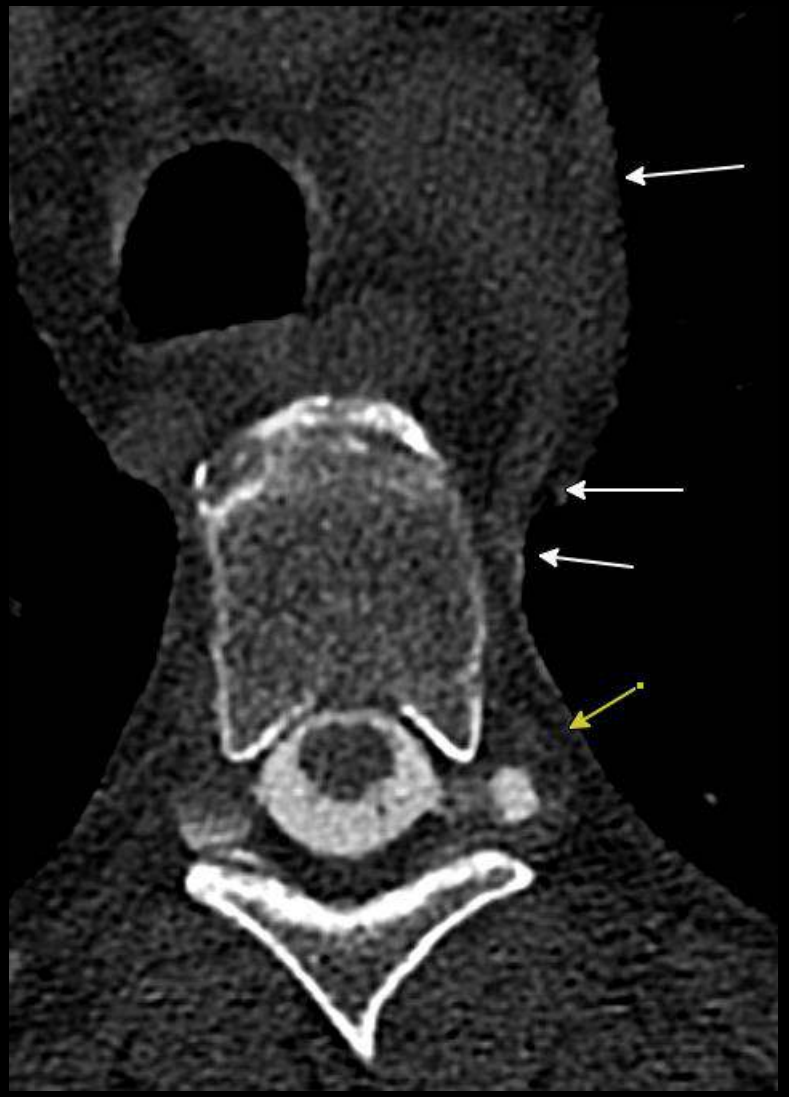
Only 1-2 months symptom relief each patch

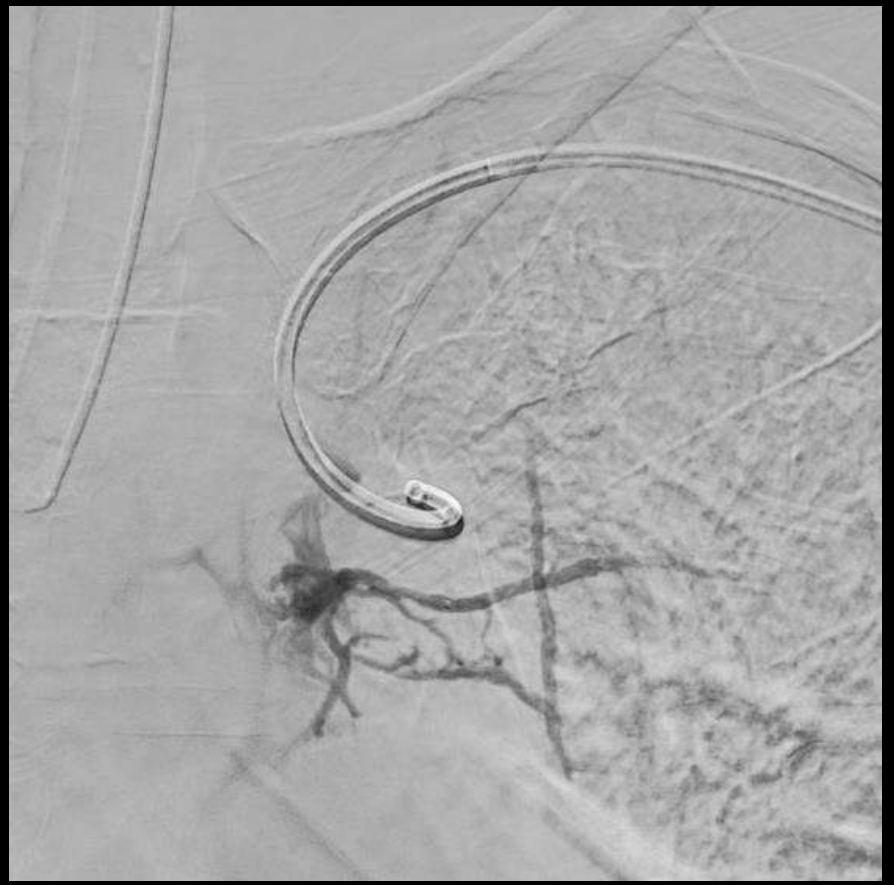


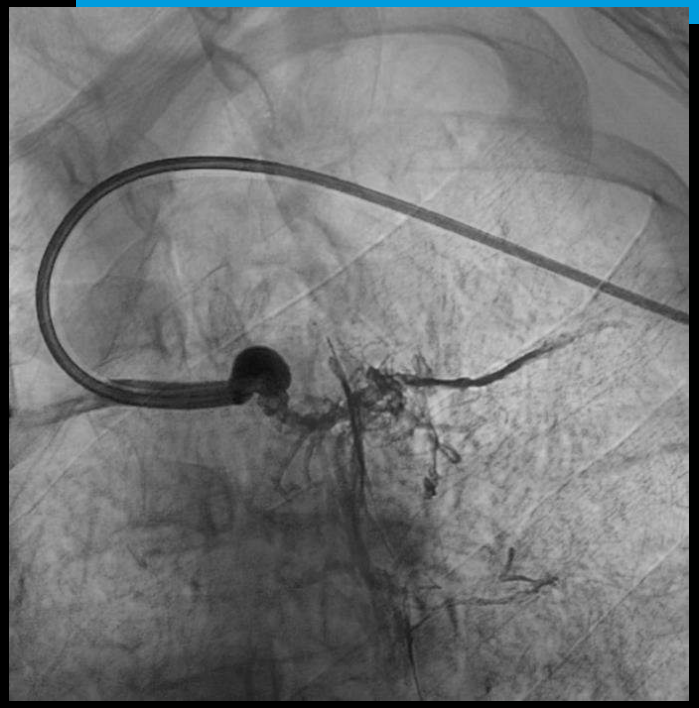
Jan 2021

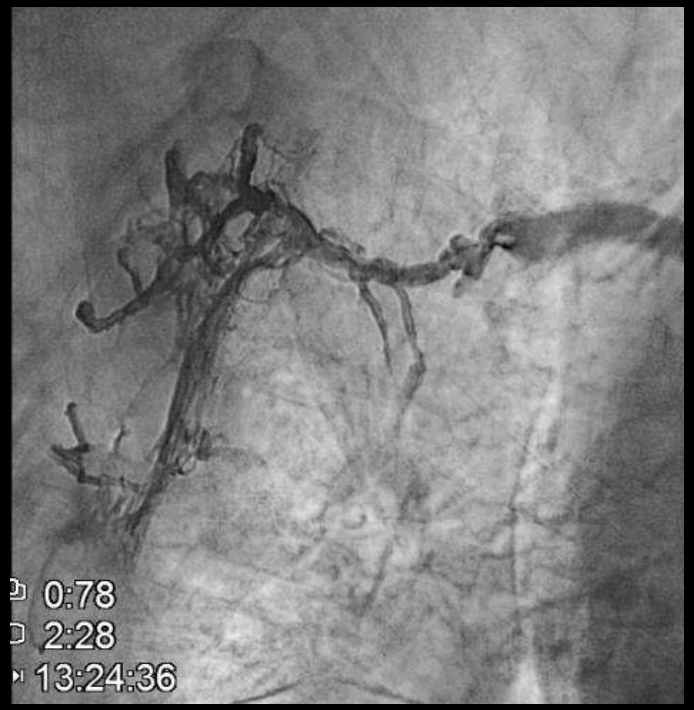
CASE 2: RESIDUAL LEFT T4 CVF

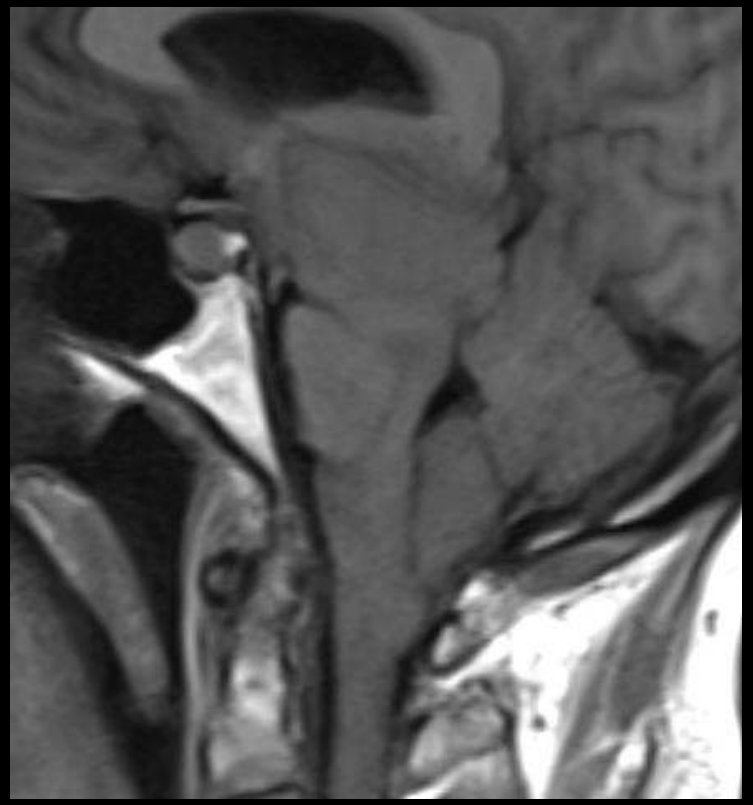


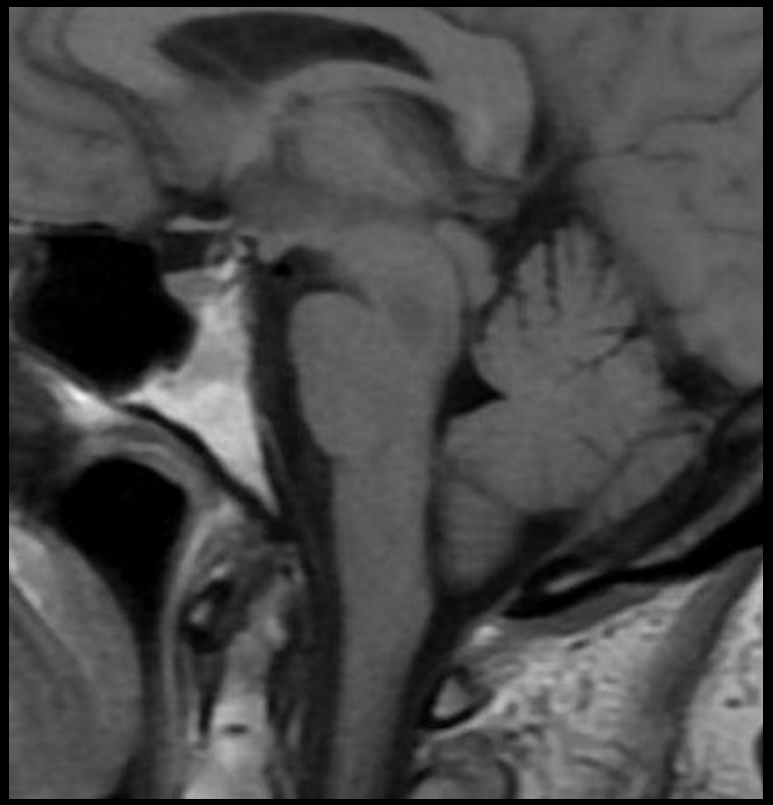








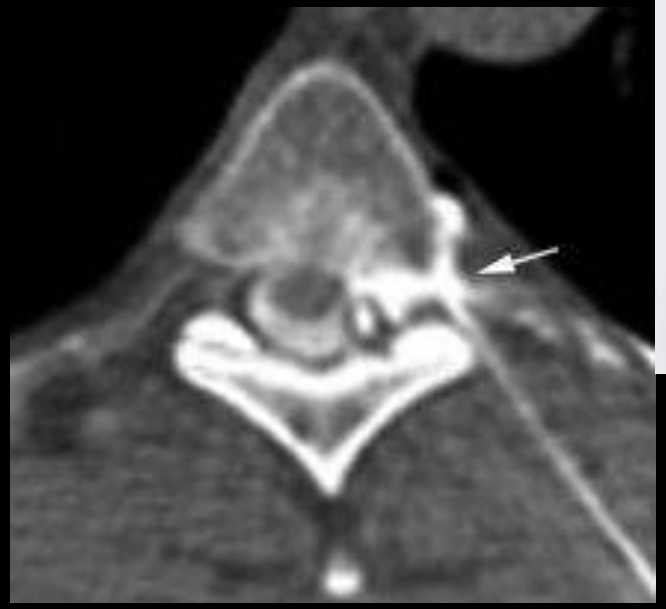




3 months post

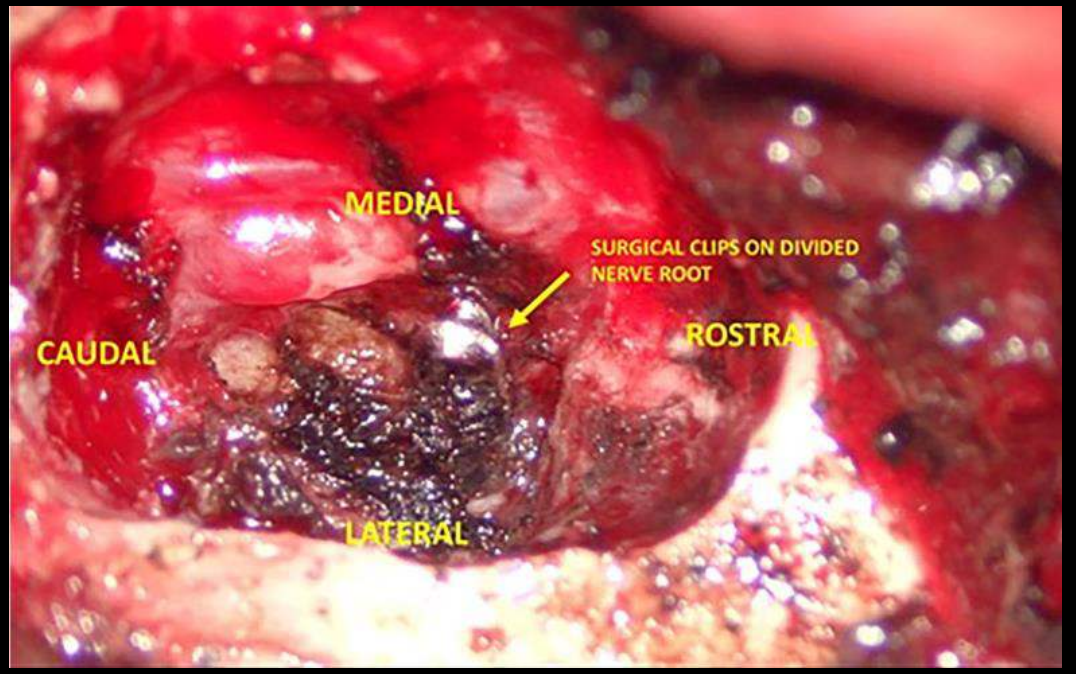
Embolization for CSF-Venous Fistula:
Very impactful/rewarding procedure…
… if done correctly!

TREATMENT ALTERNATIVES DISCUSSION



Targeted fibrin patch

- ~30-50% success first attempt?
- highly variable efficacy
- does not leave residual dense artifact

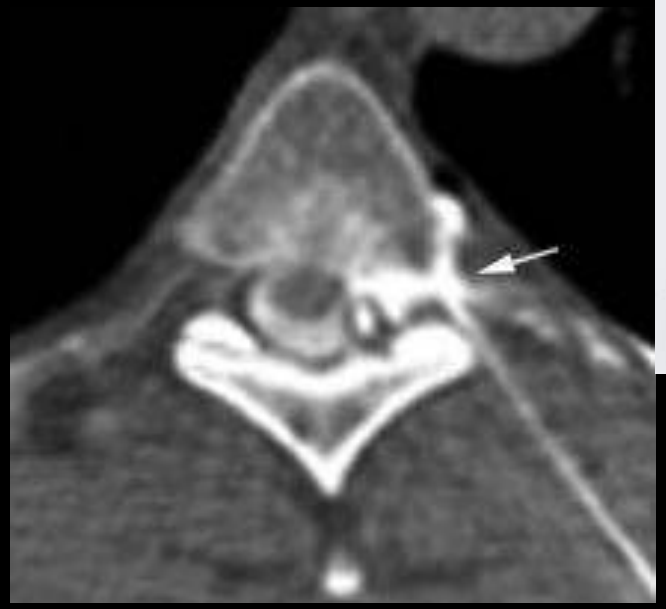


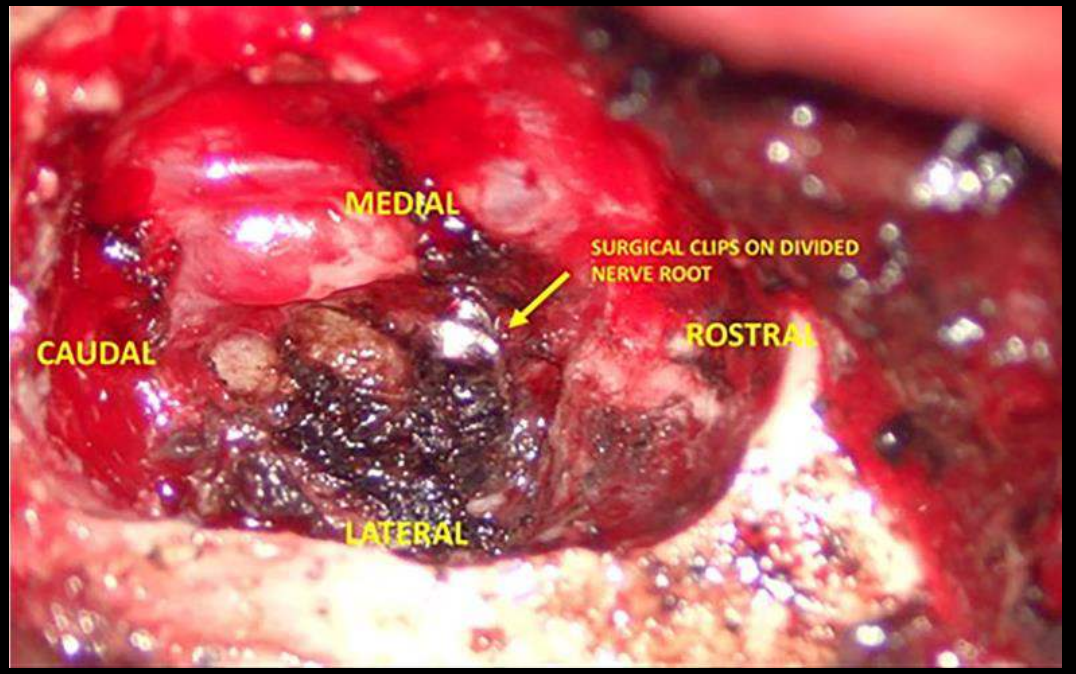
Surgical ligation

- 80-90% improvement
- Invasive/laminotomy
- +/- nerve root sacrifice
- ?Adamkiewicz

- ?Local expertise/interest

TREATMENT ALTERNATIVES DISCUSSION

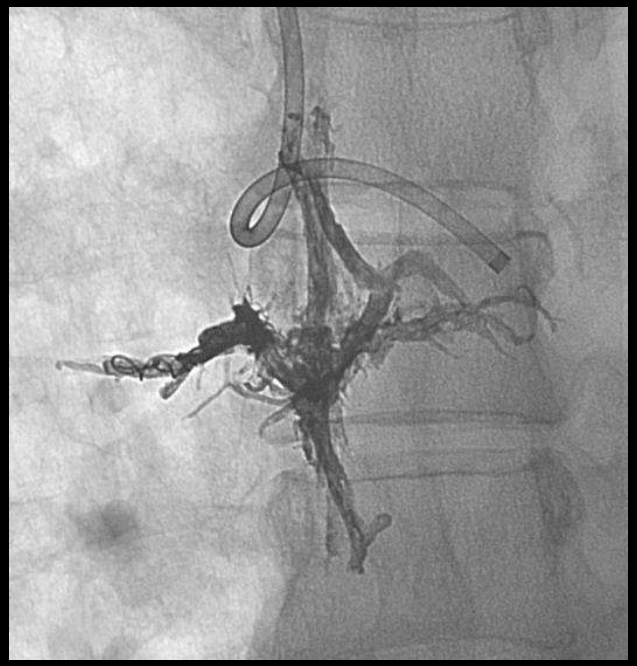




Most patients want highest efficacy treatment with least morbidity with a single treatment.

CVF TRANSVENOUS EMBOLIZATION

- Procedure now performed internationally
  - Mayo Rochester ~400+, Mayo Florida ~100
- Validated in larger, independent, US & international cohorts
  (Brinjikji JNIS 2023; Parizadeh JNIS 2023; Cagnazzo INR 2024; Cagnazzo JNIS 2025)
- 90-94% clinical and 88-94% imaging improvement (HIT-6, Bern SIH Score)
  - Mean follow-up 15 months



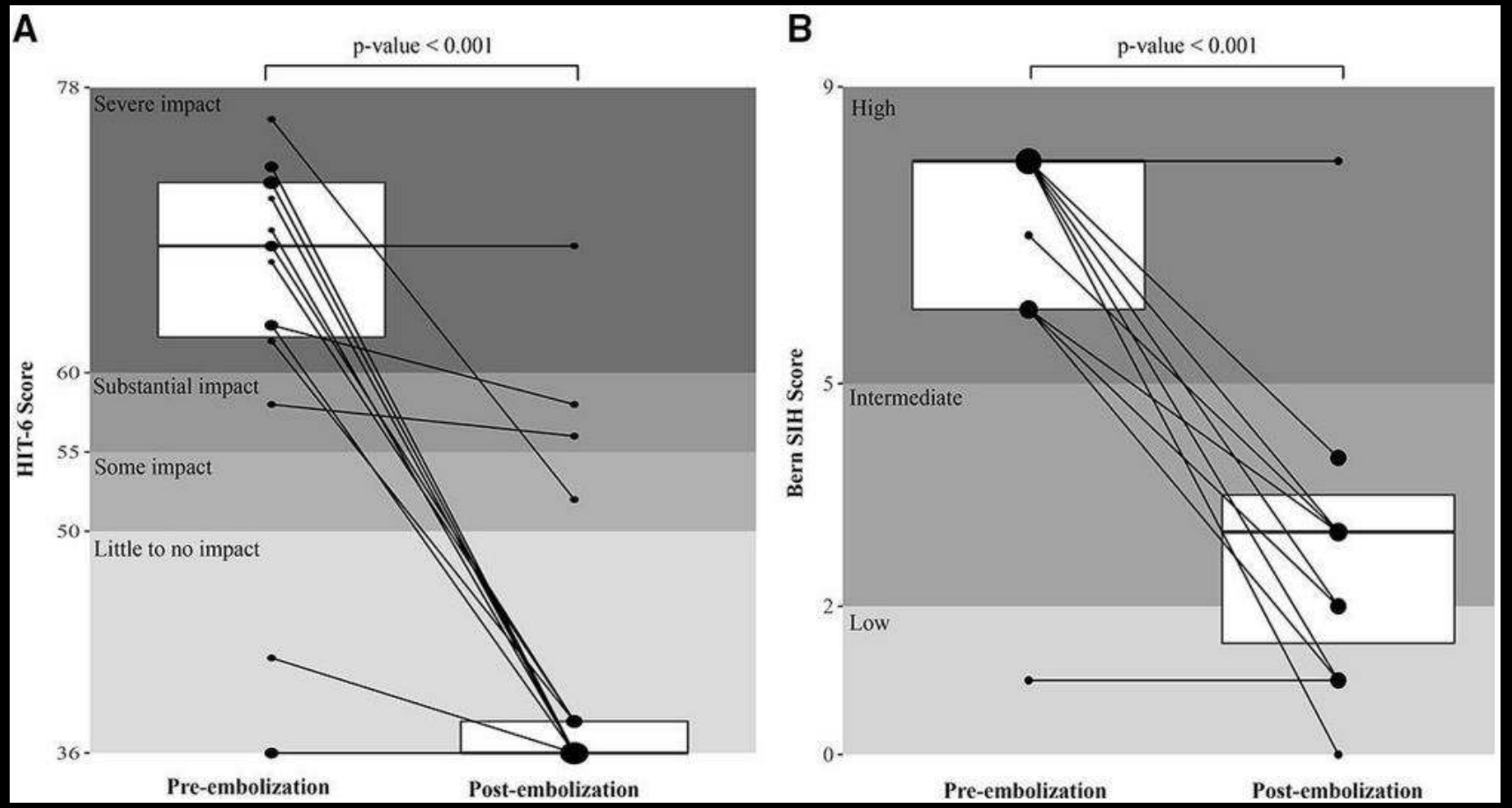
JNIS Technical Videos:

New devices and techniques

Original research

Transvenous embolization of cerebrospinal fluid-venous fistulas: Independent validation and feasibility of upper-extremity approach and using dual-microcatheter and balloon pressure cooker technique

Donna Parizadeh ,[1] Olga Fermo,[2] Prasanna Vibhute,[1] Vivek Gupta,[1] Jorge L Arturo Larco ,[1] Sanjeet S Grewal,[3] Alfredo Quinones-Hinojosa,[3] Young M Erben,[4,5] Steven Clendenen,[4] Todd D Rozen,[2] Thien J Huynh[1]

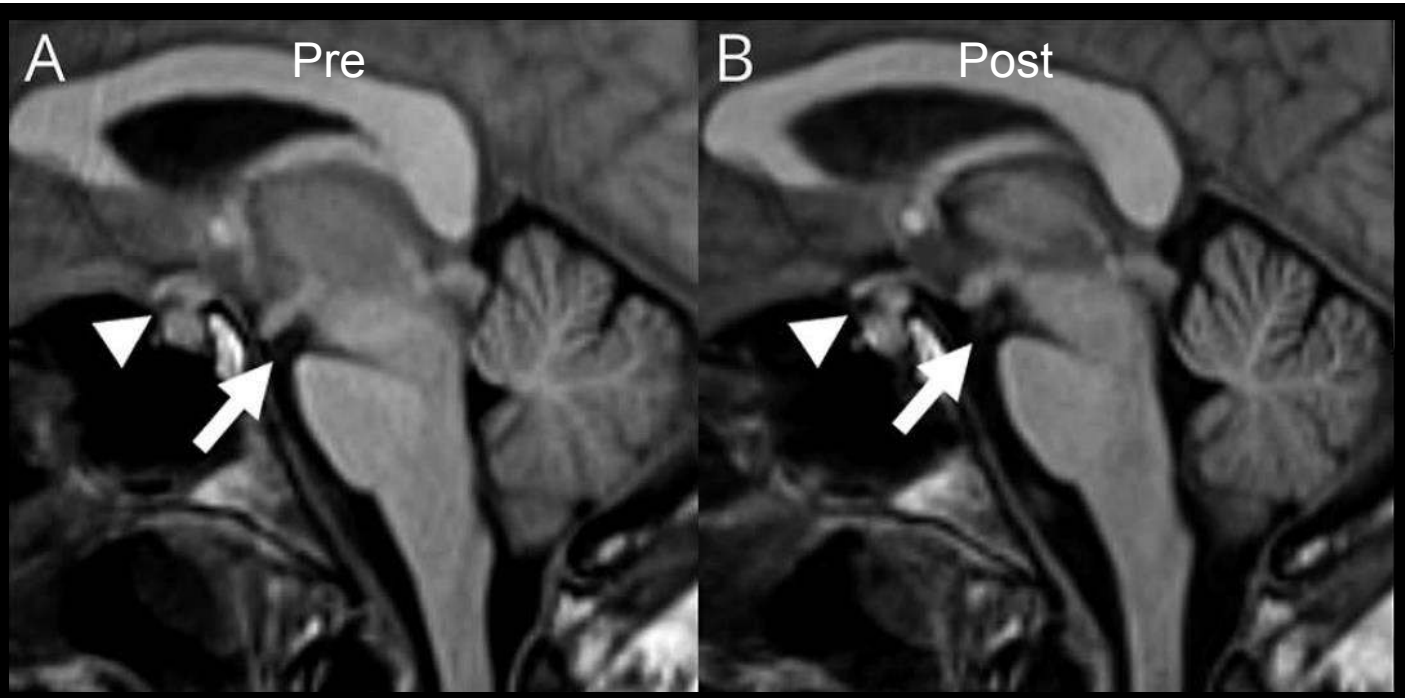


NEUROIMAGE

Rapid Clinical and Imaging Improvement in Features of Spontaneous Intracranial Hypotension in 48 hours After CSF-Venous Fistula Embolization

Elizabeth L. Saionz, Michelle P. Lin, Sheraz Ahmed, Shayan Butt, James F. Meschia, and Thien Huynh

Neurology® 2025;104:e210181. doi:10.1212/WNL.0000000000210181



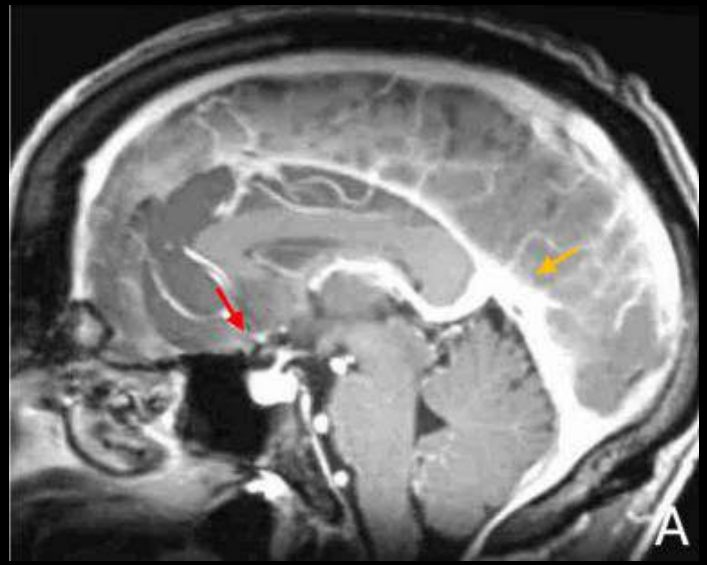
Clinical neurology

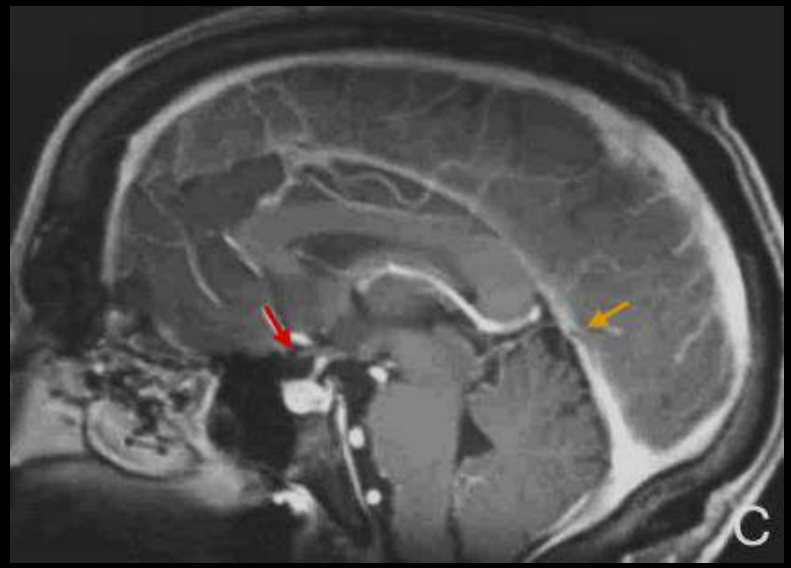
Original research

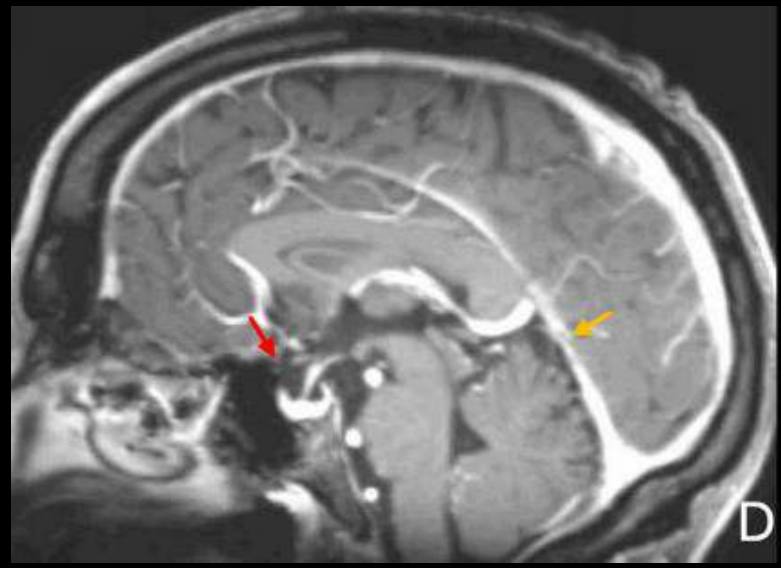
Early brain MRI changes following transvenous embolization of cerebrospinal fluid-venous fistulas in spontaneous intracranial hypotension

Federico Cagnazzo ,[1] Emmanuelle Le bars,[1] Gaetano Risi,[1] Nicolas Lonjon,[2] Liesjet E H van Dokkum,[1] Lucas Corti,[3] Vincent Costalat,[1,4] Anne Ducros[3]

J NeuroIntervent Surg 2025;**0**:1–8. doi:10.1136/jnis-2024-022957







Published May 16, 2025 as 10.3174/ajnr.A8839

SYSTEMATIC REVIEW/META-ANALYSIS

Transvenous Embolization vs. Surgical Intervention for cerebrospinal fluid Venous Fistulas: A Systematic Review and Meta-analysis

Seyed Behnam Jazayeri[1*], Mohammad Mirahmadi Eraghi[2], Julien Ognard[3,4], Sherief Ghozy[3,5], Ramanathan Kadirvel[3], Waleed Brinjikji[3,5], David F. Kallmes[3]

- Similar partial or complete (90%) clinical improvement rates
- Symptom resolution similar (59% embo vs 70% surgery; p = 0.38)
- Retreatment rates 15% embo vs 11% surgery (p = 0.63)

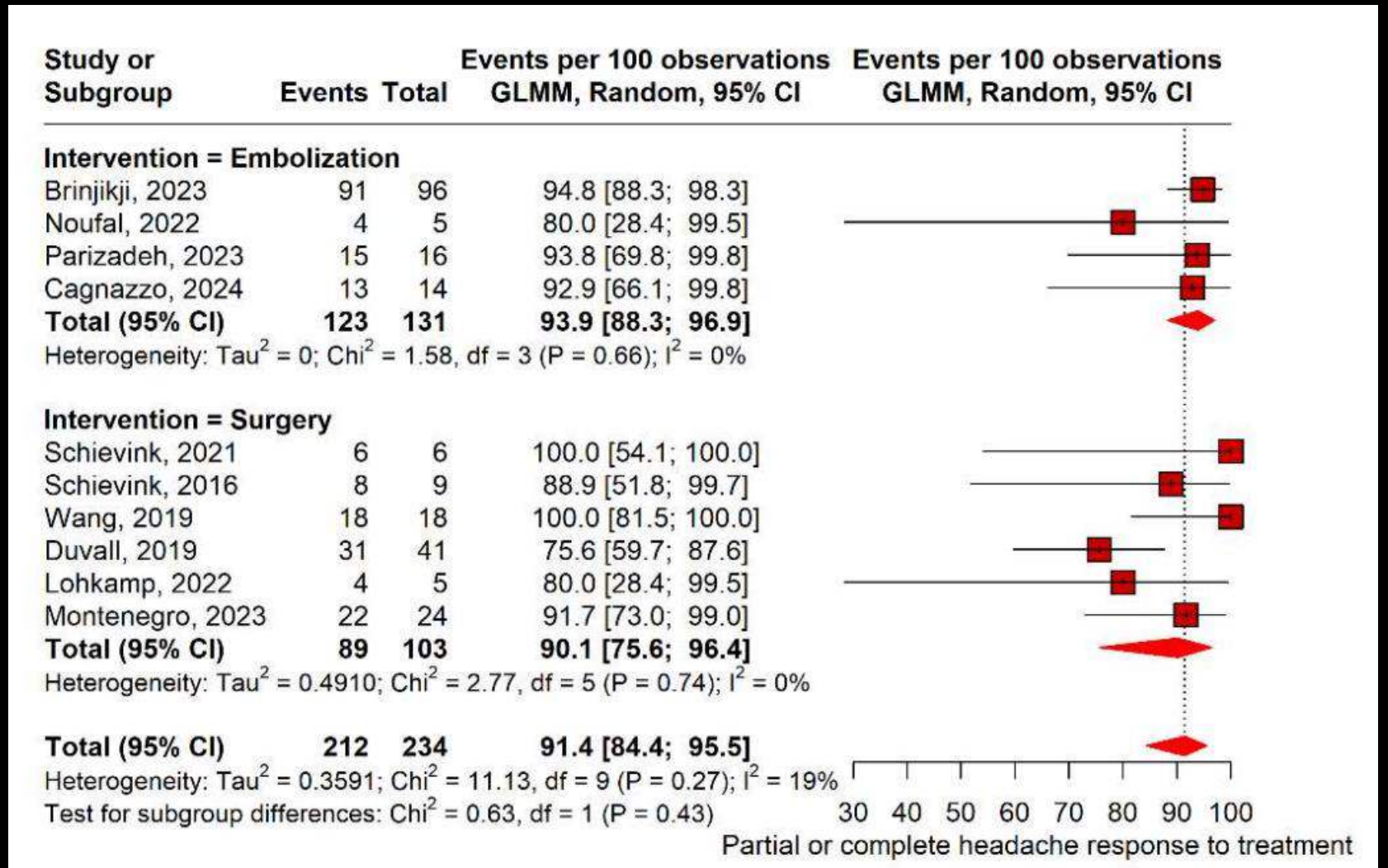
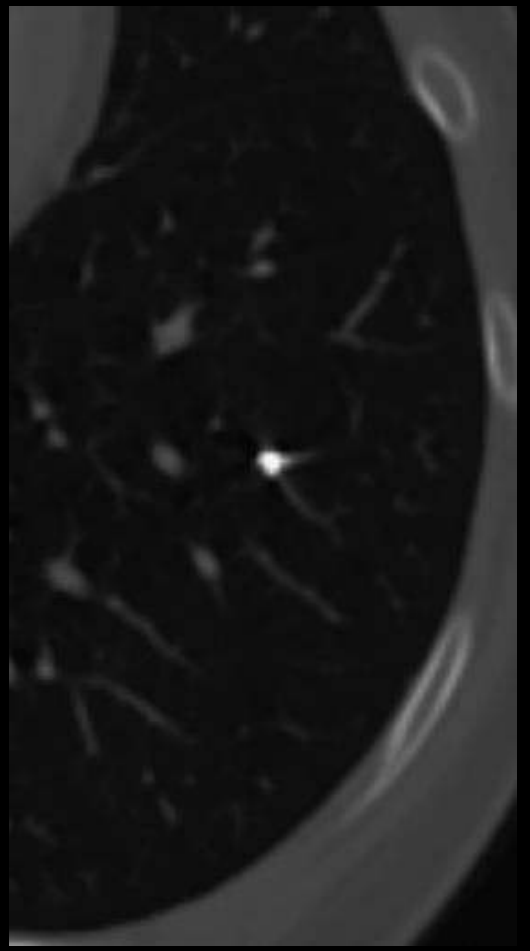


FIG 2 Forest plot of partial or complete response to treatment for headache

SAFETY/COMPLICATIONS

- High technical success rate
- No neurological complications (no cord compression, cord ischemia)
- 1% radiculopathy/numbness which resolved after a year; no motor deficits
  - (1 personal patient with persistent hand weakness/numbness, CVF Right T1)
- 5% asymptomatic pulmonary onyx
- 5% paraspinal/epidural vein perforation (no sequela)



Brinjikji JNIS 2023; Parizadeh JNIS 2023

TREATMENT FAILURES (5-10%)?

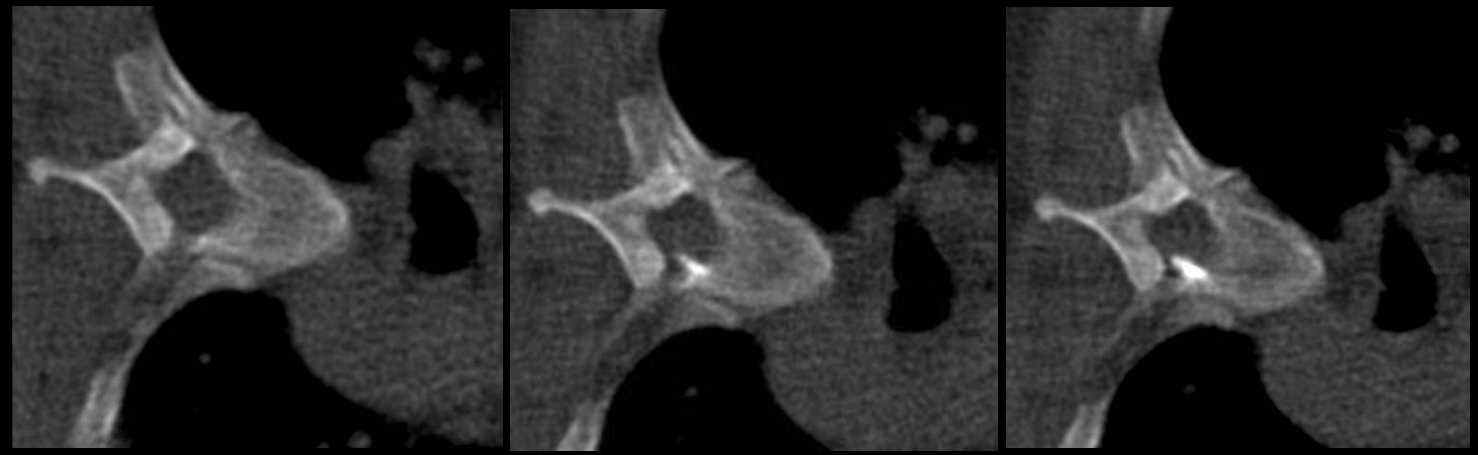
- Technical nuances
  - Unable to localize or confirm CVF closure using myelography intra-procedure
    - Relies on clear/definite depiction of CVF on DSM/CTM
    - Use anatomical landmarks for microcatheter positioning and onyx cast distribution
    - Ensure thorough embolization - Insufficient embolization results in residual CVF

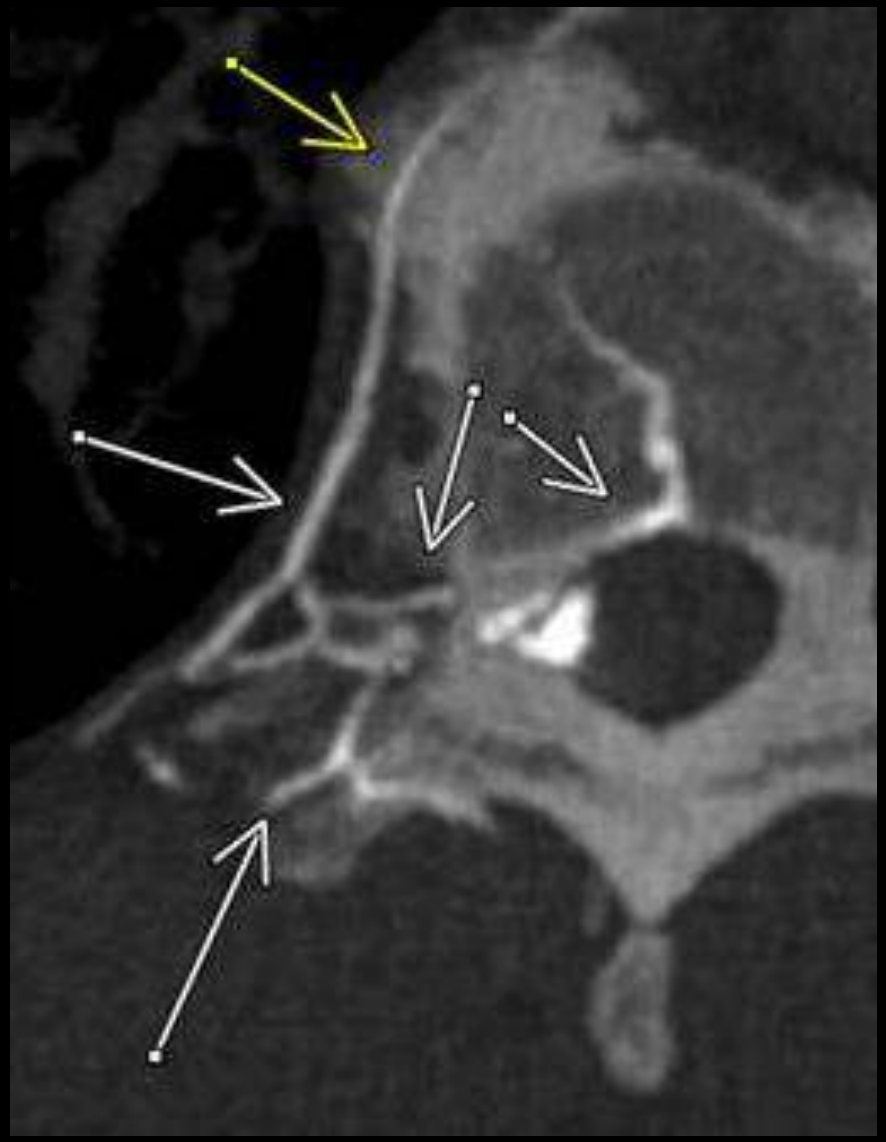
Published December 28, 2023 as 10.3174/ajnr.A8082

ORIGINAL RESEARCH
SPINE IMAGING AND SPINE IMAGE-GUIDED INTERVENTIONS

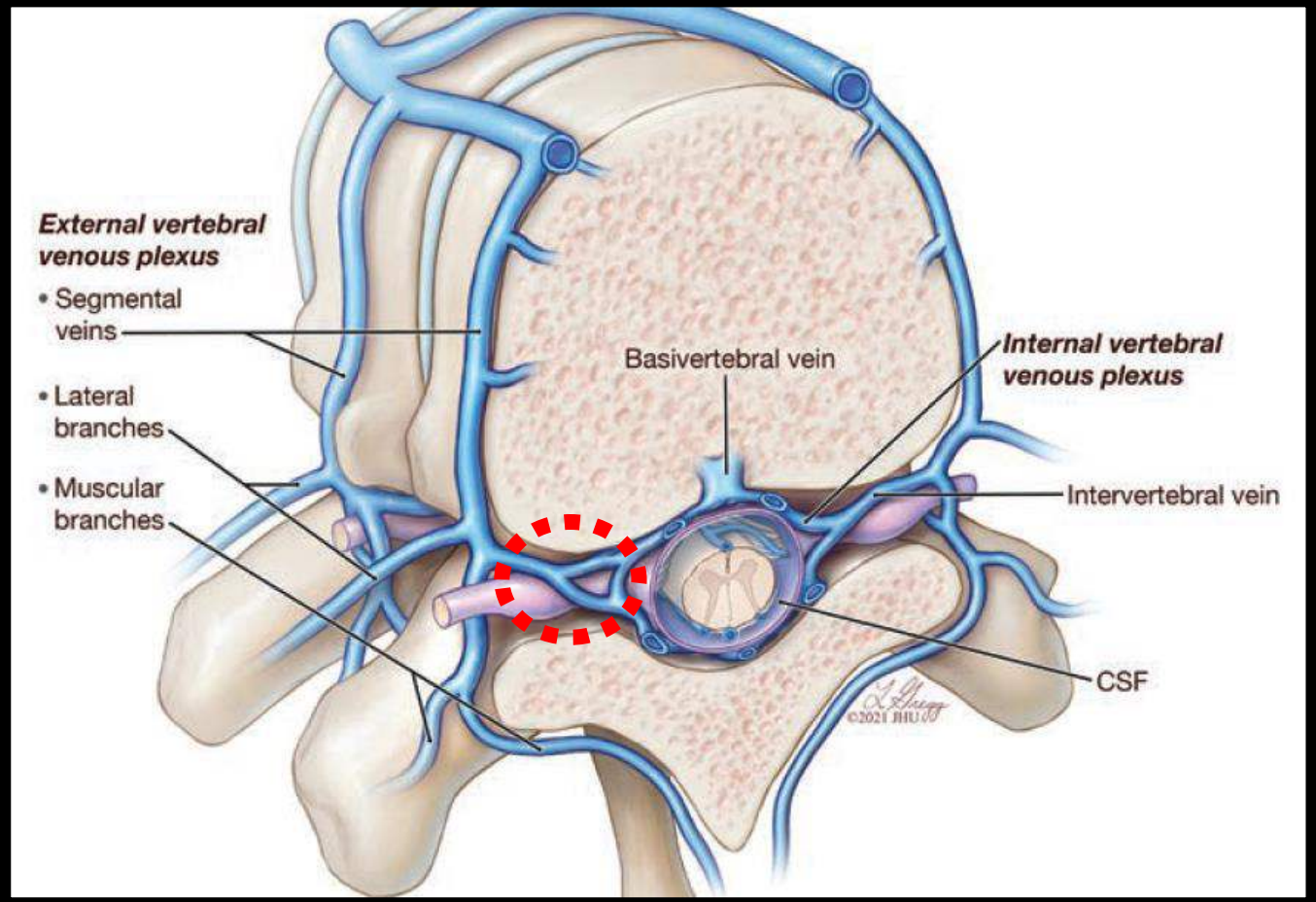
Lateral Decubitus Dynamic CT Myelography with Real-Time Bolus Tracking (dCTM-BT) for Evaluation of CSF-Venous Fistulas: Diagnostic Yield Stratified by Brain Imaging Findings

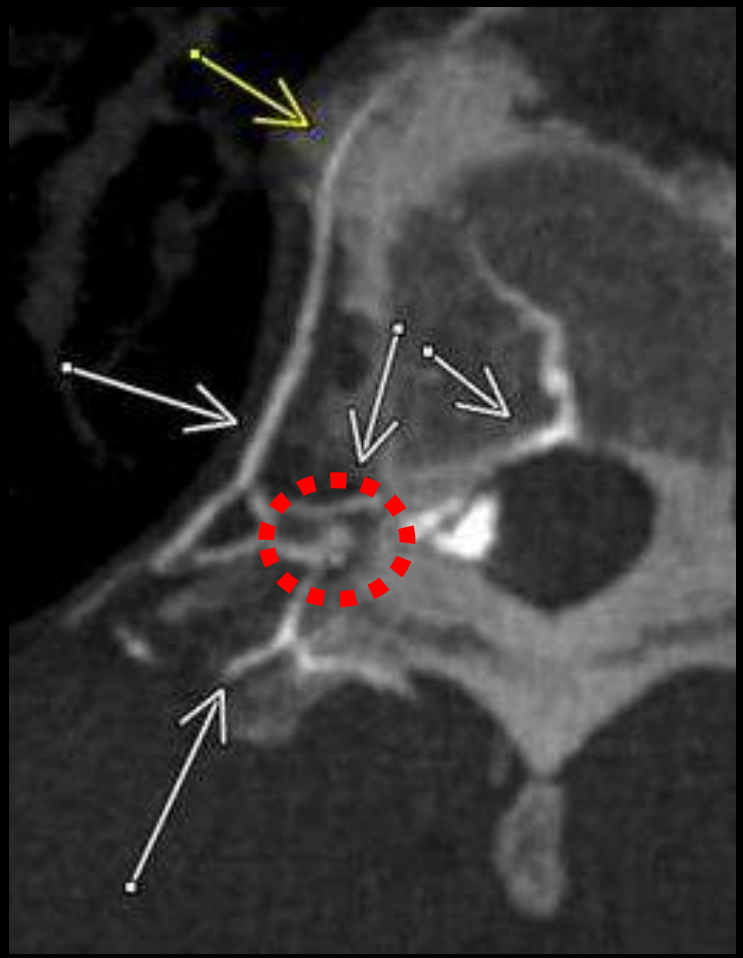
Thien J. Huynh, Donna Parizadeh, Ahmed K. Ahmed, Christopher T. Gandia, Hal C. Davison, John V. Murray, Ian T. Mark, Ajay A. Madhavan, Darya Shlapak, Todd D. Rozen, Waleed Brinjikji, Prasanna Vibhute, Vivek Gupta, Kacie Brewer, and Olga Fermo





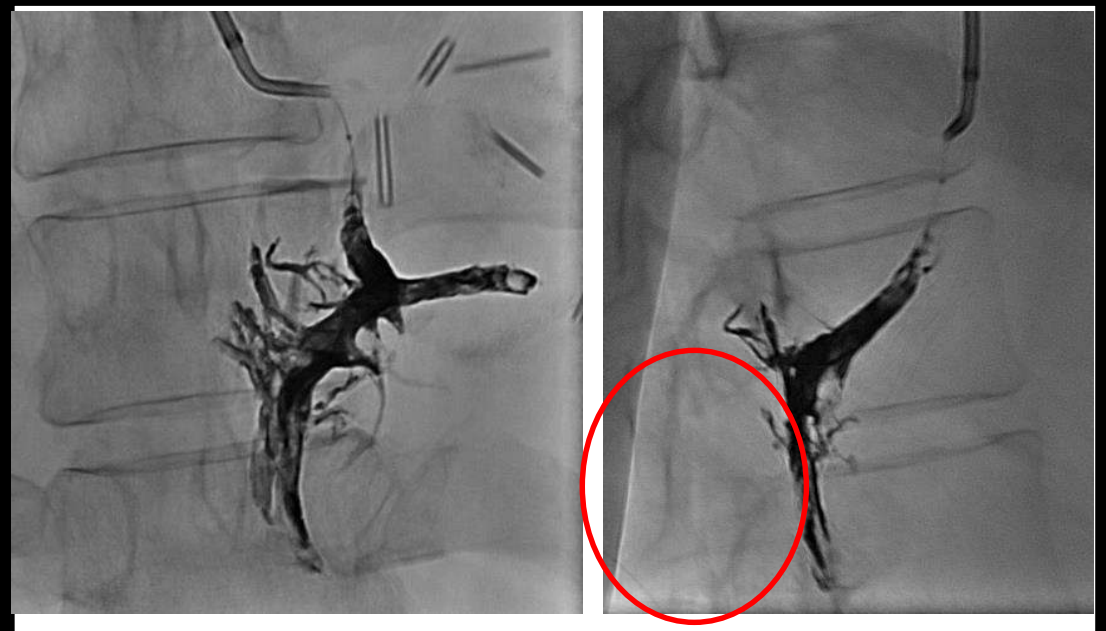
ANATOMY OF CSF-VENOUS FISTULA & PARASPINAL VEINS



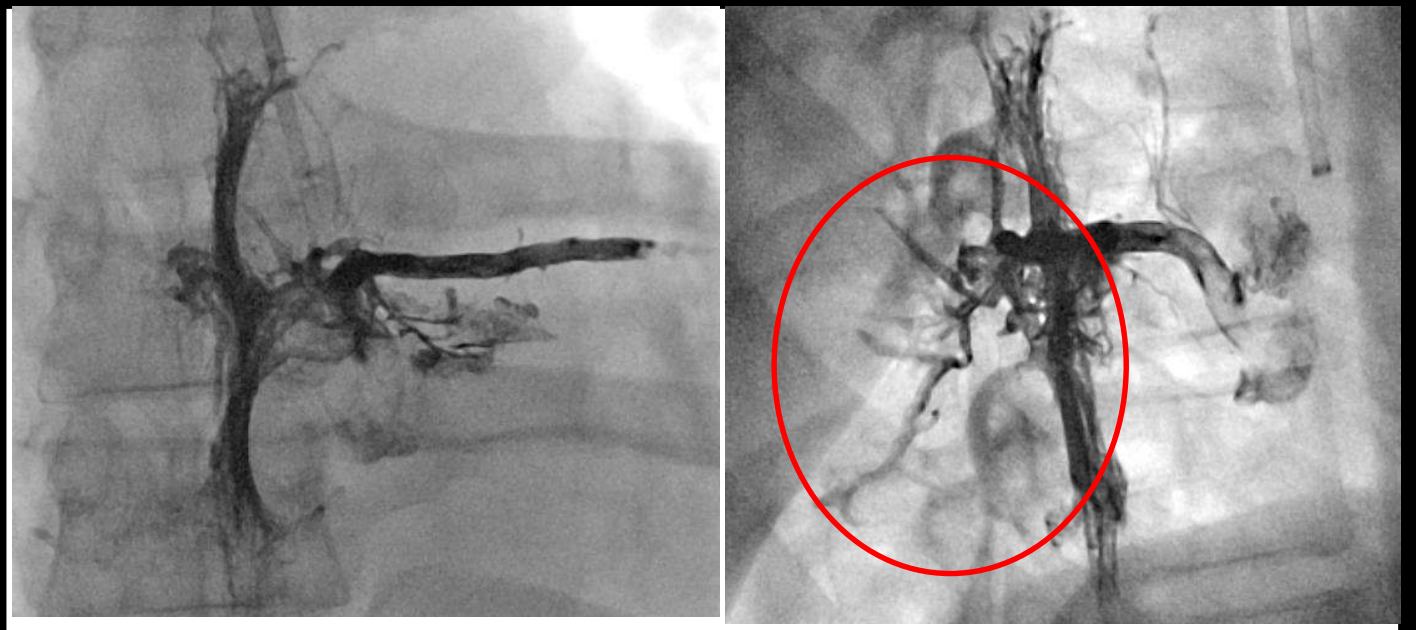


Kranz et al. AJR 2021

Lateral/Oblique view helpful to identify posterior/muscular branch embolization

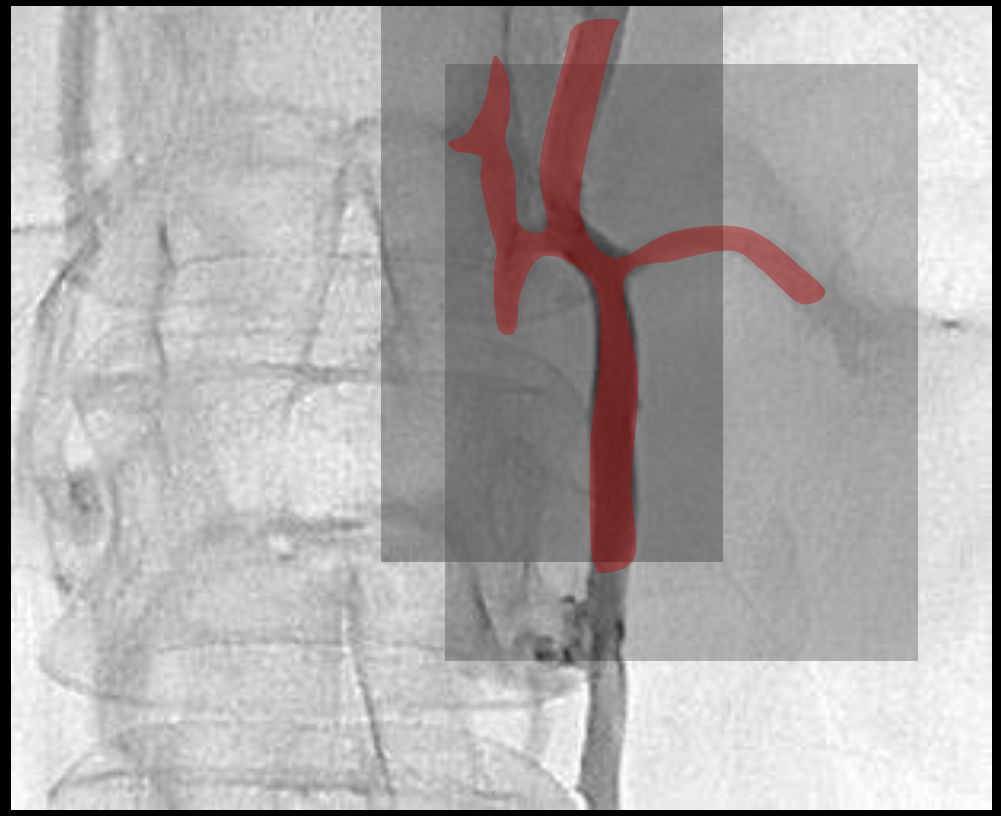


Left T10; no clinical or imaging response post embolization; additional CT fibrin glue patch with subsequent improvement



Left T8; expected rebound headache, resolution of orthostatic headache; improved brain MRI

Dual-Microcatheter and Coil/Balloon Pressure Cooker Technique



JNIS Technical Video:

Dual-Microcatheter and Coil/Balloon Pressure Cooker Technique

Ideal Catheter Positioning

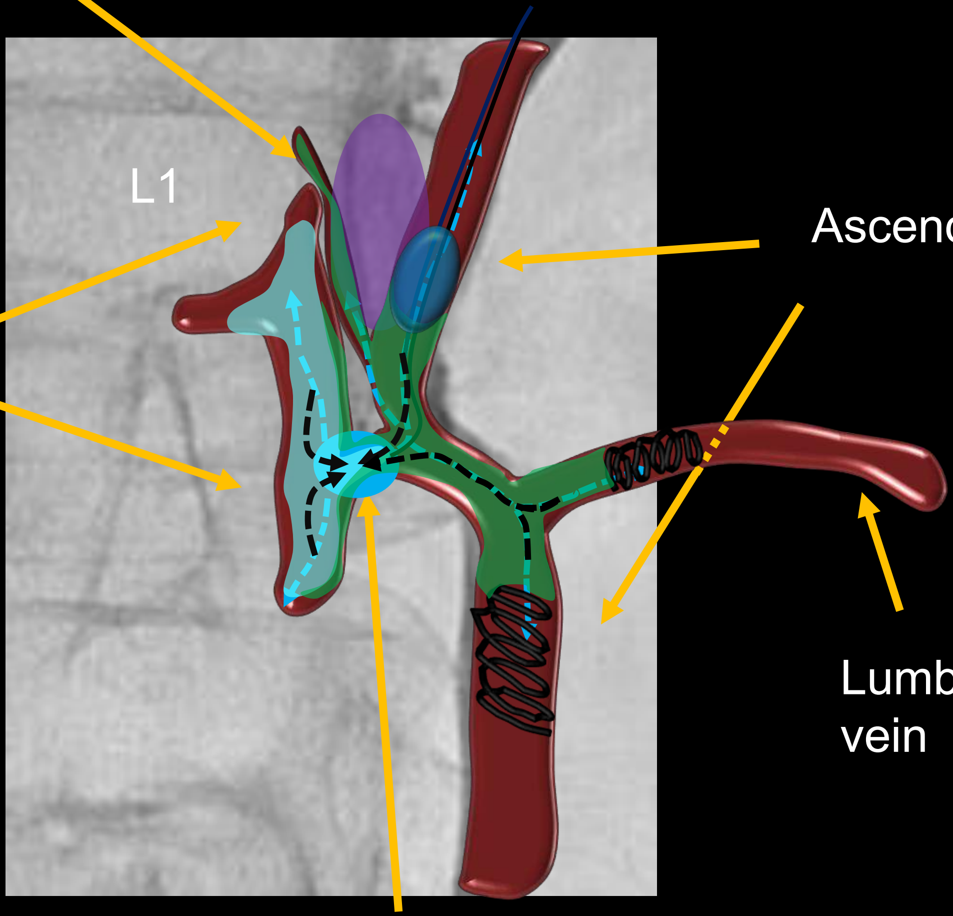
1) Coil placement: Exiting venous tributaries (lumbar/intercostal vein/ segmental/ intersegmental veins.)
(Lateral epidural venous plexus
2) Microcatheter placement: at foraminal venous plexus (under immediately adjacent to pedicle)
3) Balloon microcatheter placement

Implications of Technique

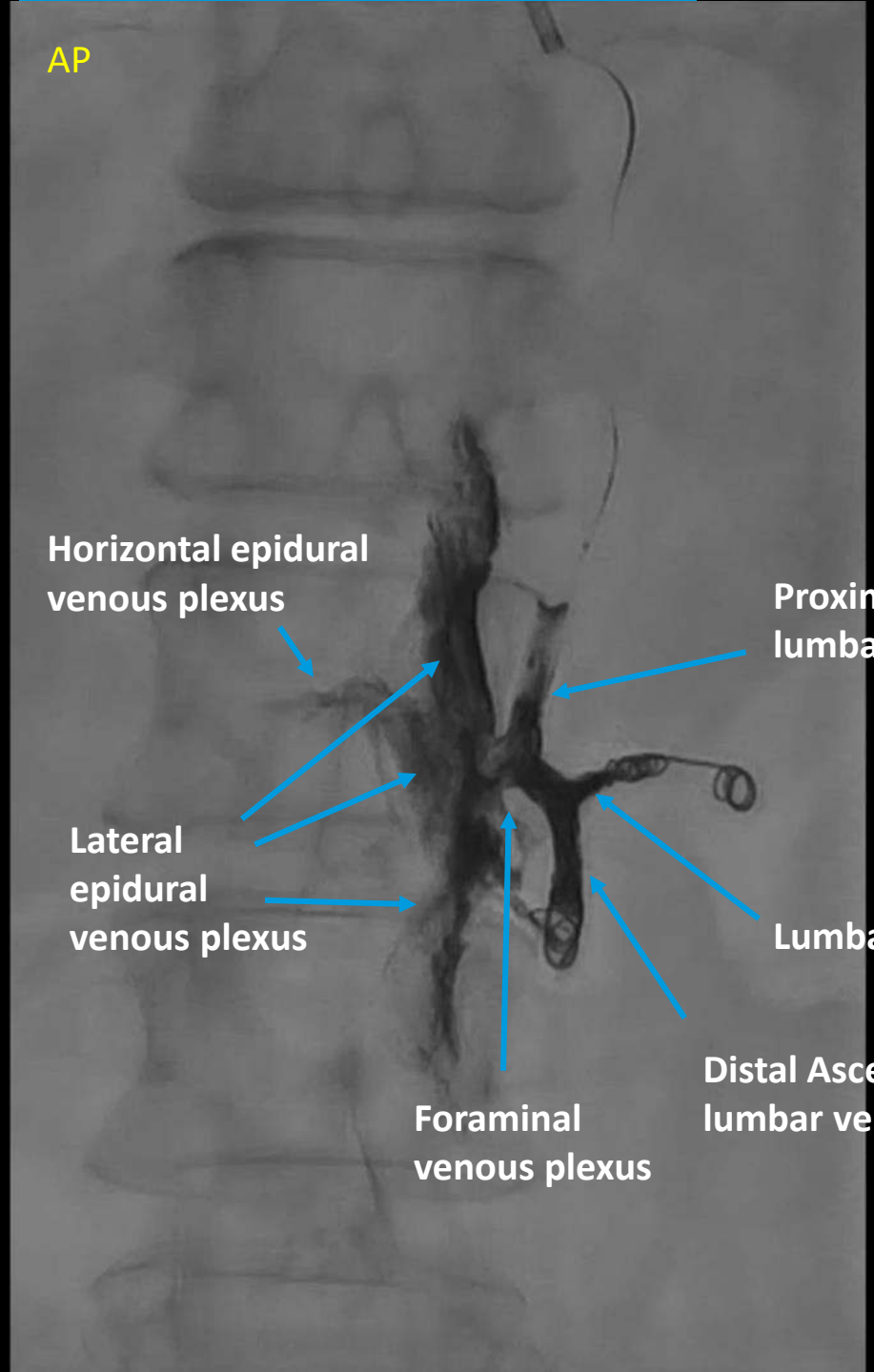
-Ensures full embolic material penetration of high resistance small veins around the site of fistula/
-Dual microcatheter enables excellent control over location of embolization: **Ensures highest chance of embolizing the site of fistula**
-Control reflux: **Saves time and embolic agent**

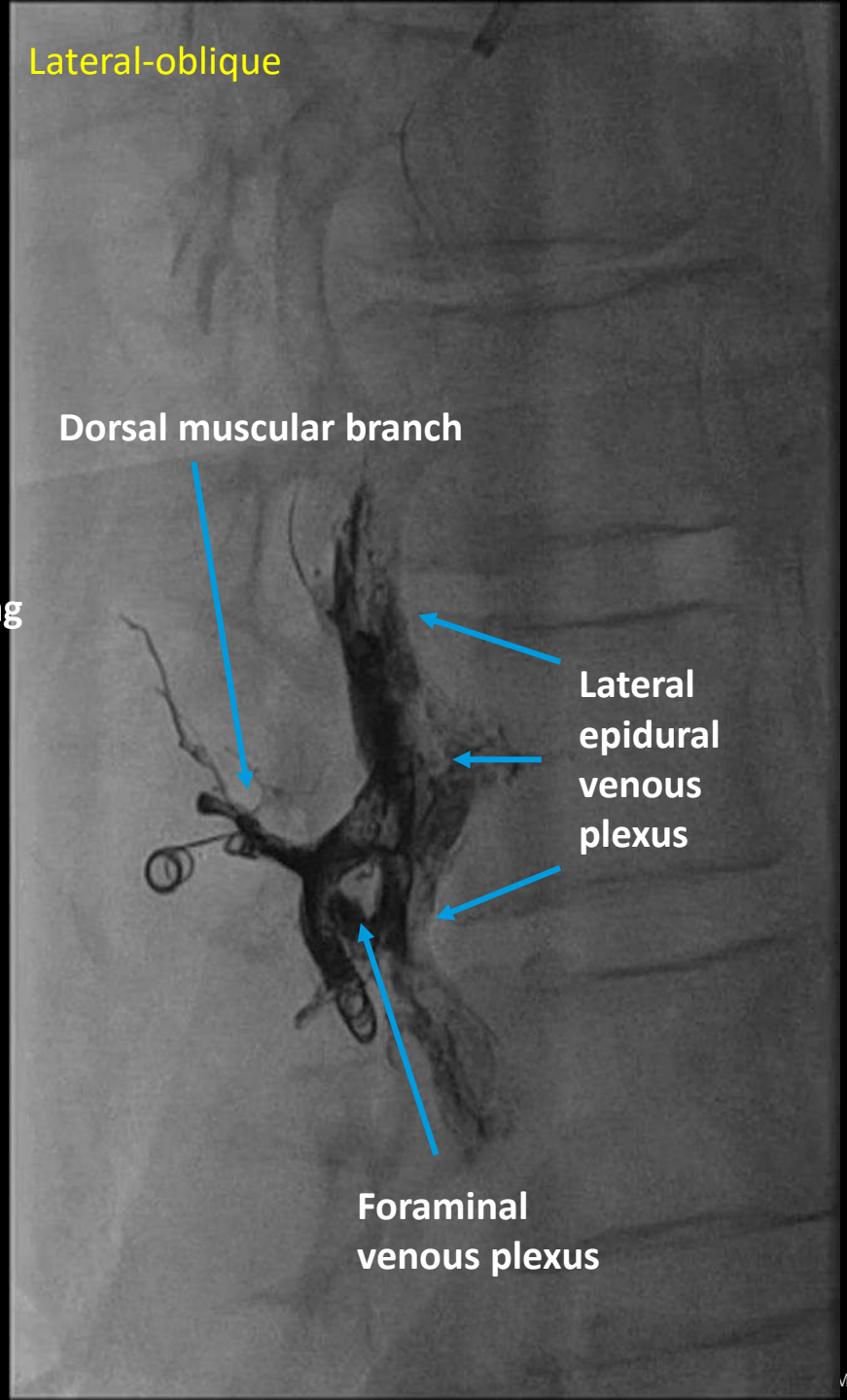
CSF-venous fistula leak Embolization

-We use **Onyx 34** at lateral epidural venous plexus then switch to **Onyx 18** to embolize all exiting venous tributaries



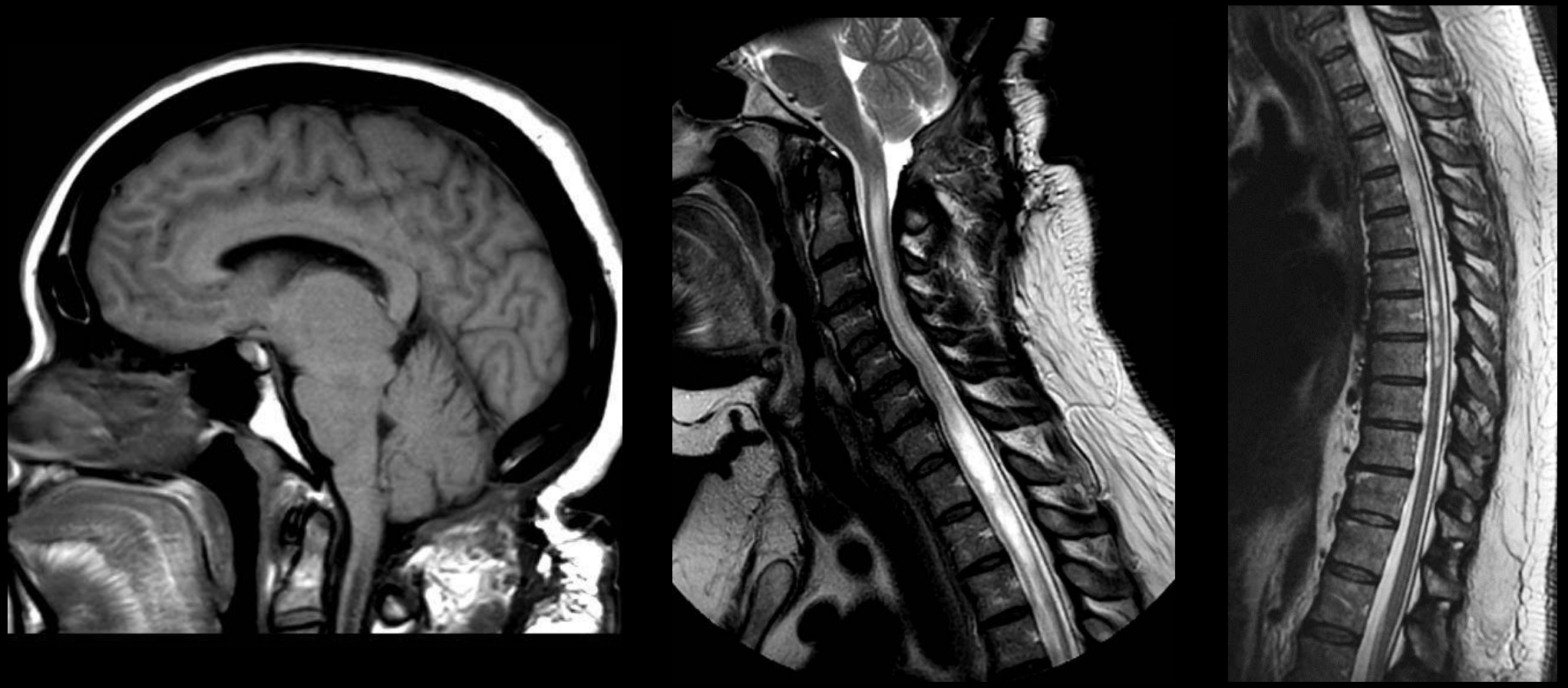
JNIS Technical Video:


AP
Horizontal epidural venous plexus
Proximal Ascending lumbar vein
Lateral epidural venous plexus
Lumbar vein
Distal Ascending lumbar vein
Foraminal venous plexus

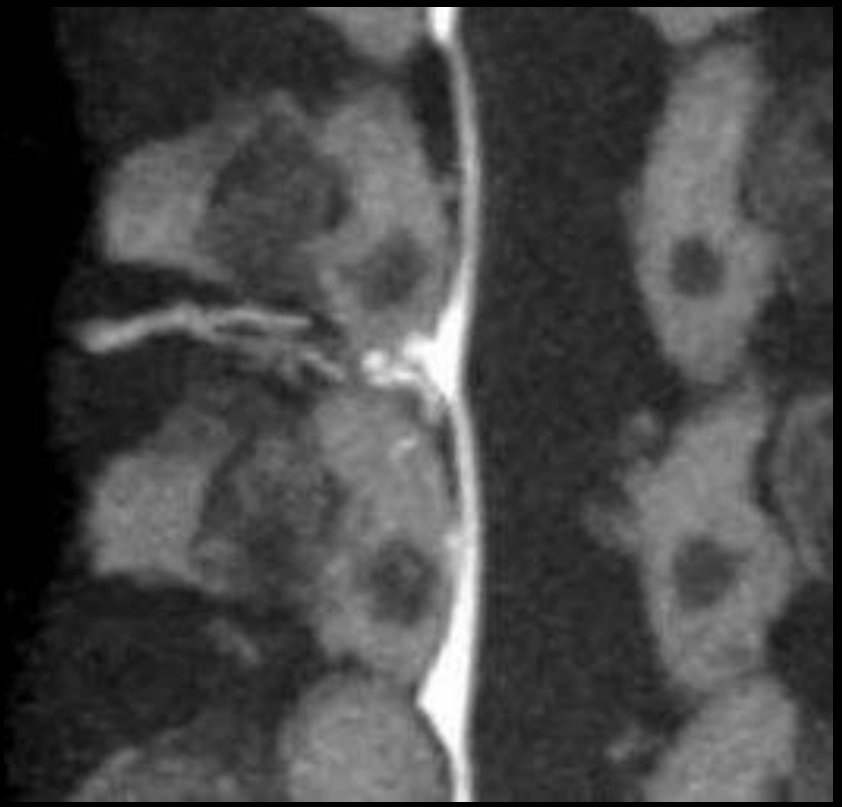

Lateral-oblique
Dorsal muscular branch
Lateral epidural venous plexus
Foraminal venous plexus

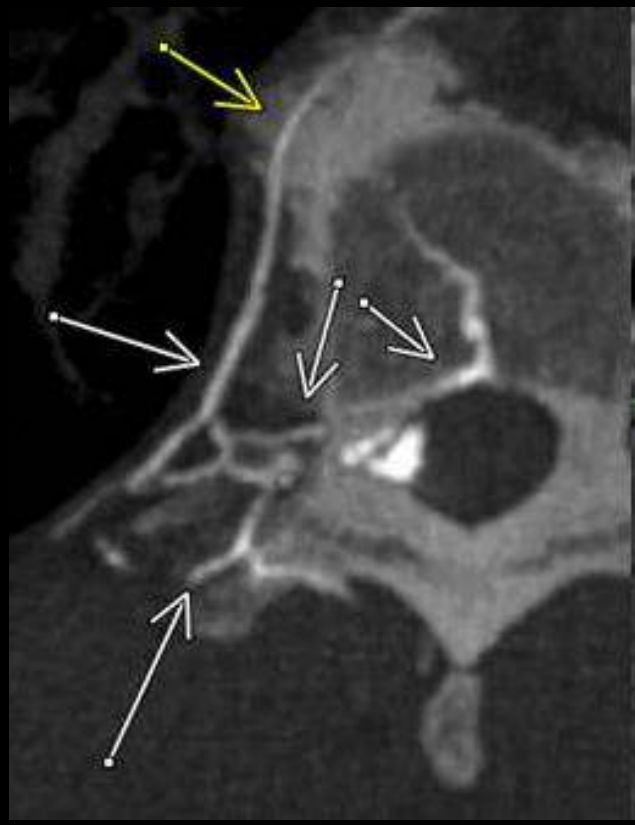
EFFECTIVE FOR COMPLEX FISTULAS

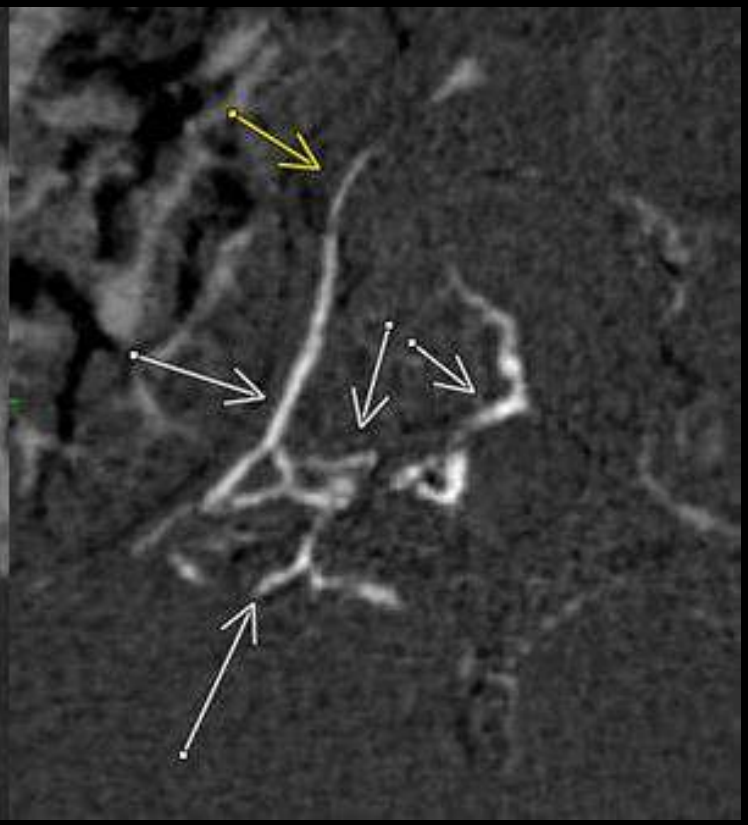
- 50F, daily orthostatic headaches and neck pain, progressive left upper and lower extremity weakness, numbness (since 2018)

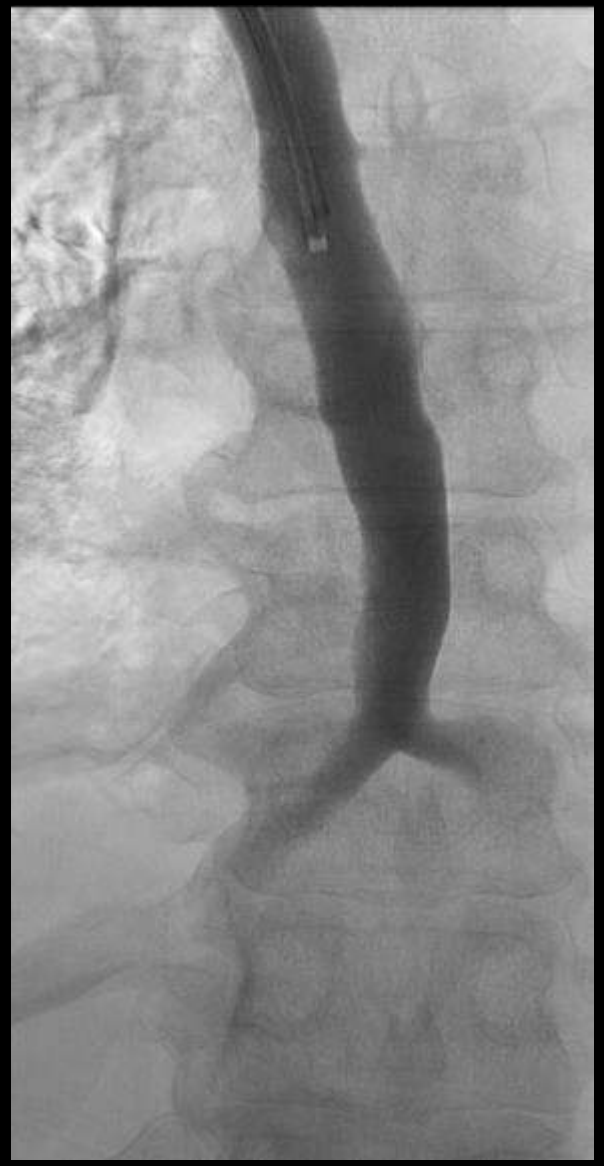


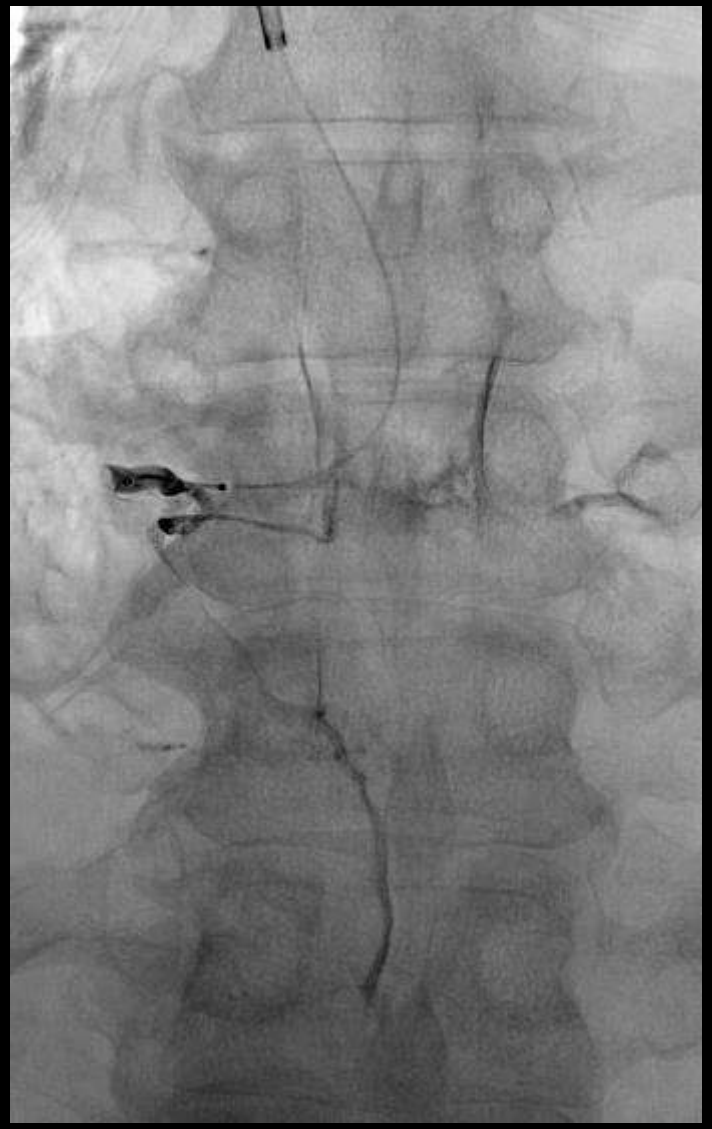
Middlebrooks et al World Neurosurg 2020

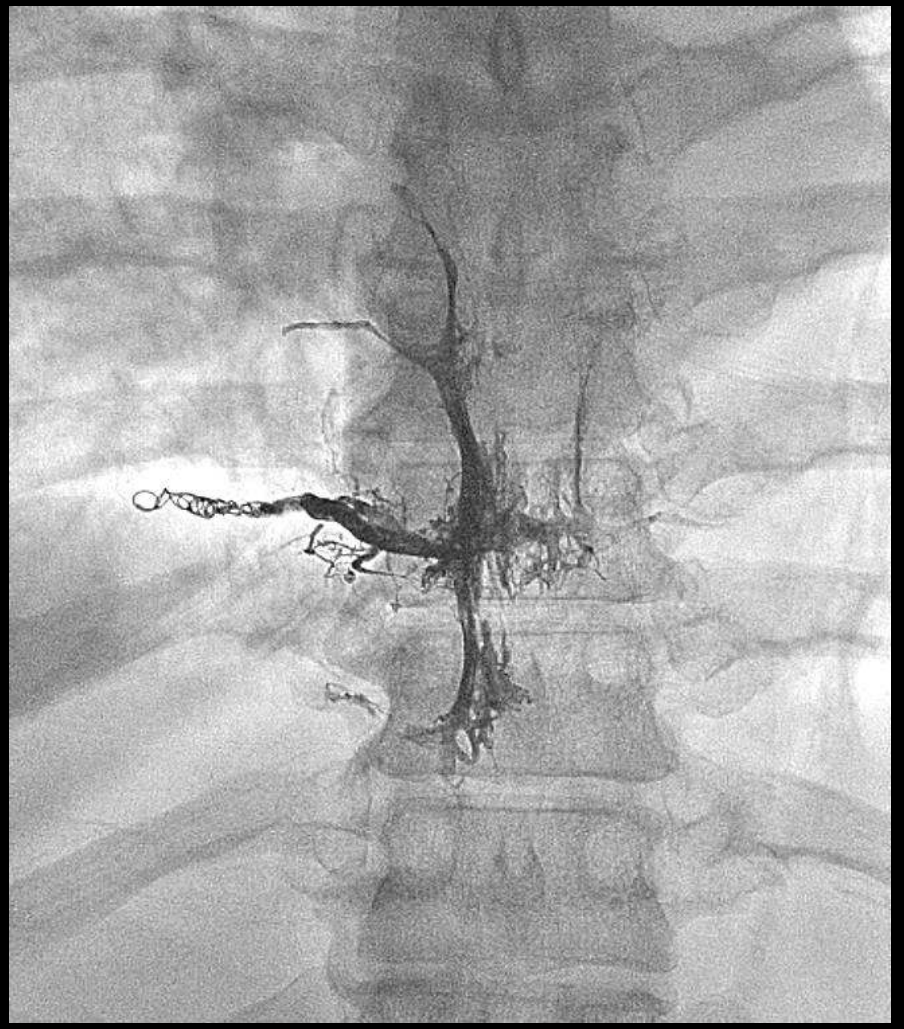


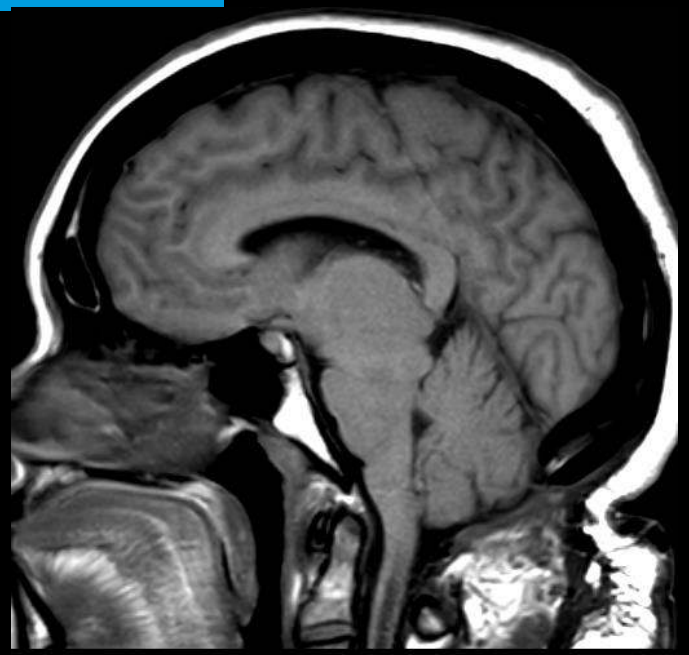
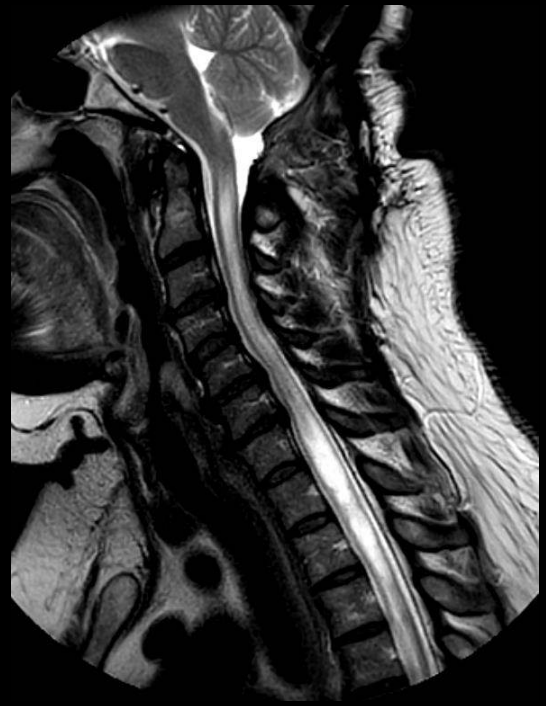
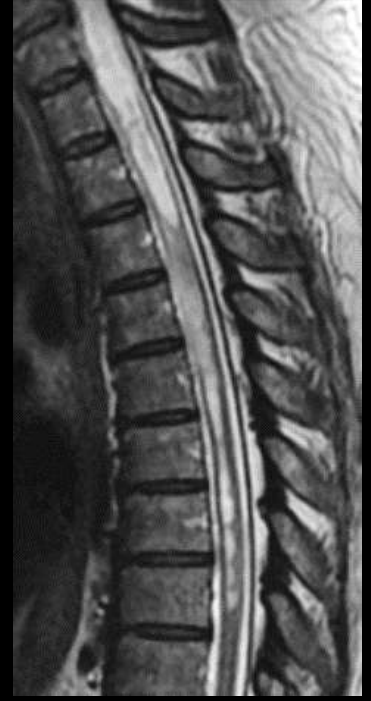






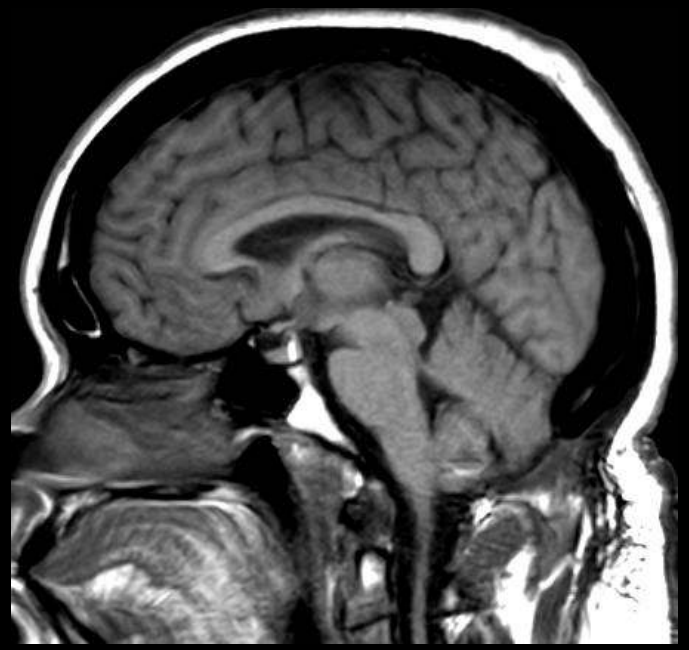
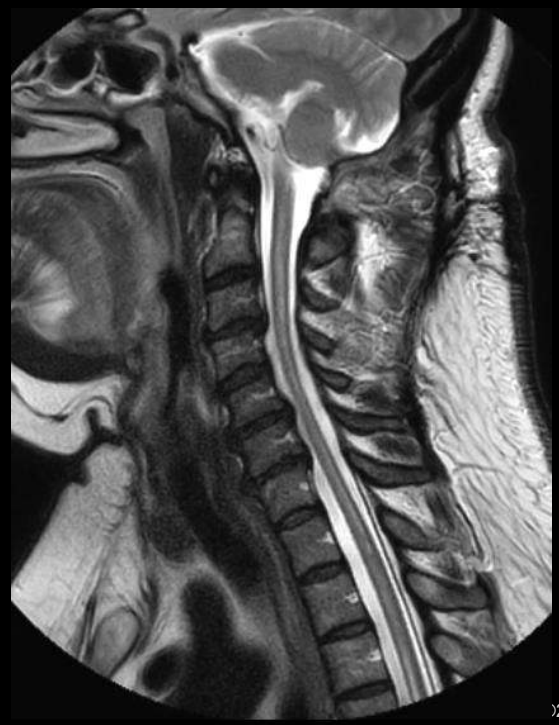
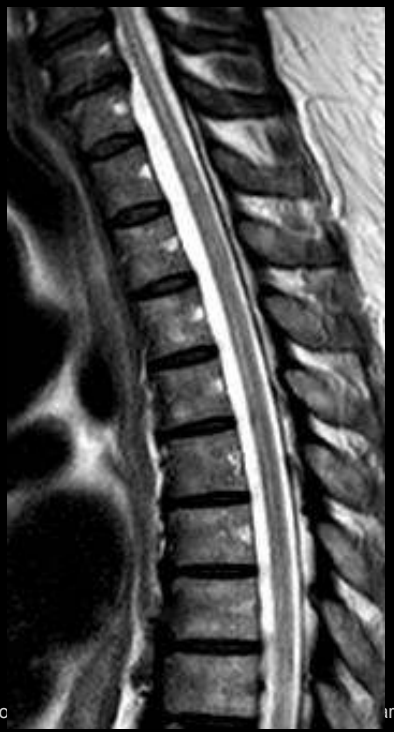




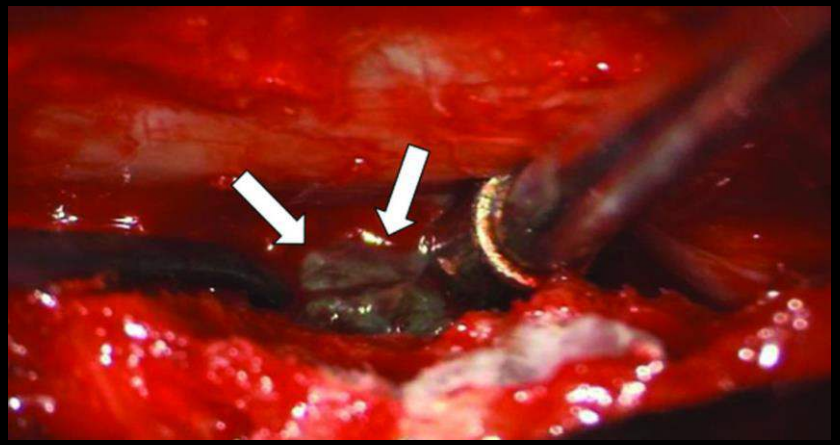
3-month follow-up imaging

Resolution of headaches and halted progression of myelopathy

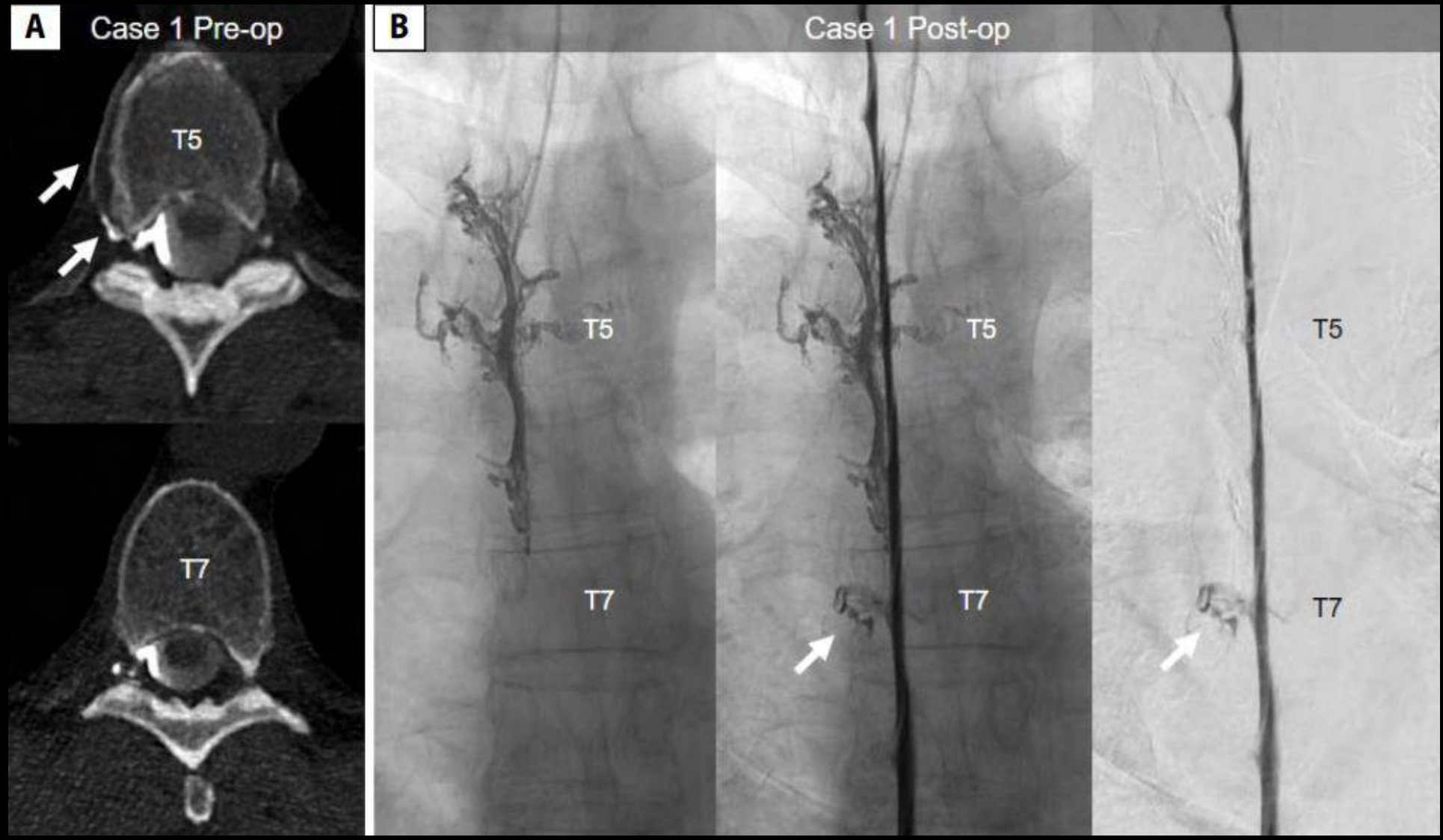
PITFALLS/TREATMENT FAILURES

- Incomplete embolization
  - Surgery remains a viable treatment option post-embolization
    - Schievink AJNR 2022



- De novo CVF leak site

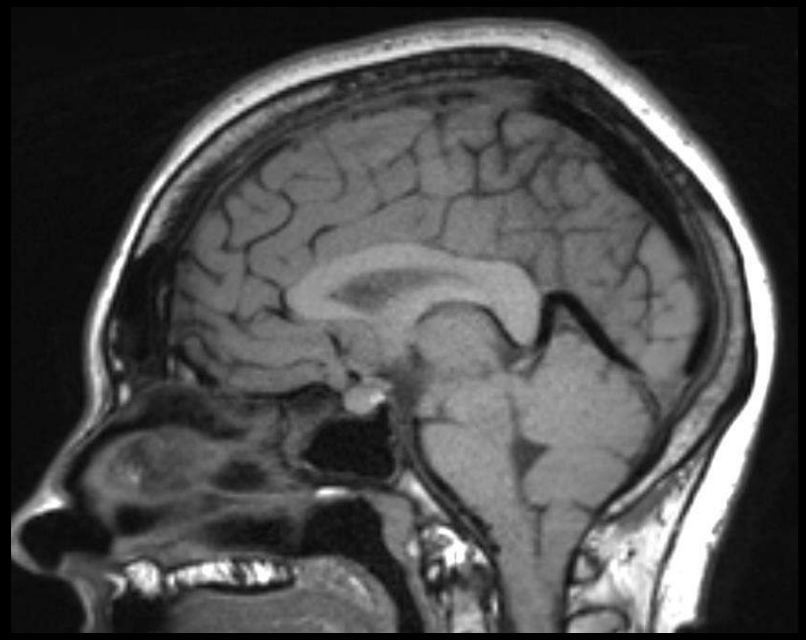
New CVF at separate level (5 months)

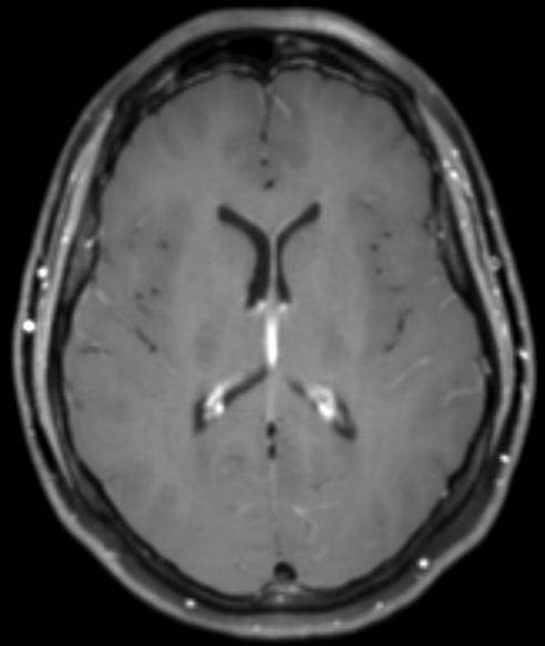


Zayat/Fermo/Huynh Neurol Pol 2024 (Malinzak Neurology Clin P 2021)

FINAL CASE

- 30 year-old woman with chronic intractable new persistent daily headaches for 3+ years



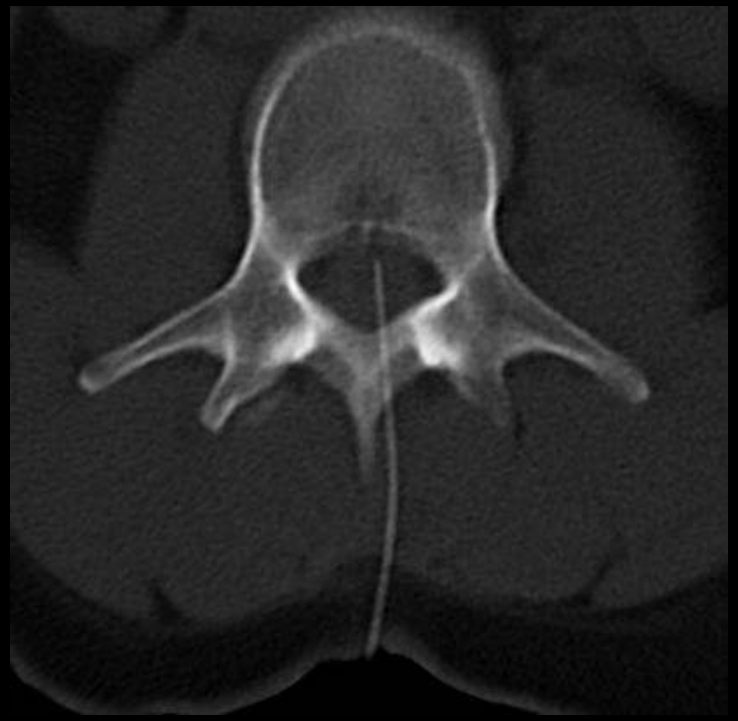


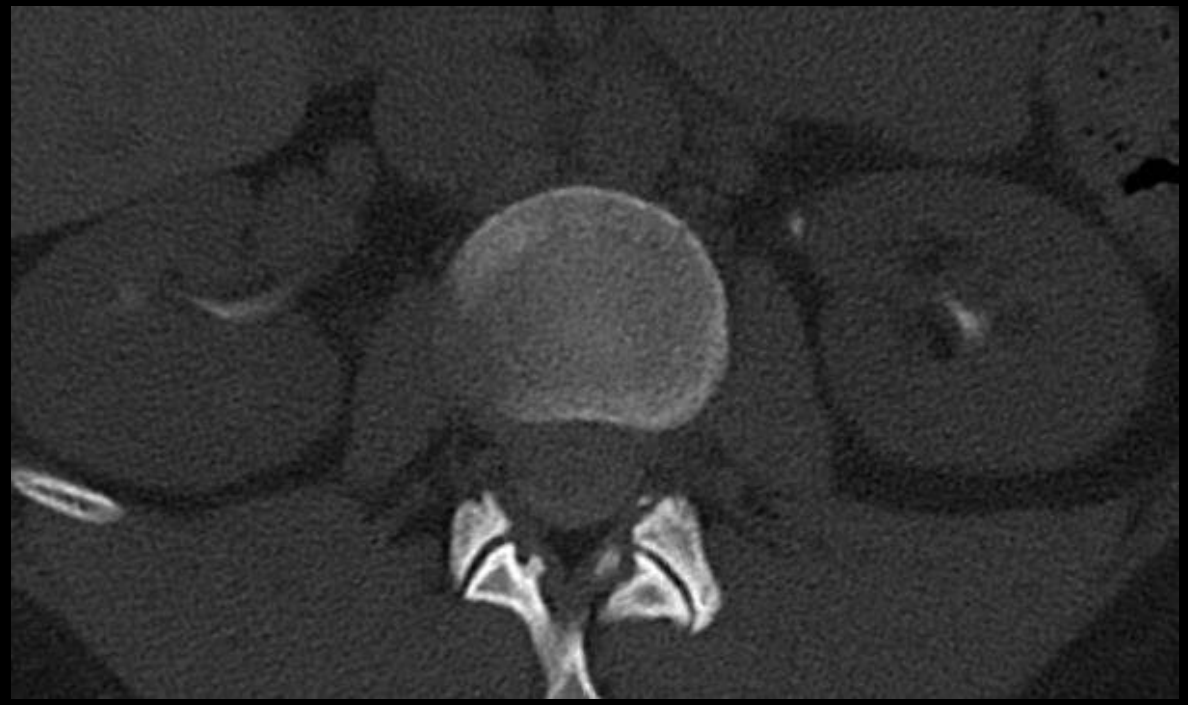
- Multiple lateral decubitus DSM, CTM (+ photon counting CT), MR+gad myelo negative for CVF
- Always + with early renal contrast excretion

- Multiple spinal epidural blood patches and fibrin patches performed without improvement in clinical or imaging features

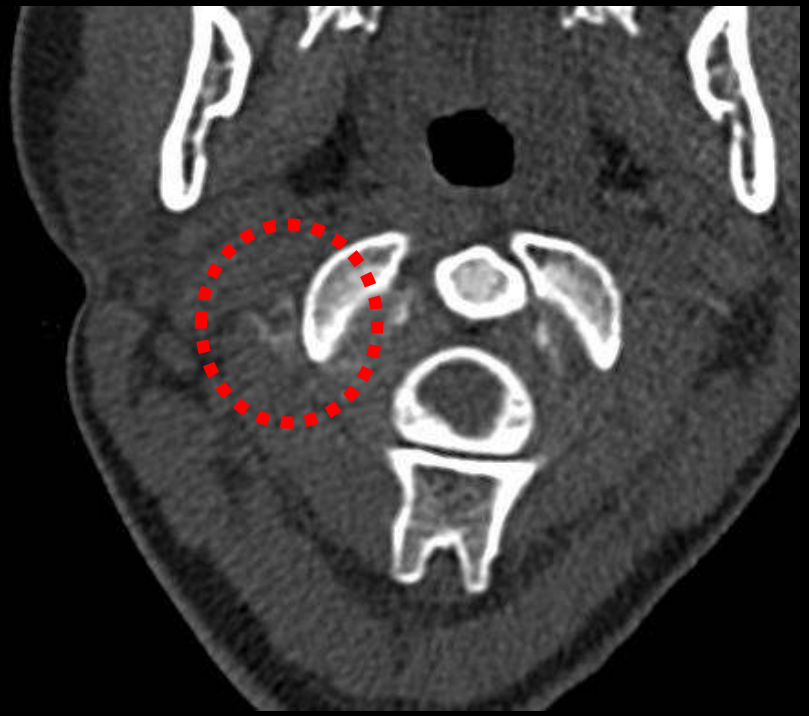
REPEAT SAME-DAY BILATERAL CTM

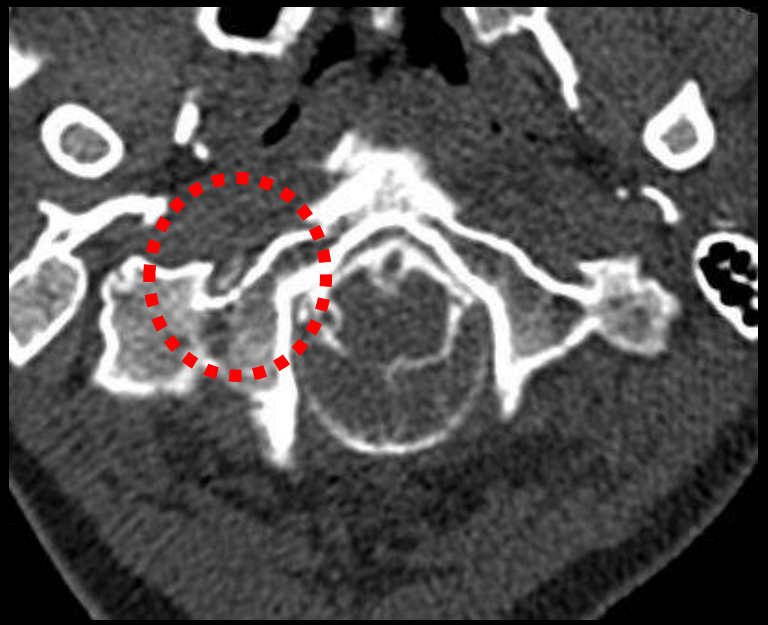
- Left side: negative
- Right side: extensive contrast leak prior to first injection; right-side injection negative

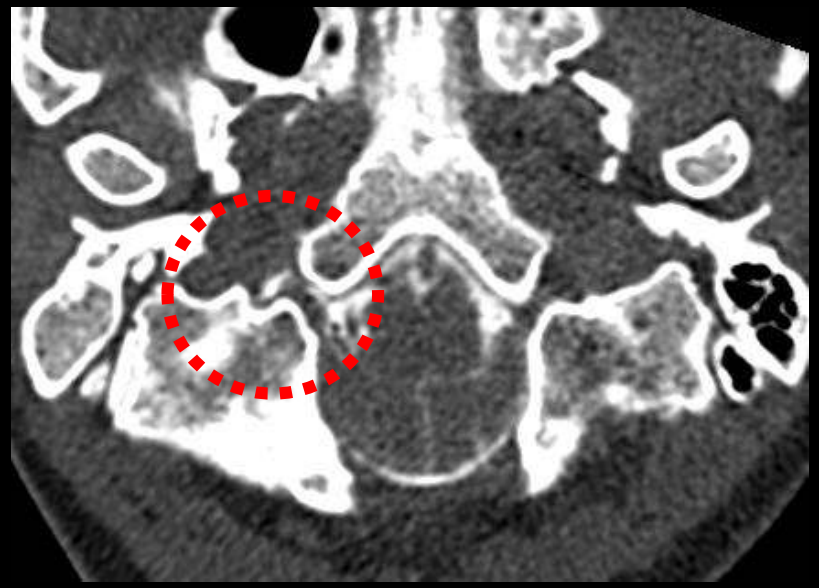




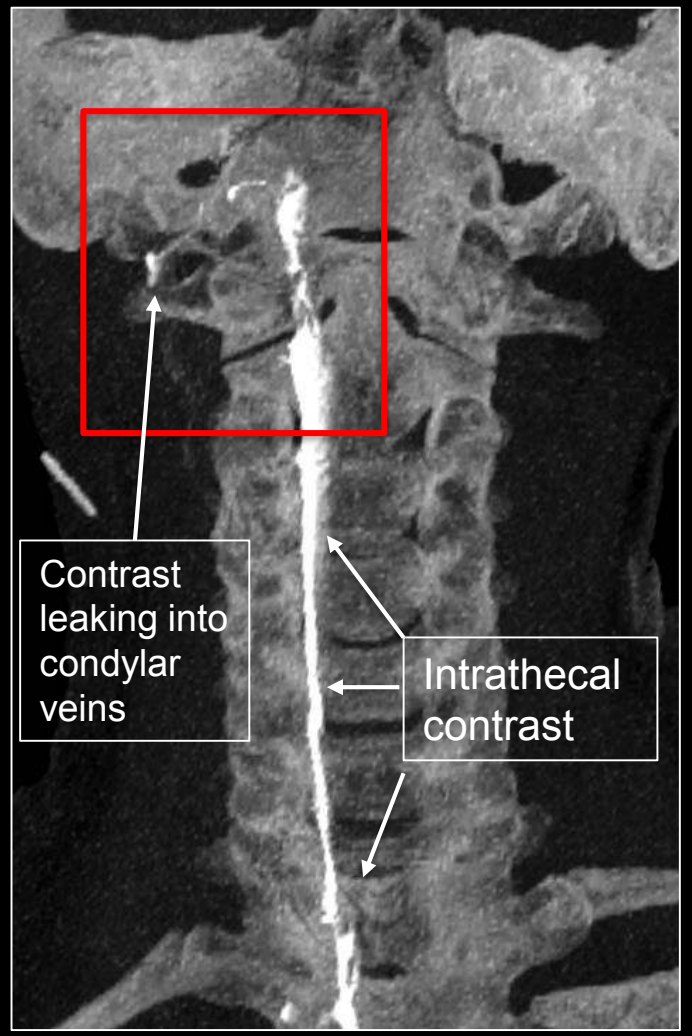
- Repeated left lateral injection (3rd injection)
- About to give up…. Finding?

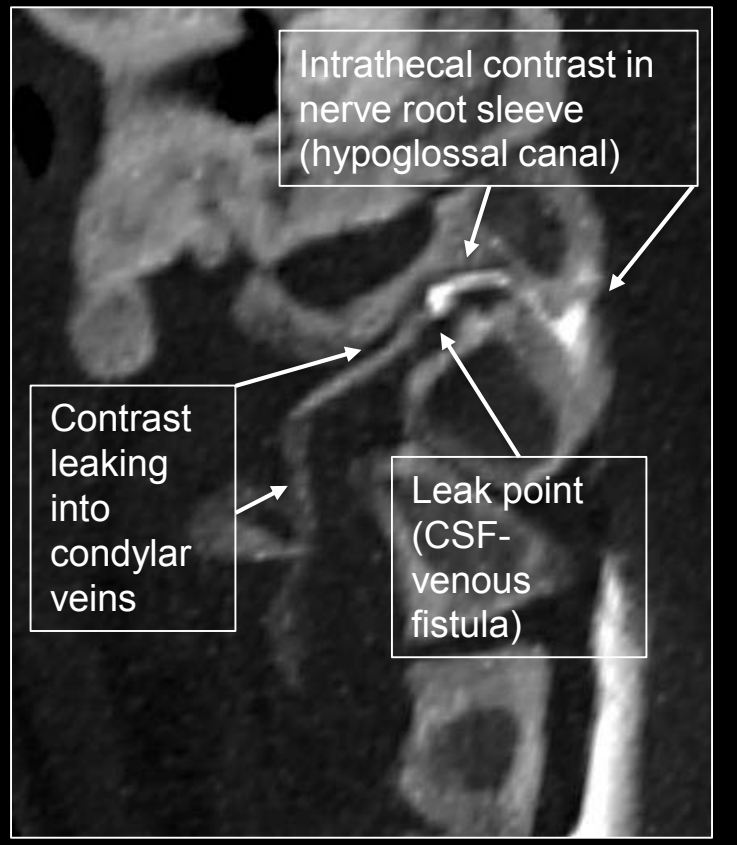






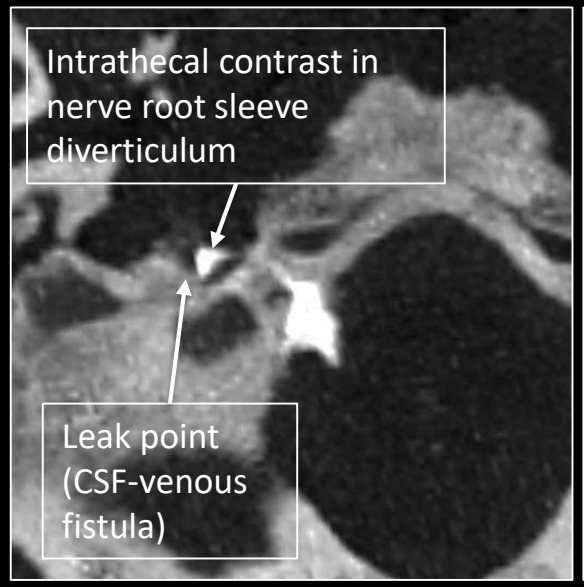
- Repeated dedicated right CTM
- Right anterior condylar confluence CSF-venous fistula (novel finding not previously reported in literature)



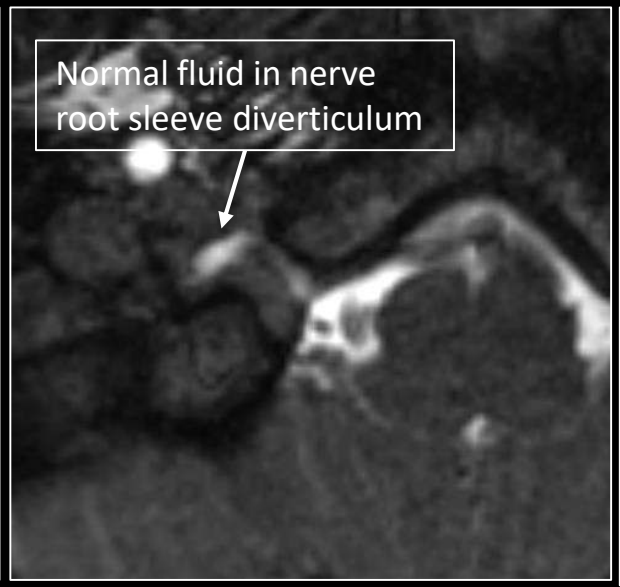


Magnified CTM coronal view (from red box)

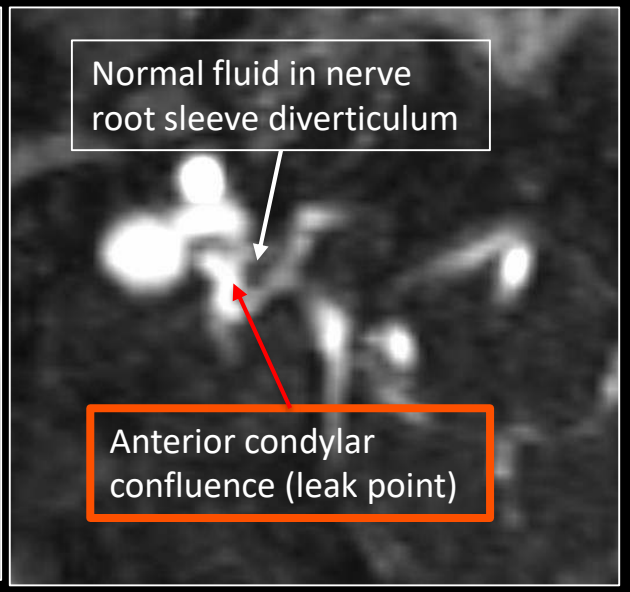
Procedural Planning Anatomy: MRV Venous Mapping at same slice as T2 SPACE and CTM



Axial CTM

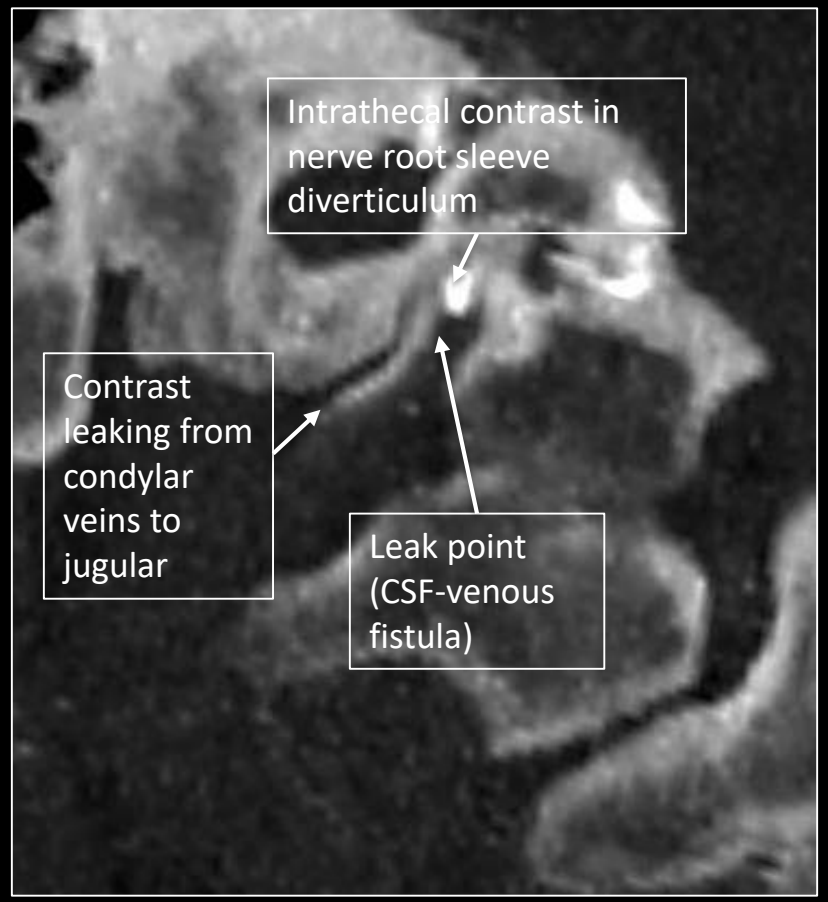


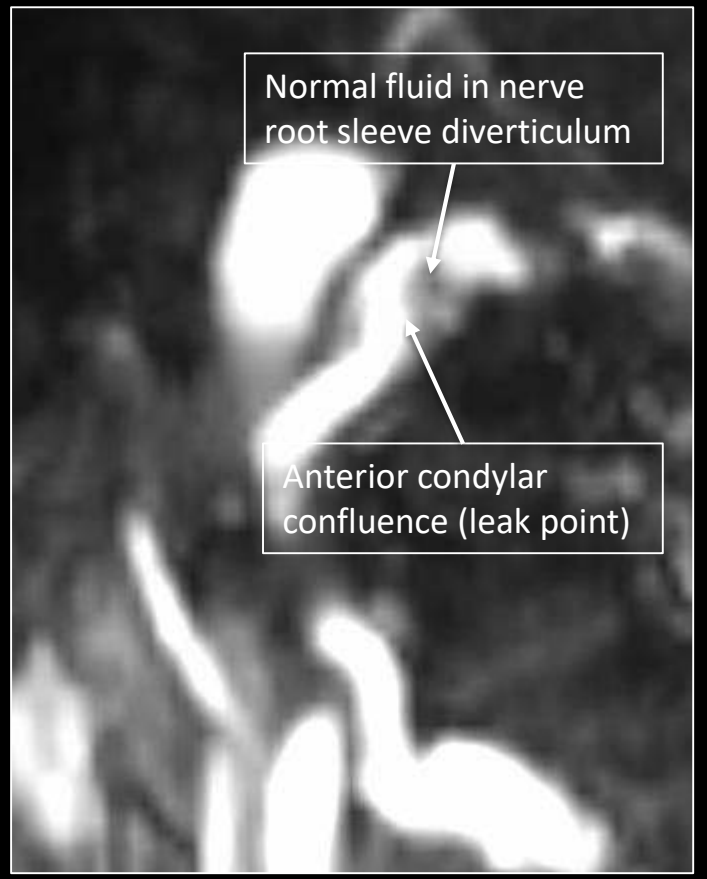
Axial T2 SPACE



Axial MRV C+

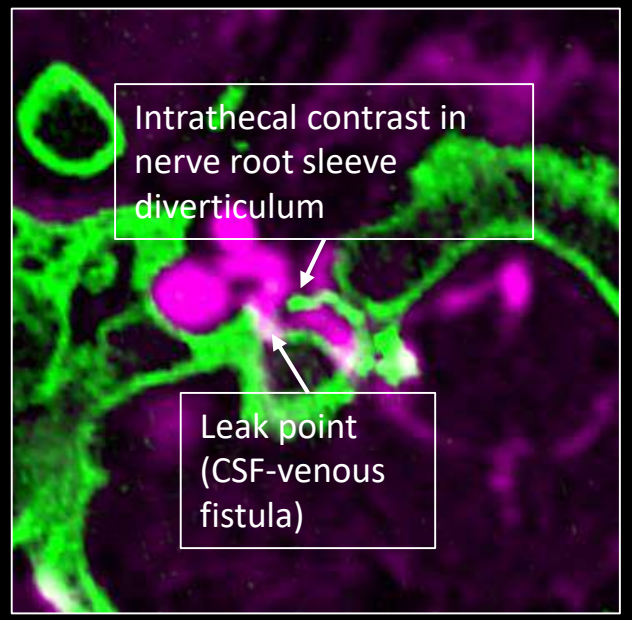
MRV Venous Mapping at same slice as CTM (Coronal)

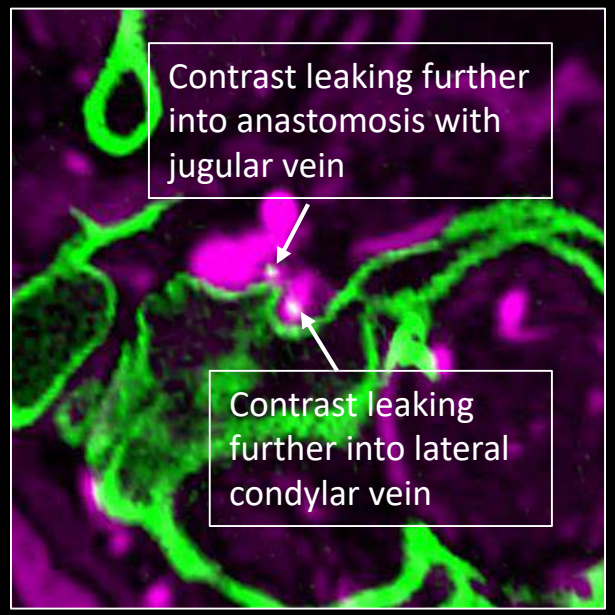




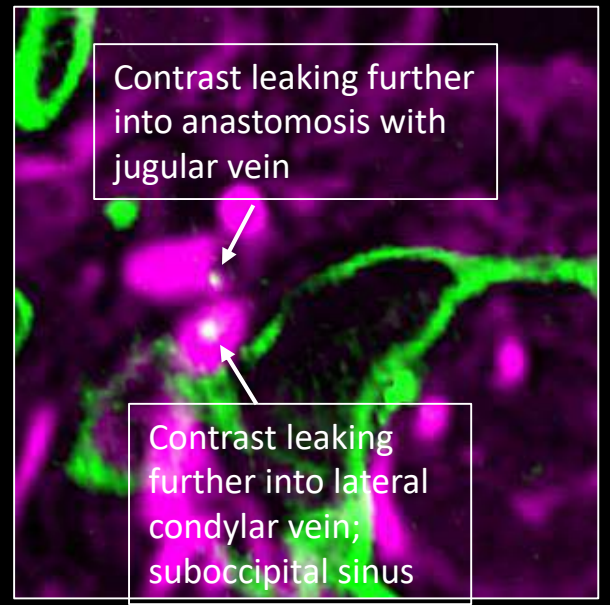
Axial MRV C+ (Pink) overlayed with CTM (green)

Superior

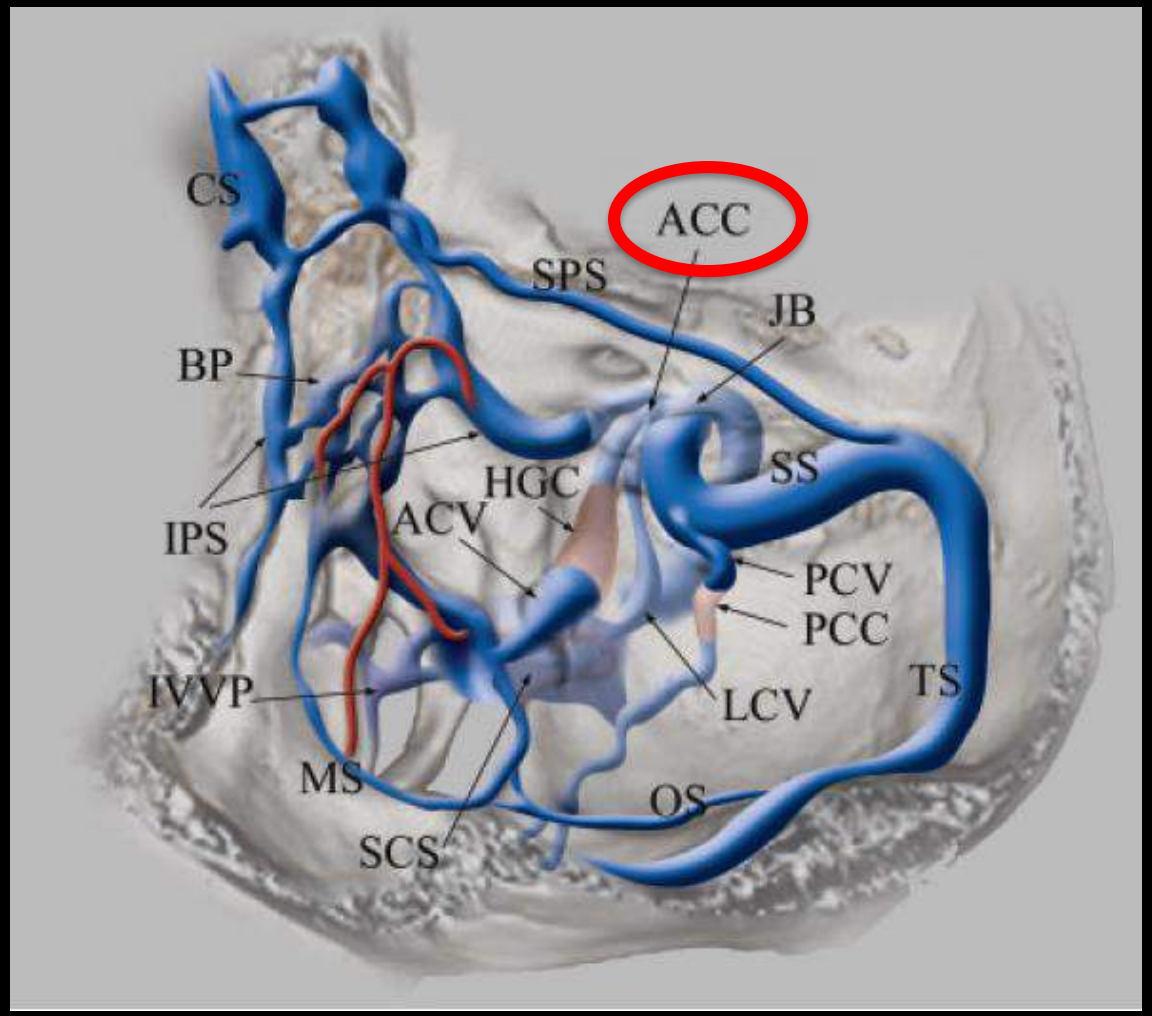




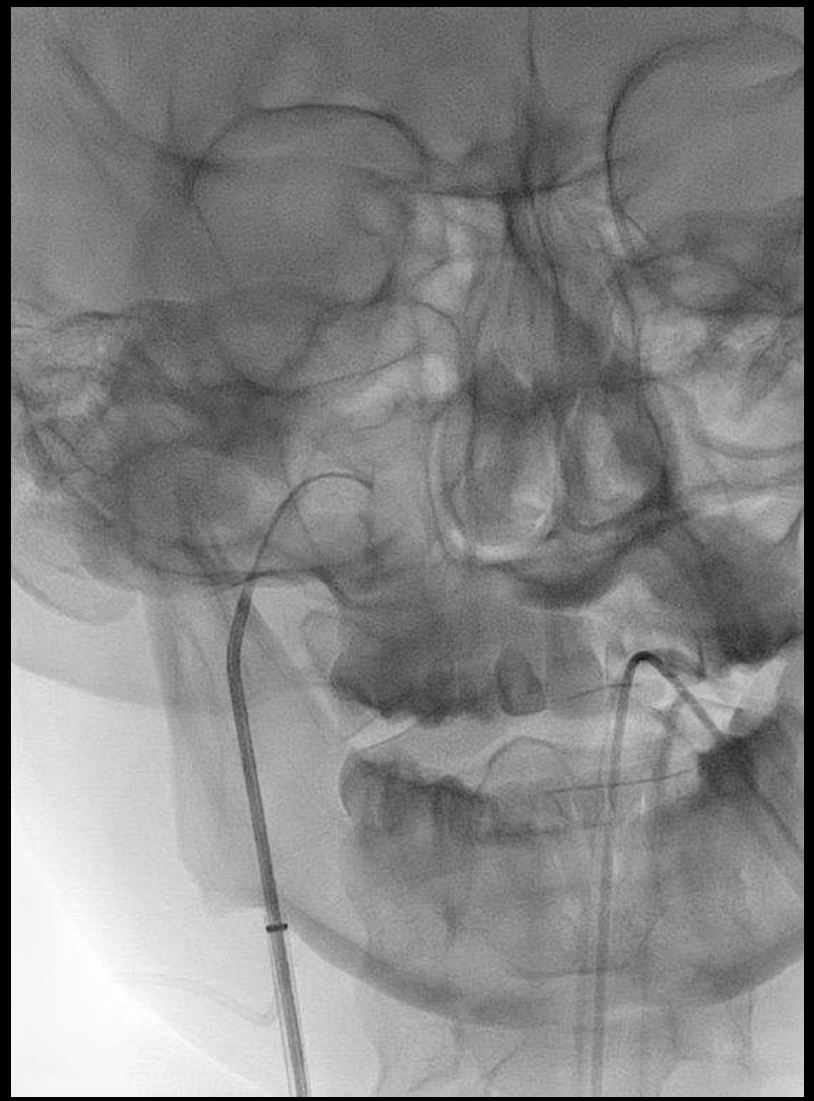
Inferior

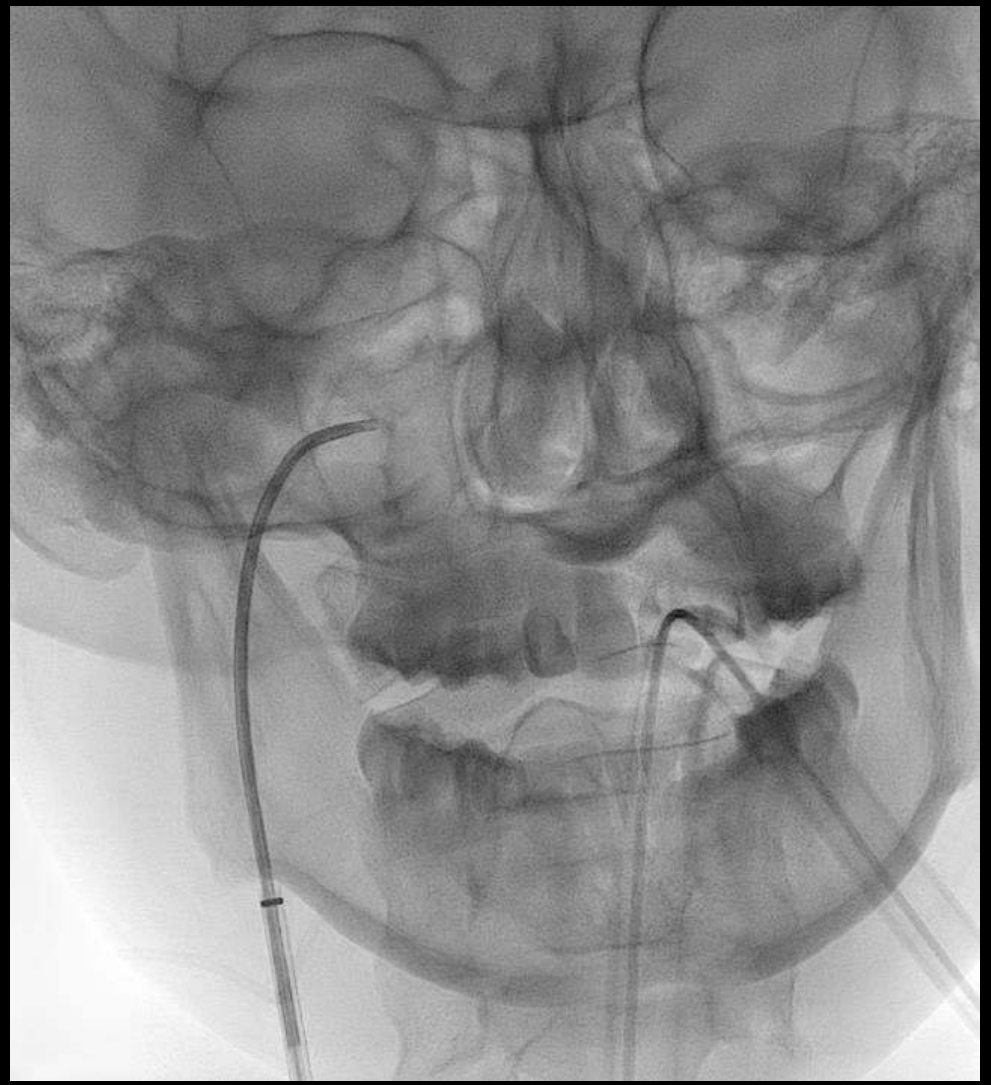


Target for embolization is Anterior Condylar Confluence (ACC)

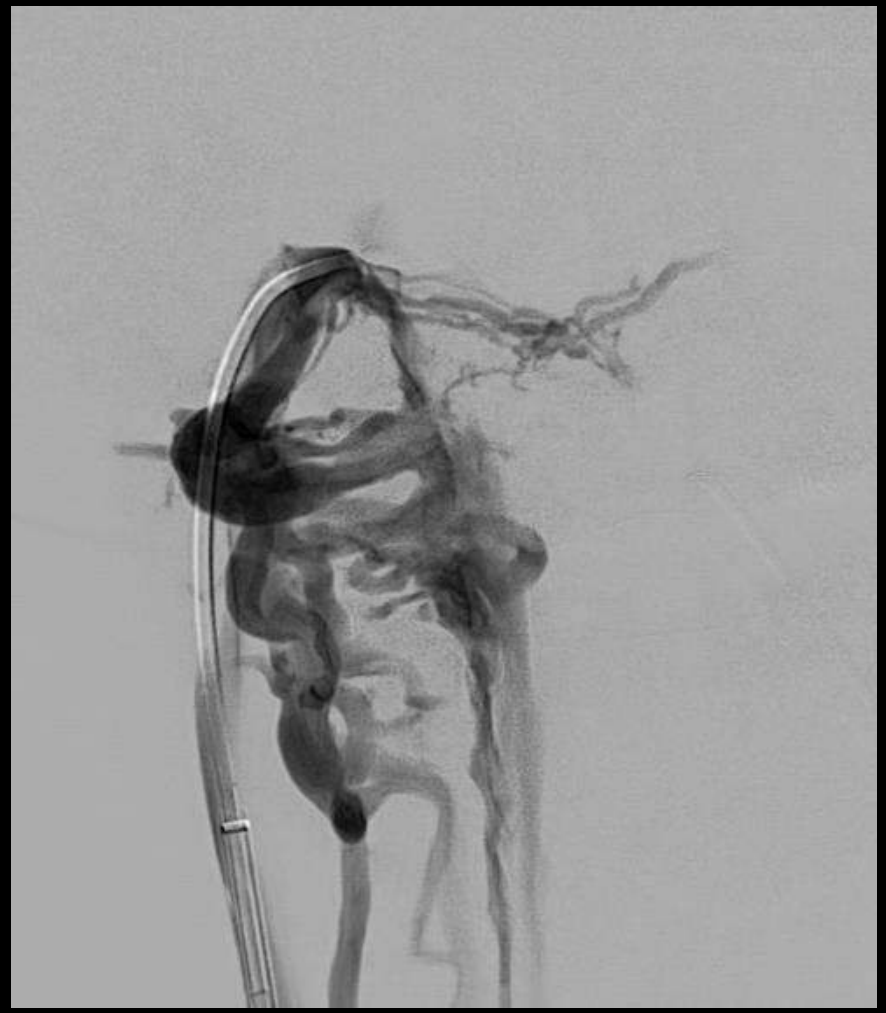


Navigation to anterior condylar confluence





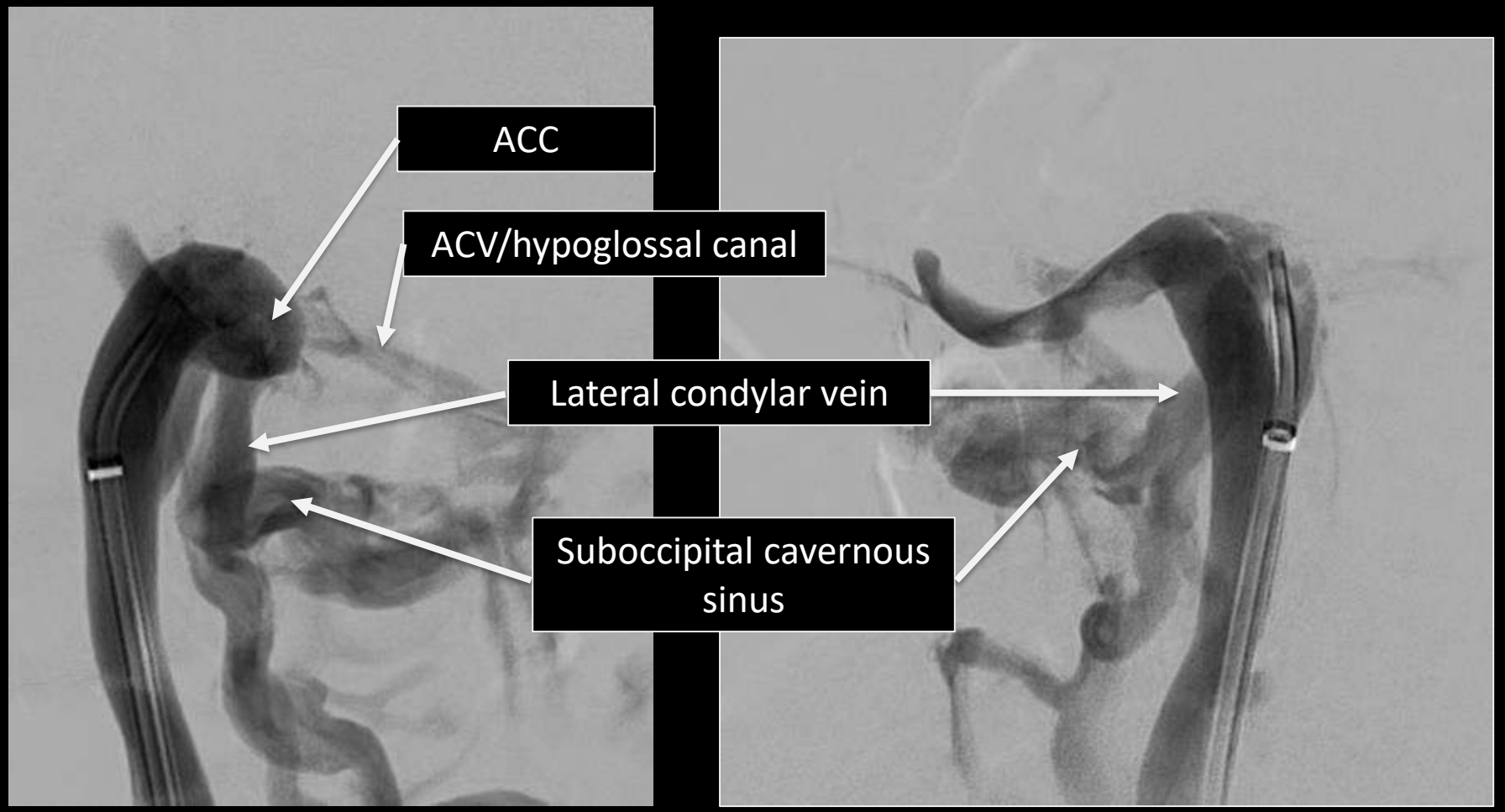
Angiography performed including rotational angio showing anterior condylar confluence and adjacent tributaries.



AP

Lateral

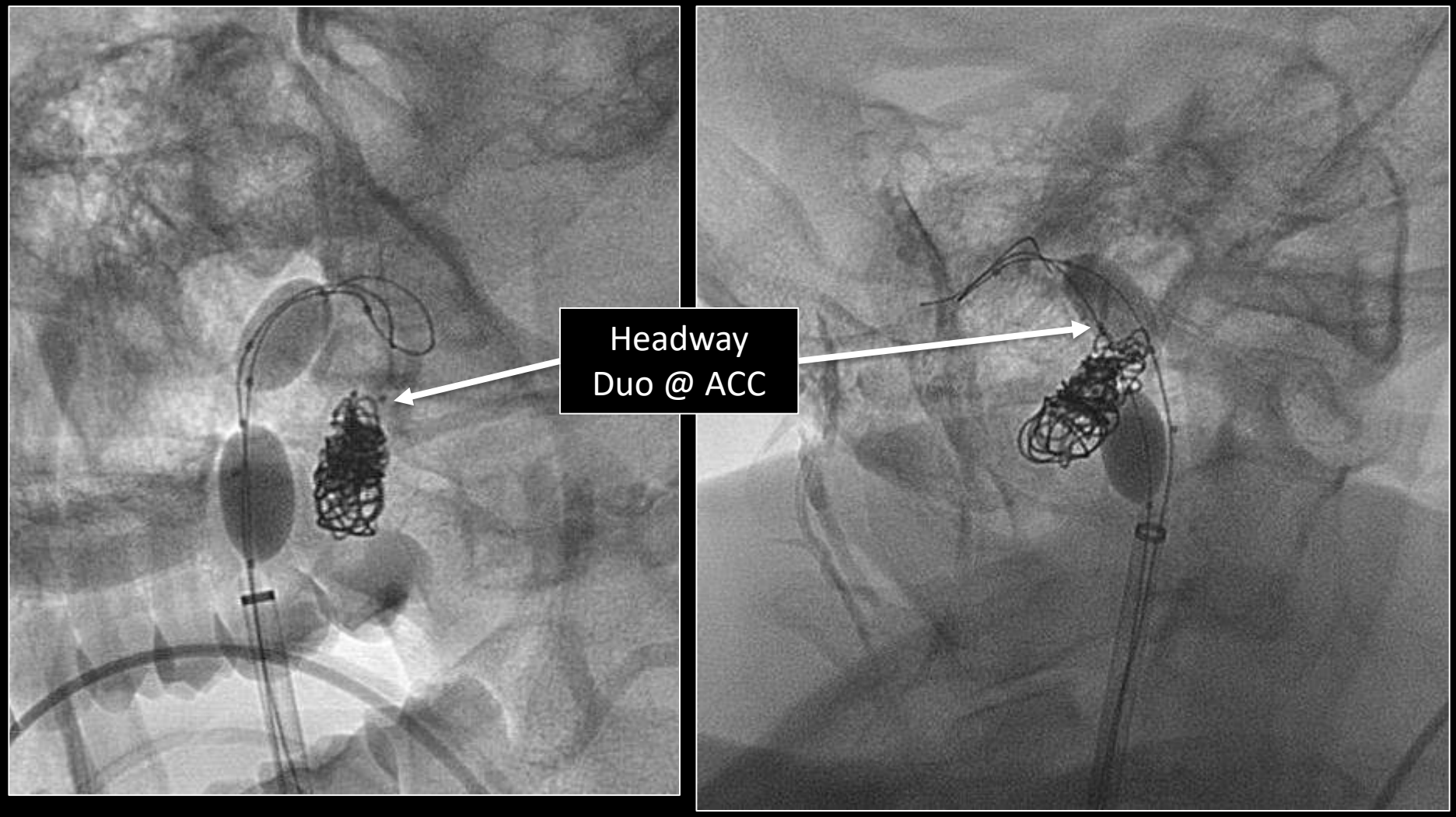
Working projection views demonstrating ACC (target) and adjacent tributaries



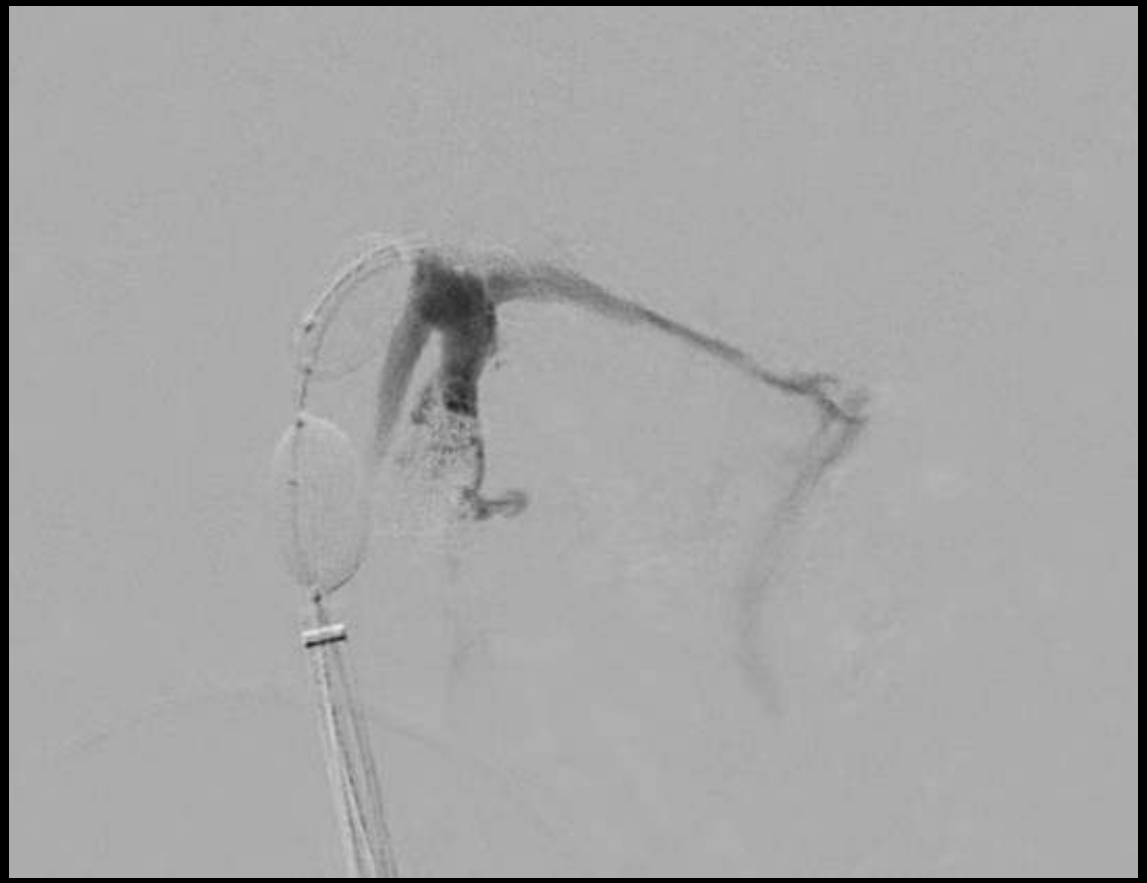
LAO

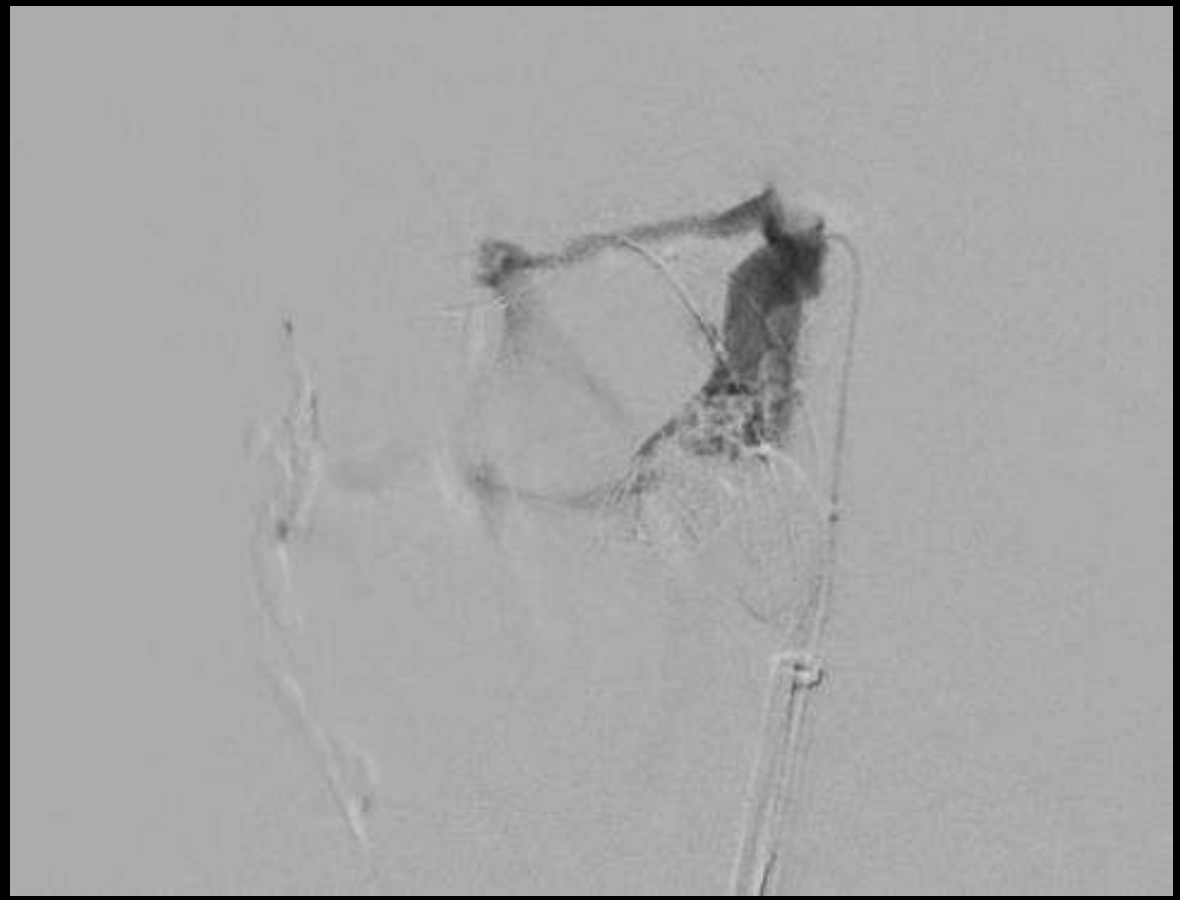
Lateral Oblique

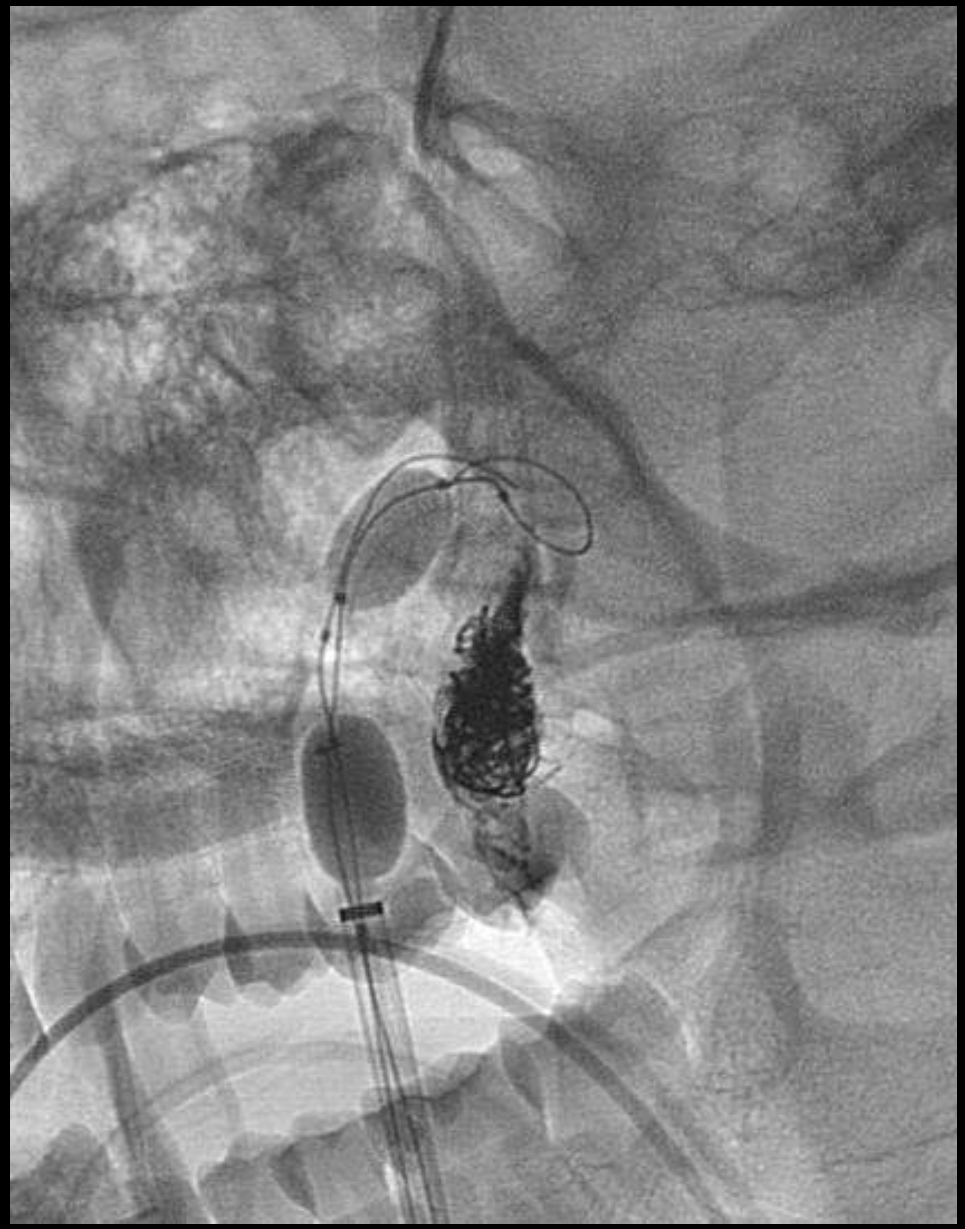
1) Coils deployed in Lateral condylar vein to prevent Onyx reflux from ACC
2) Balloons deployed in jugular to prevent additional reflux (needed 2x to be sure)
3) Headway duo tip positioned in ACC (confirmed with XperCT)

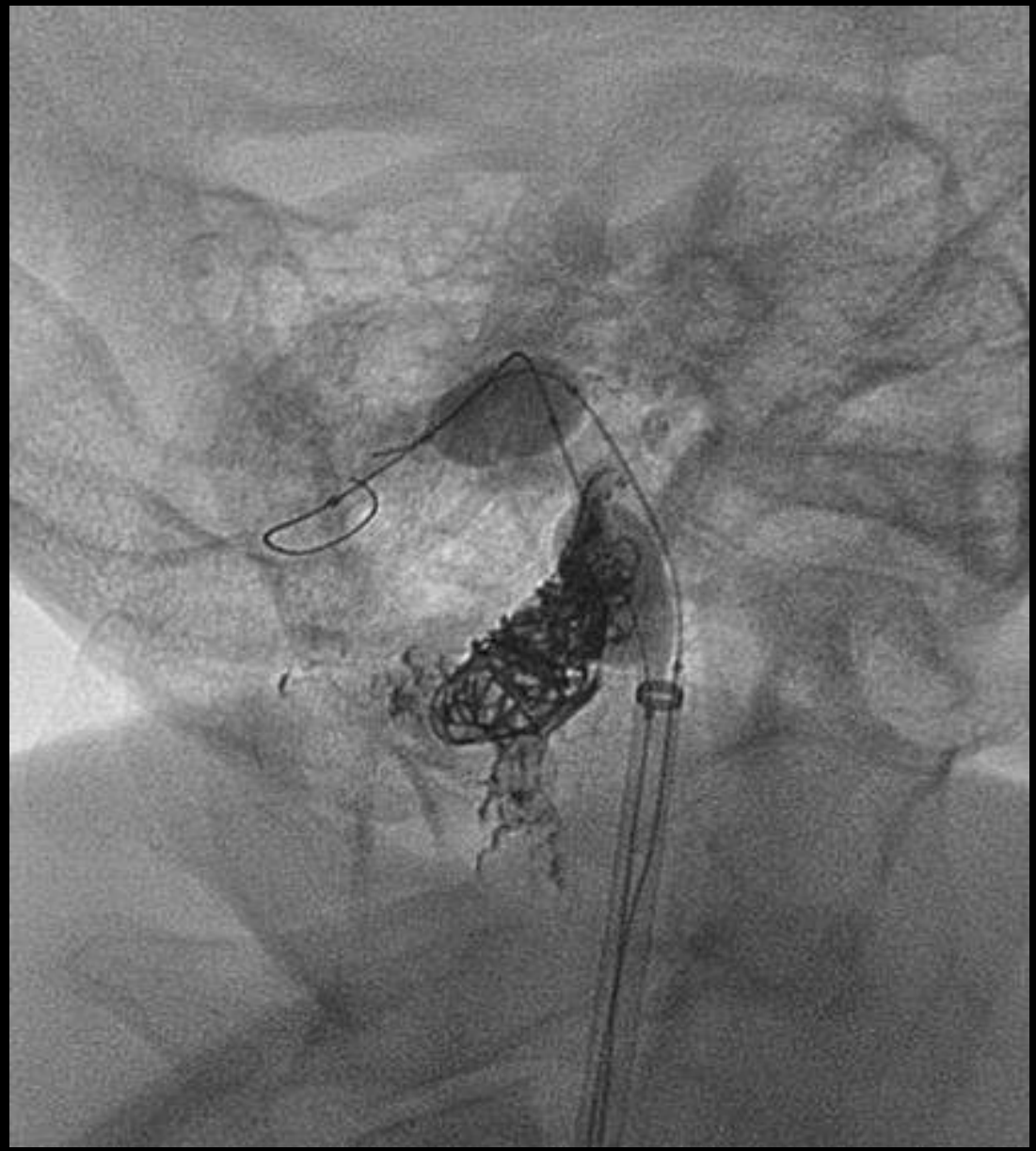


Headway Duo microcatheter injection confirming position at ACC and suitable for embolization

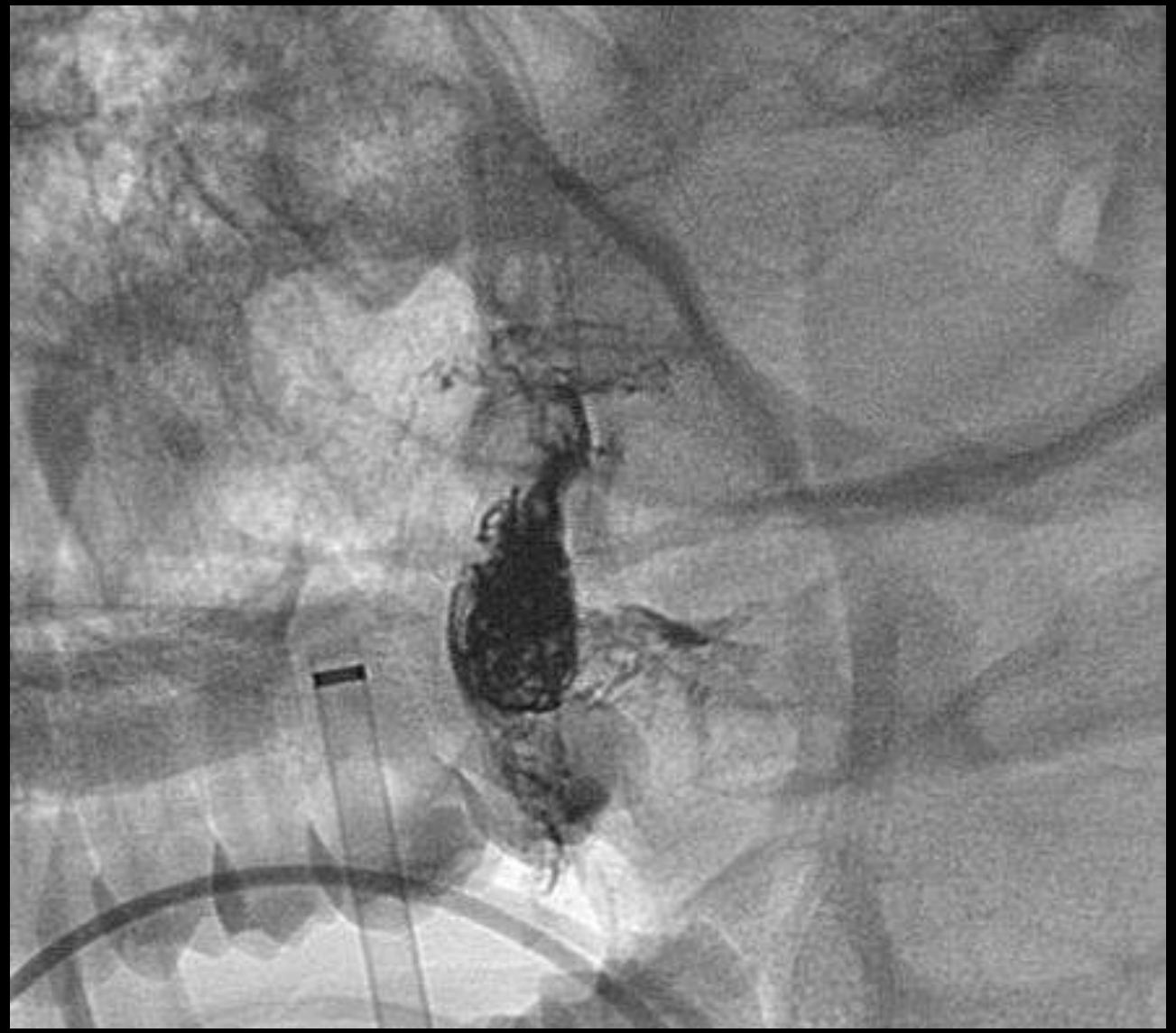


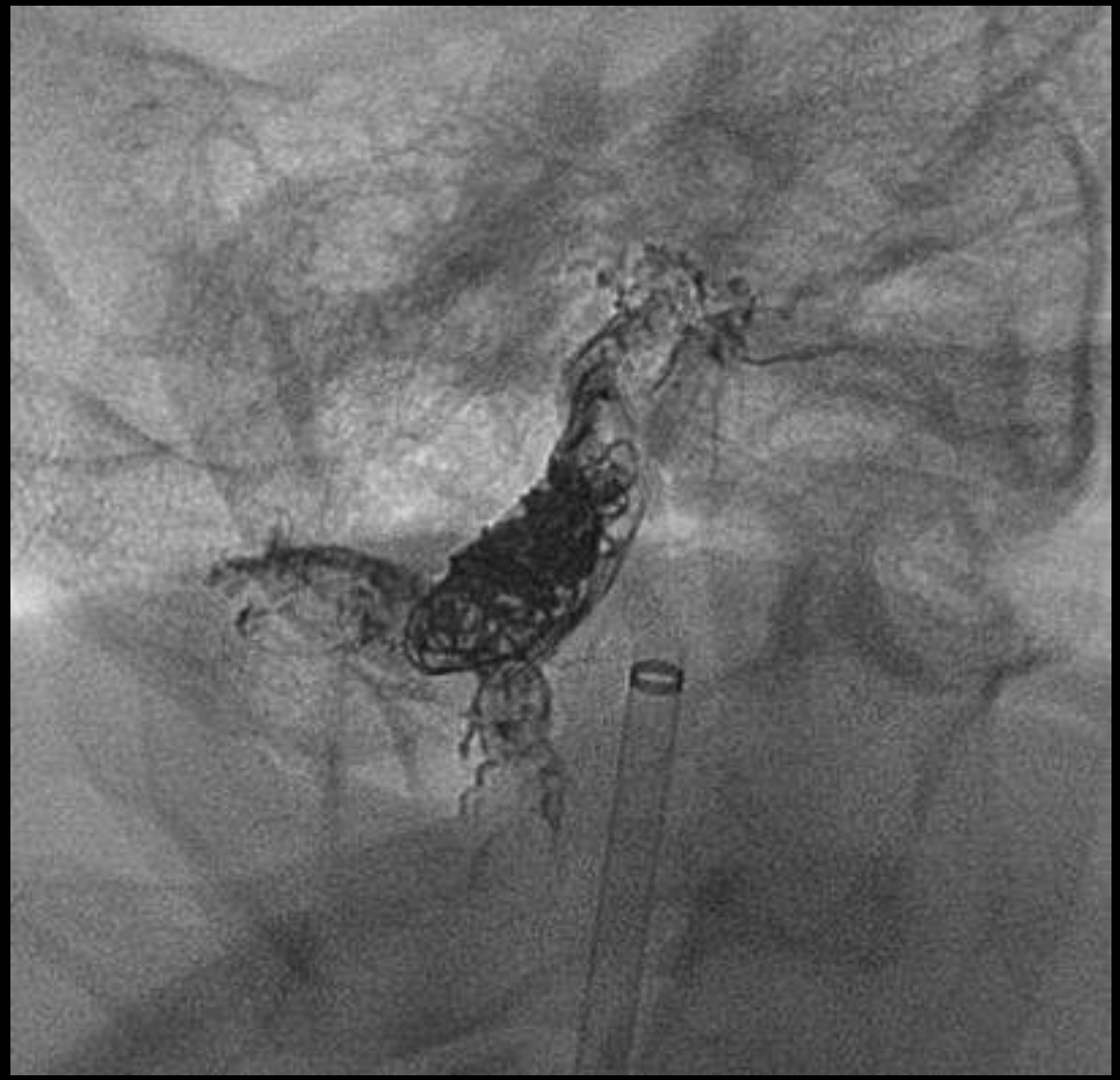


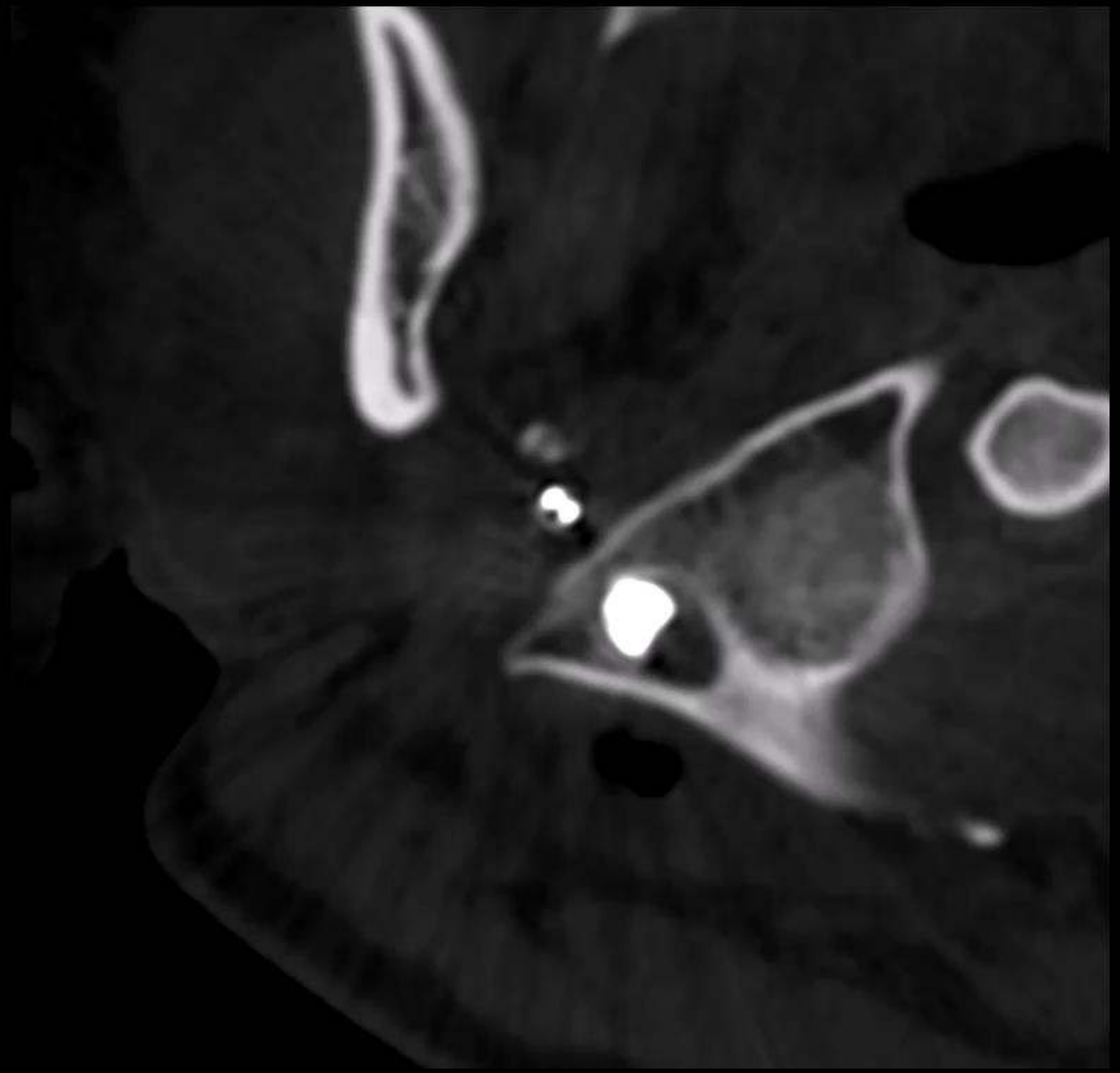




Final Onyx 34 Embolization cast

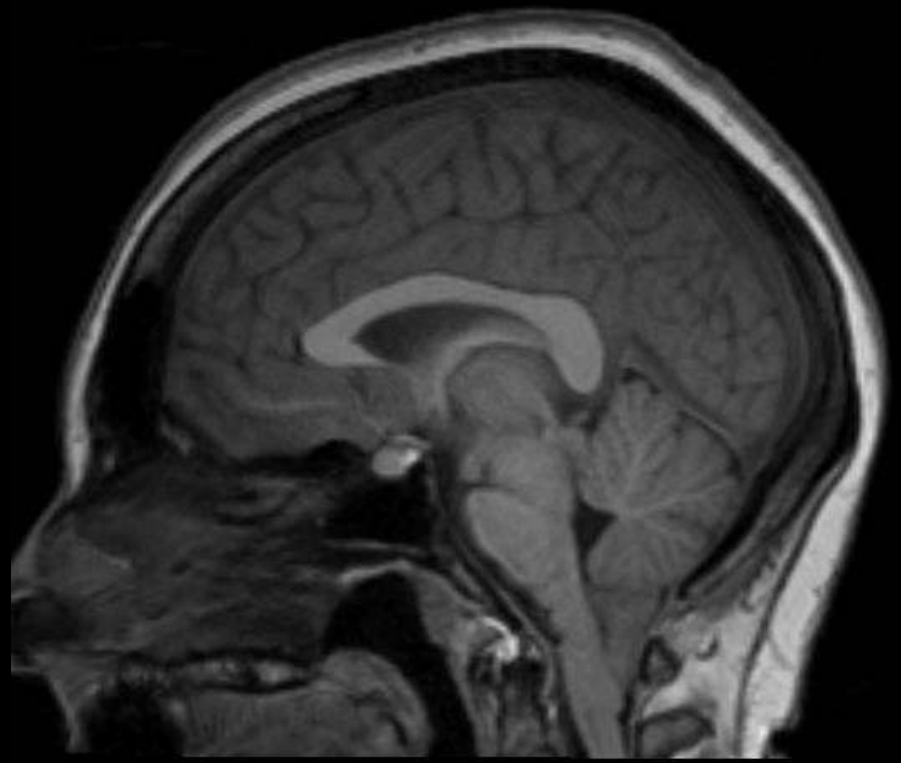




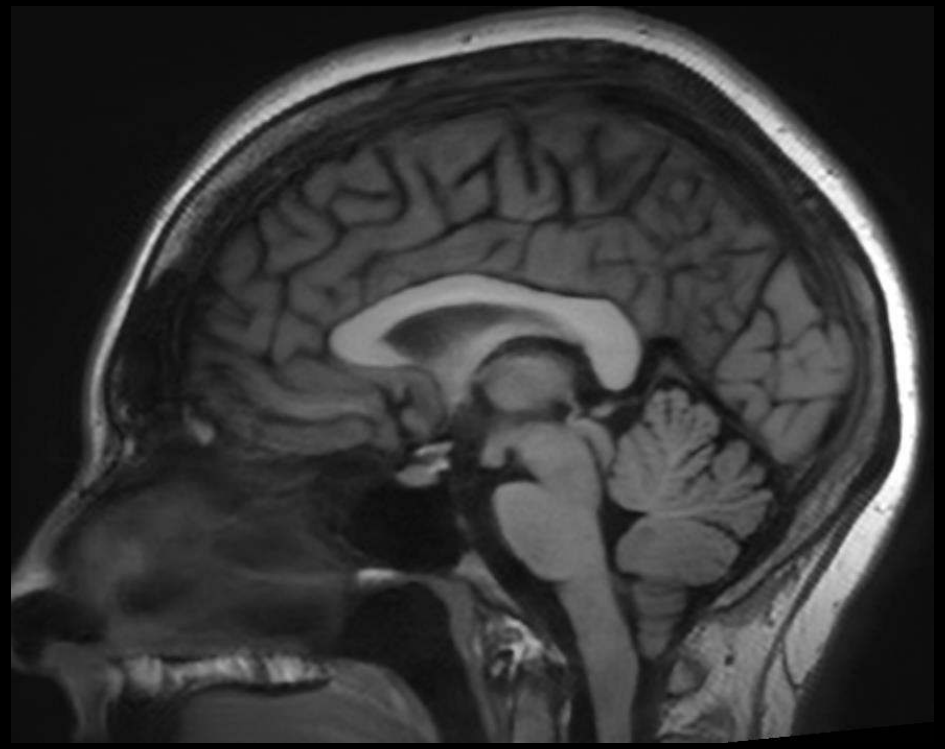


Initial diplopia/rebound headache controlled with Diamox
Transient mild tongue deviation 1-month

2 month & 5-month follow up:
Compete resolution of orthostatic headaches
Markedly improved quality of life back to work/baseline (very much improved)

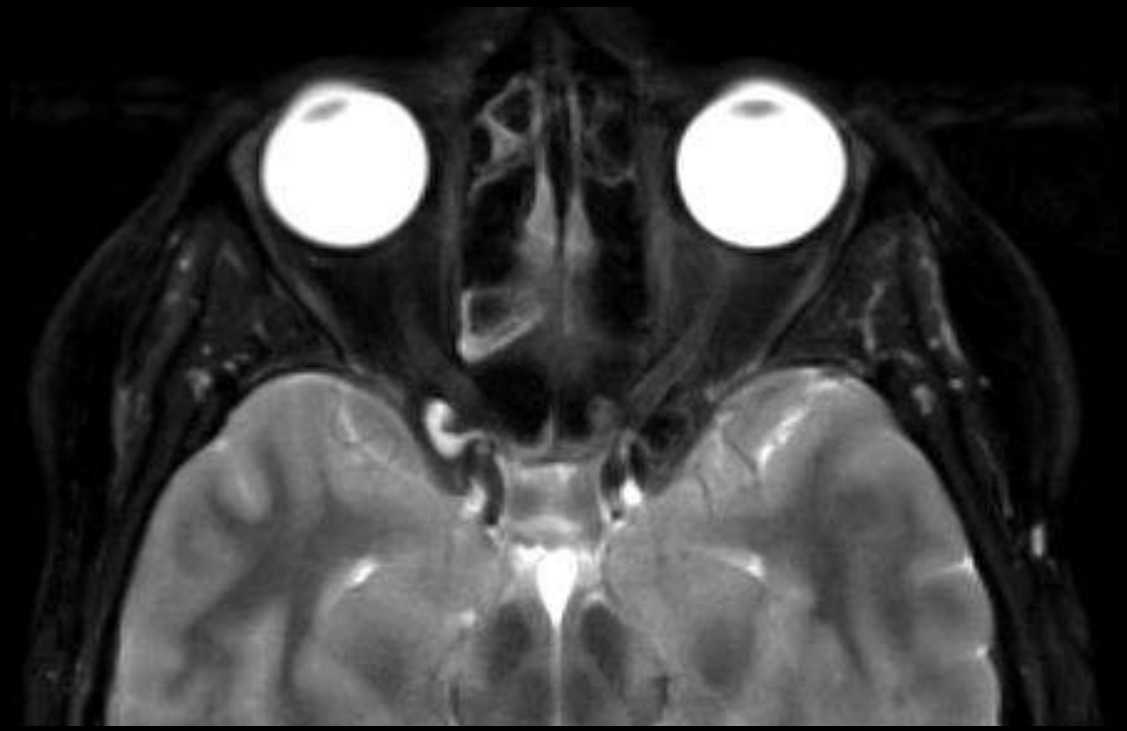


Baseline
sagittal T1

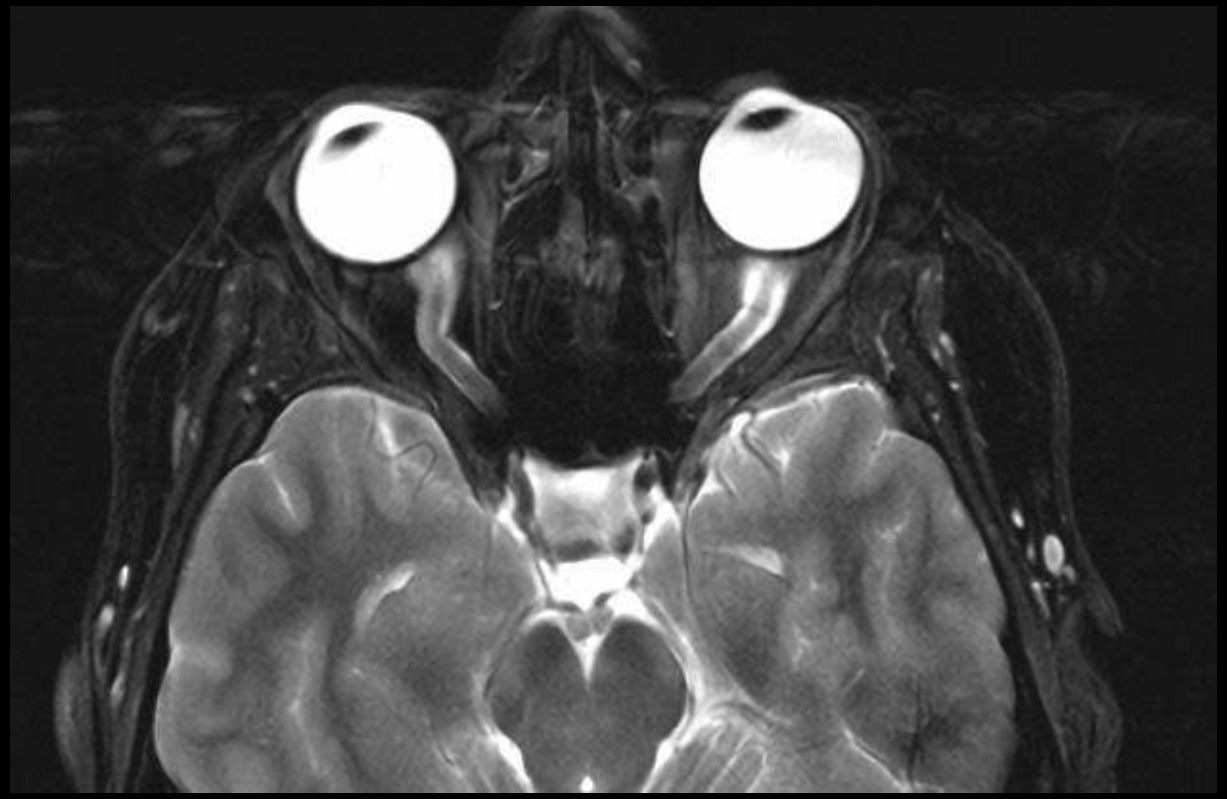


2-month & 5-month
follow-up

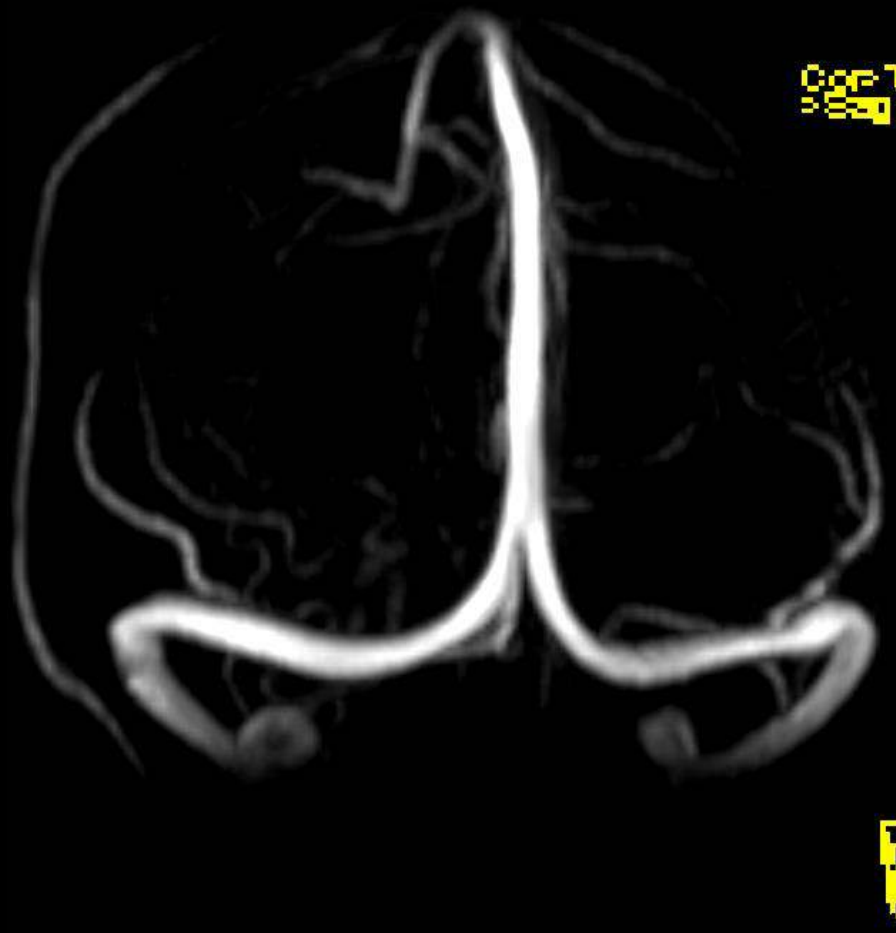
Normal intra-ocular pressures and neuro-ophtho exam at 1-month follow-up



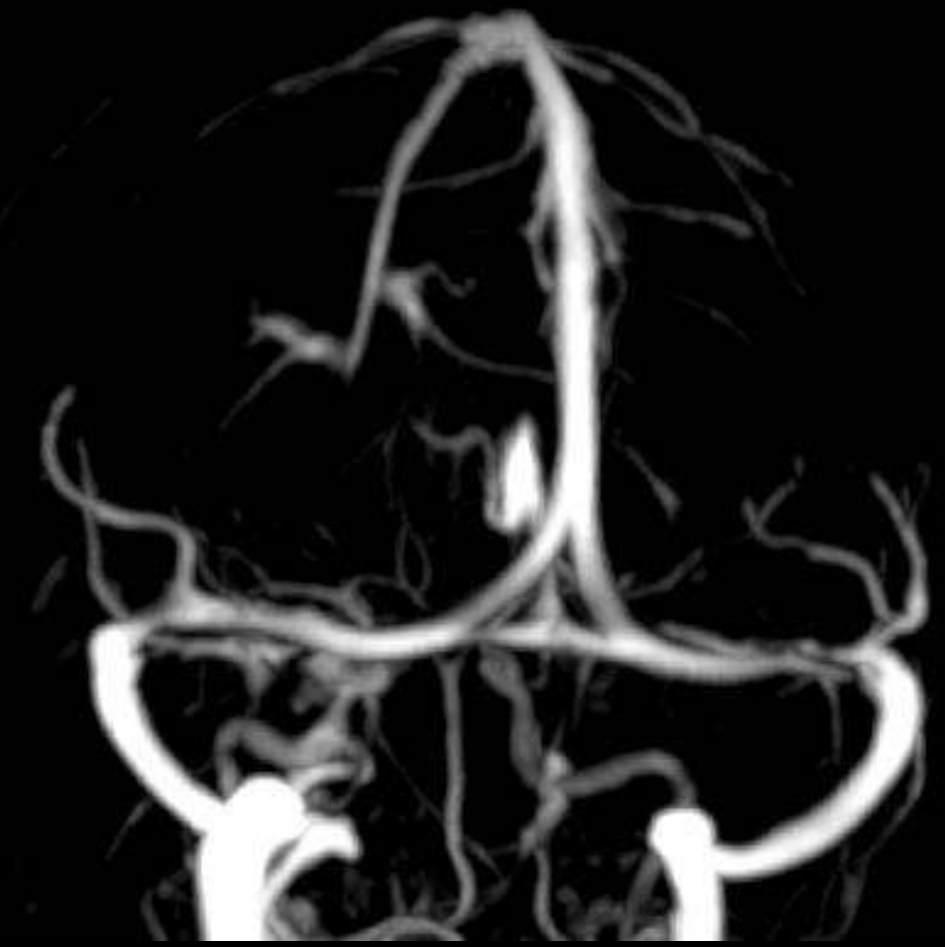
Baseline
Axial T2



2-month & 5-
month follow-up



Baseline
MRV



5-month
follow-up

CONCLUSIONS

> "Patients and their health care providers are fortunate that the armamentarium for treating spontaneous spinal CSF-venous fistula is expanding." Schievink AJNR 2022

- Transvenous embolization has high efficacy and safety and can be considered a durable first-line treatment for SIH patients with CVF
- Efficacy comparable to surgical ligation; appear to be superior to fibrin for a single treatment (operator dependent?)
- Technical nuances - thorough embolization required to avoid treatment failure (pressure-cooker technique)
- Opportunities for multicenter training/collaboration in this new frontier to improve patient care

THANK YOU!

Questions?

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Fibrin Glue Patching for CSF-Venous Fistulas: What We've Learned in Our First 100 Patients

Mark Mamlouk, MD

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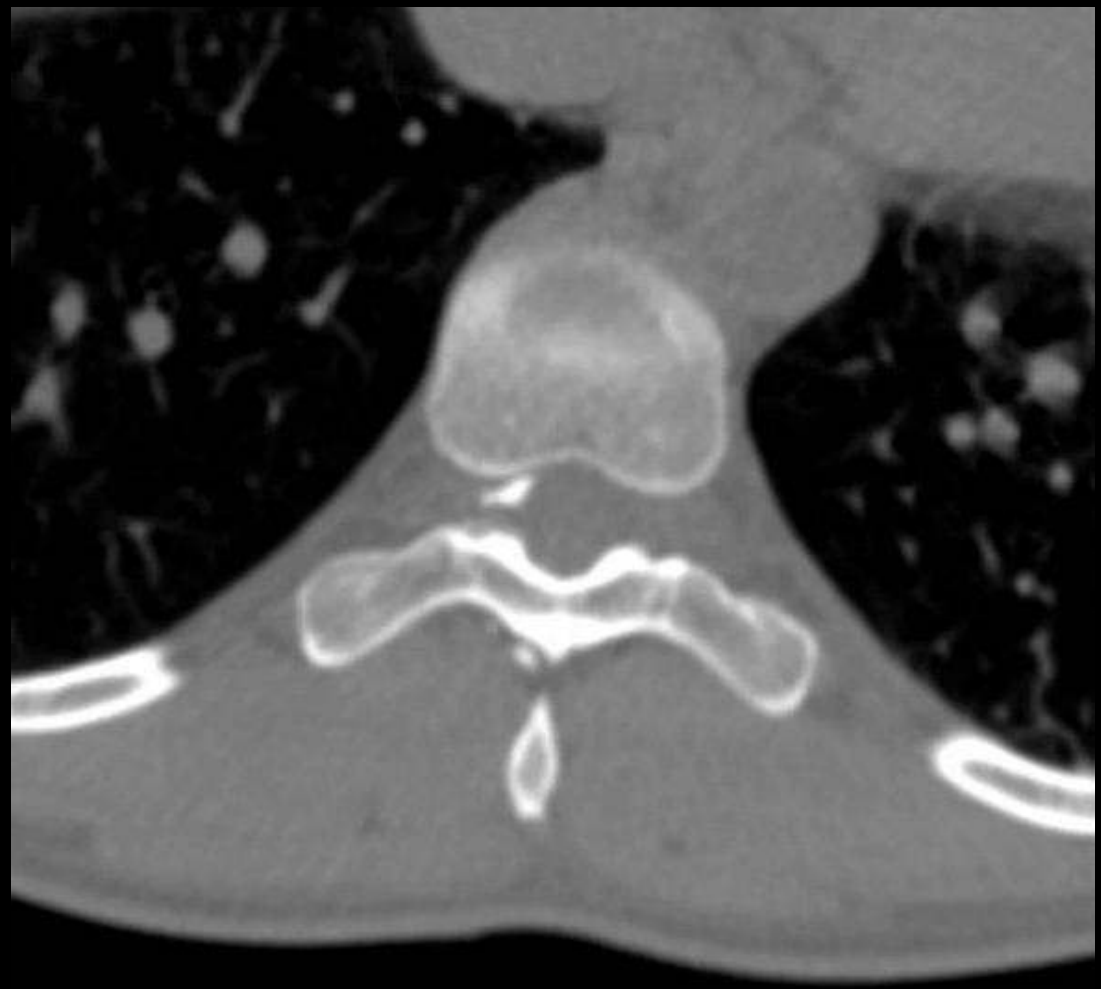
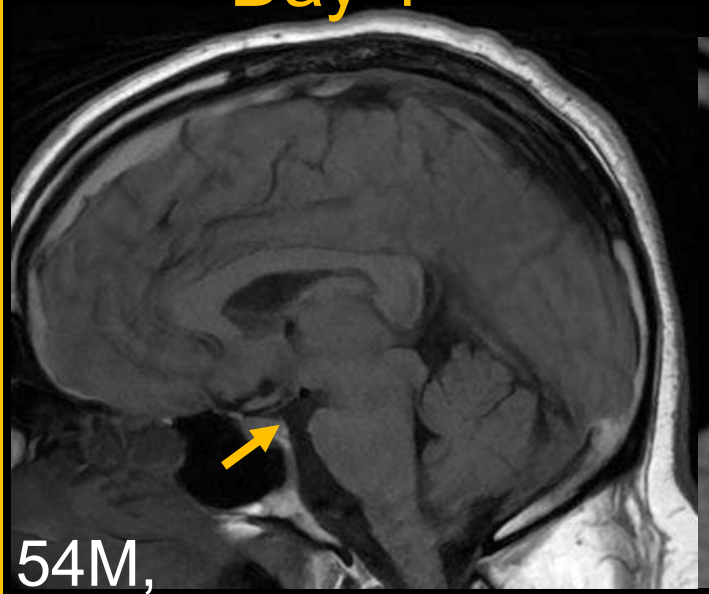
Director of Spinal CSF Leak Program
Kaiser Permanente, Santa Clara, CA

Associate Clinical Professor – Volunteer
University of California, San Francisco

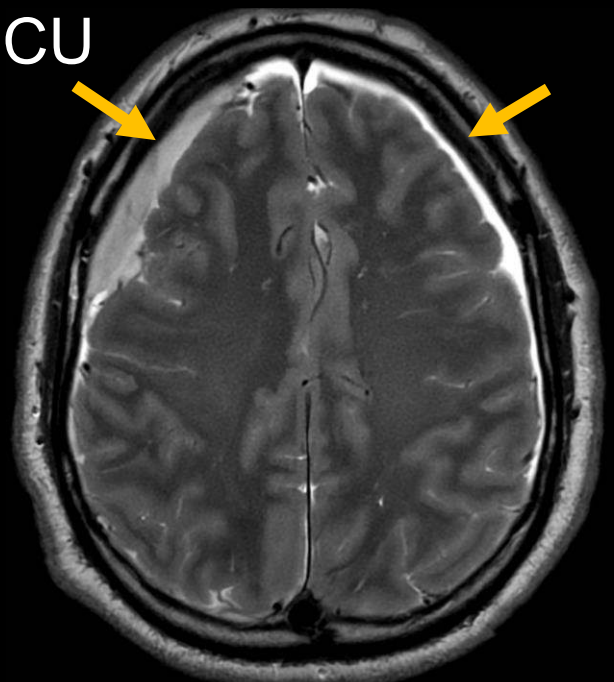


Ease & Efficiency of Glue

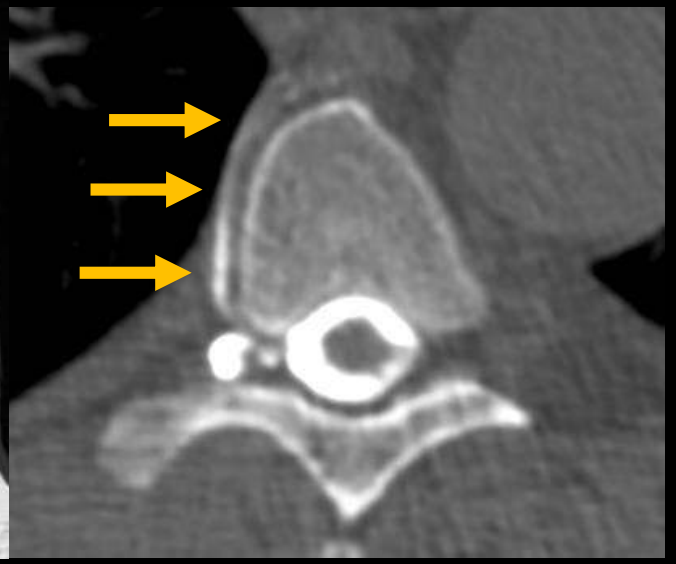
Day 1



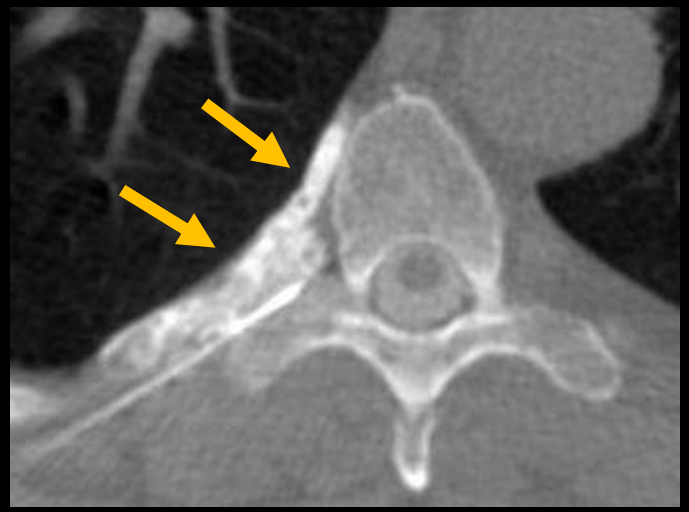
54M,
ICU



Day 2



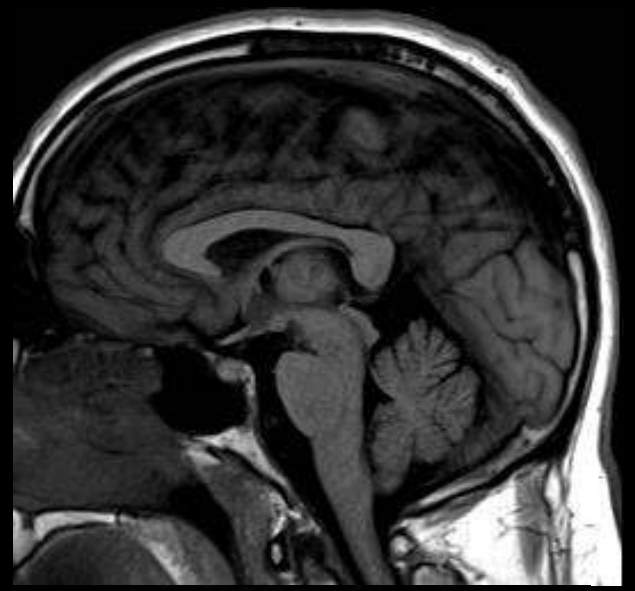
R T6 CVF

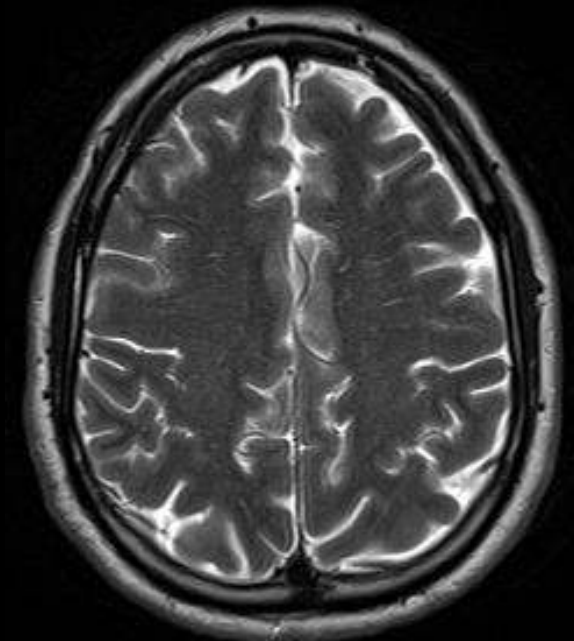


Fibrin Glue

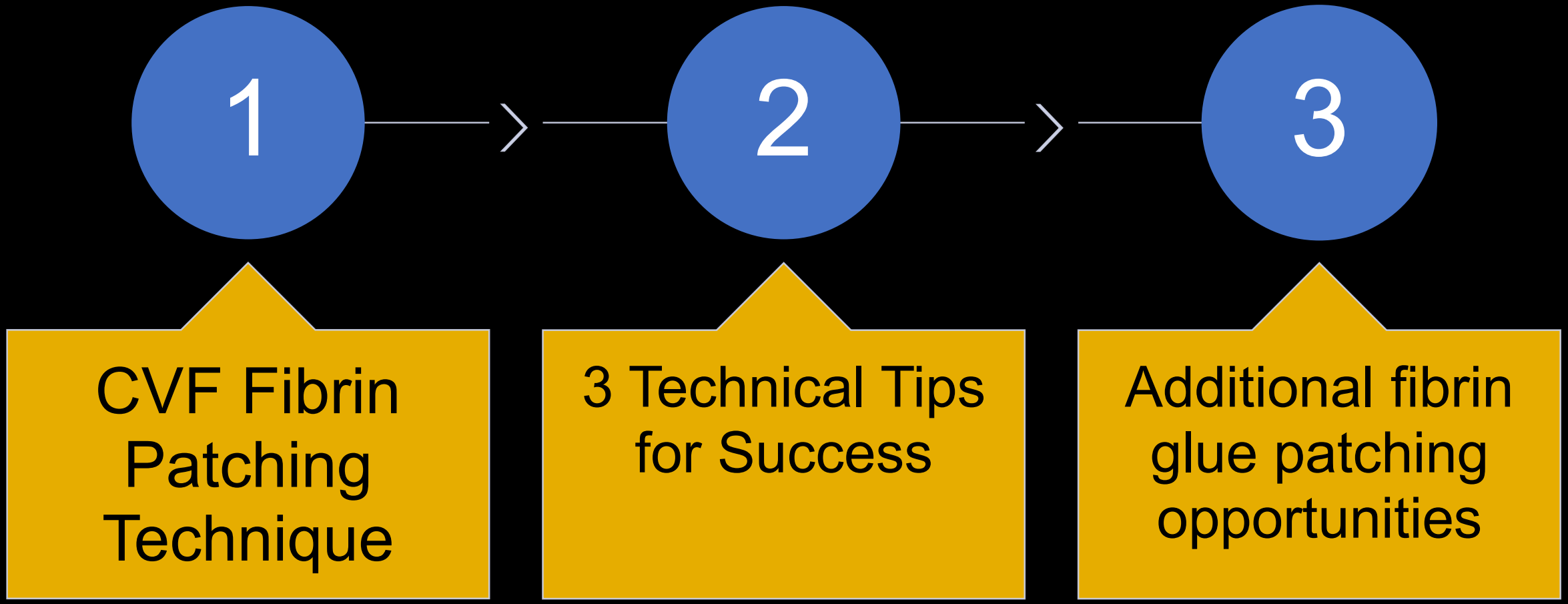
Day 3

Normal F/up MRI

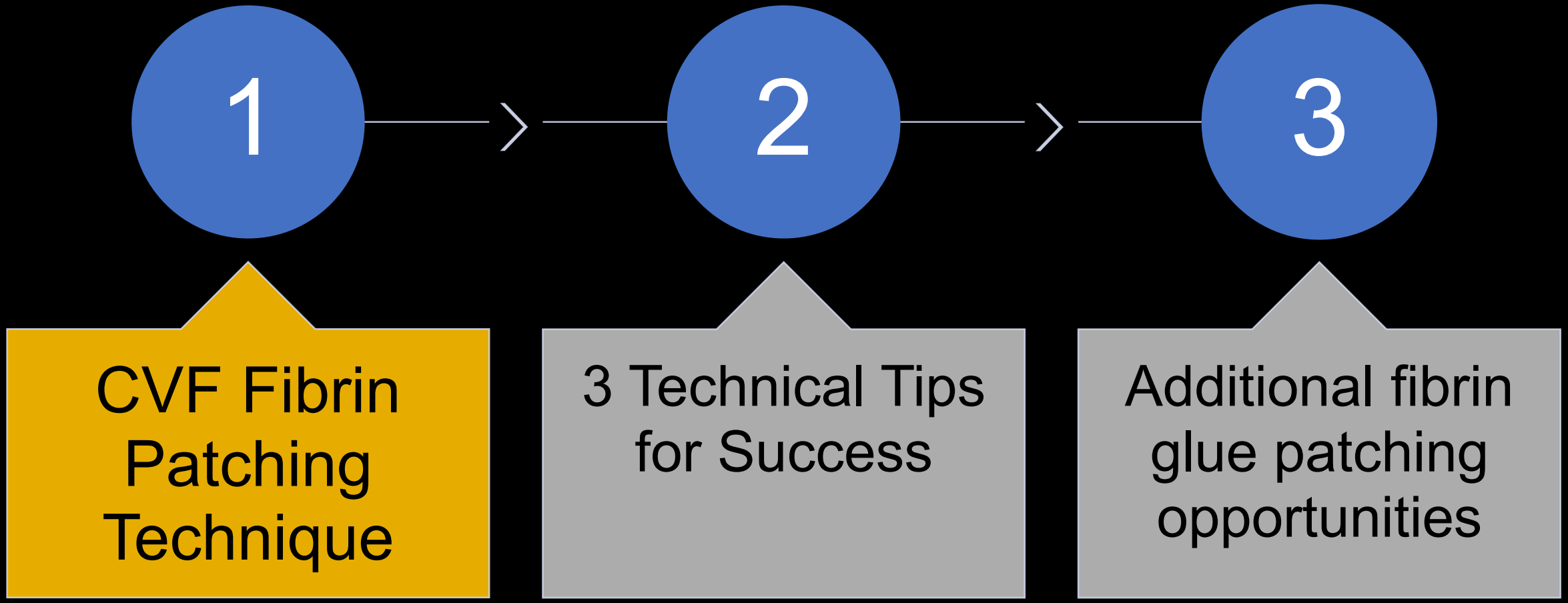




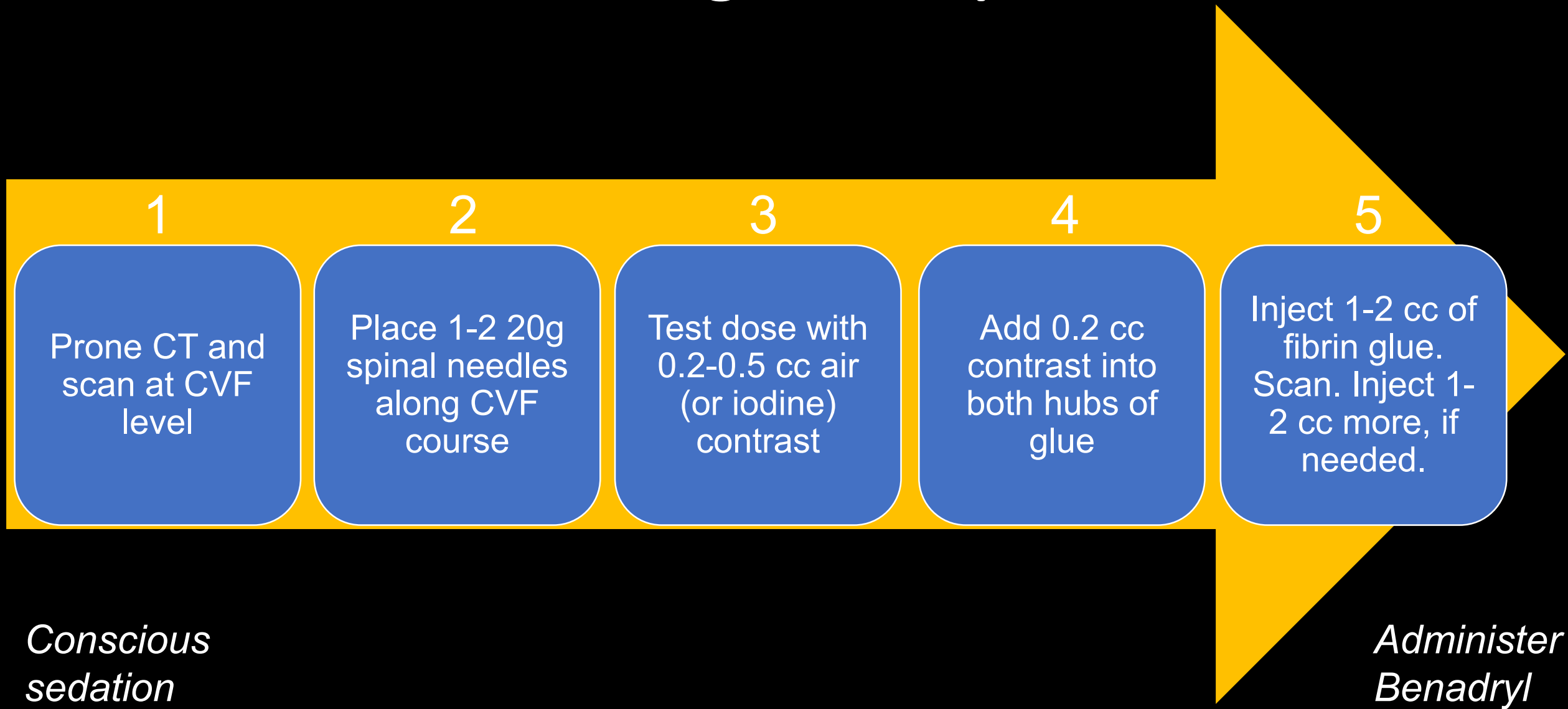
Our Spinal Leak Journey



Our Spinal Leak Journey



CVF Fibrin Glue Patching Technique

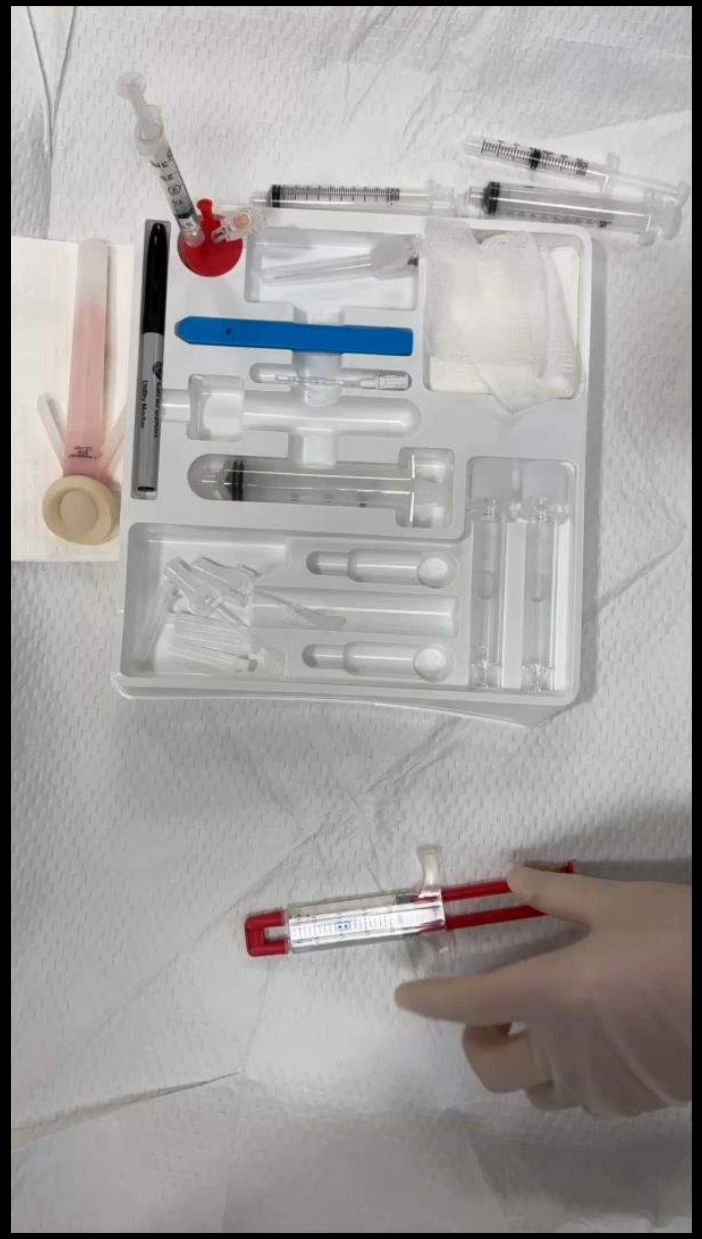


Conscious sedation

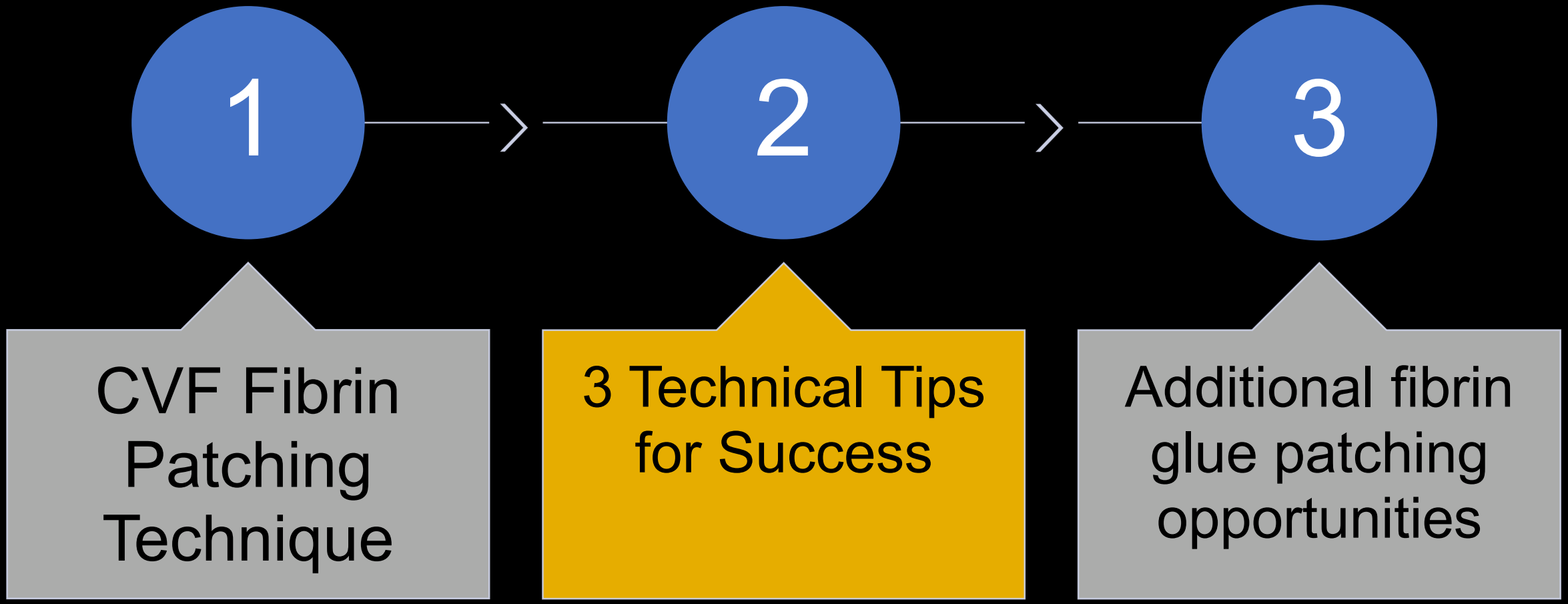
Administer Benadryl

Fibrin glue for CSF leaks – off-label use in USA

Fibrin Glue Preparation & Injection



Our Spinal Leak Journey



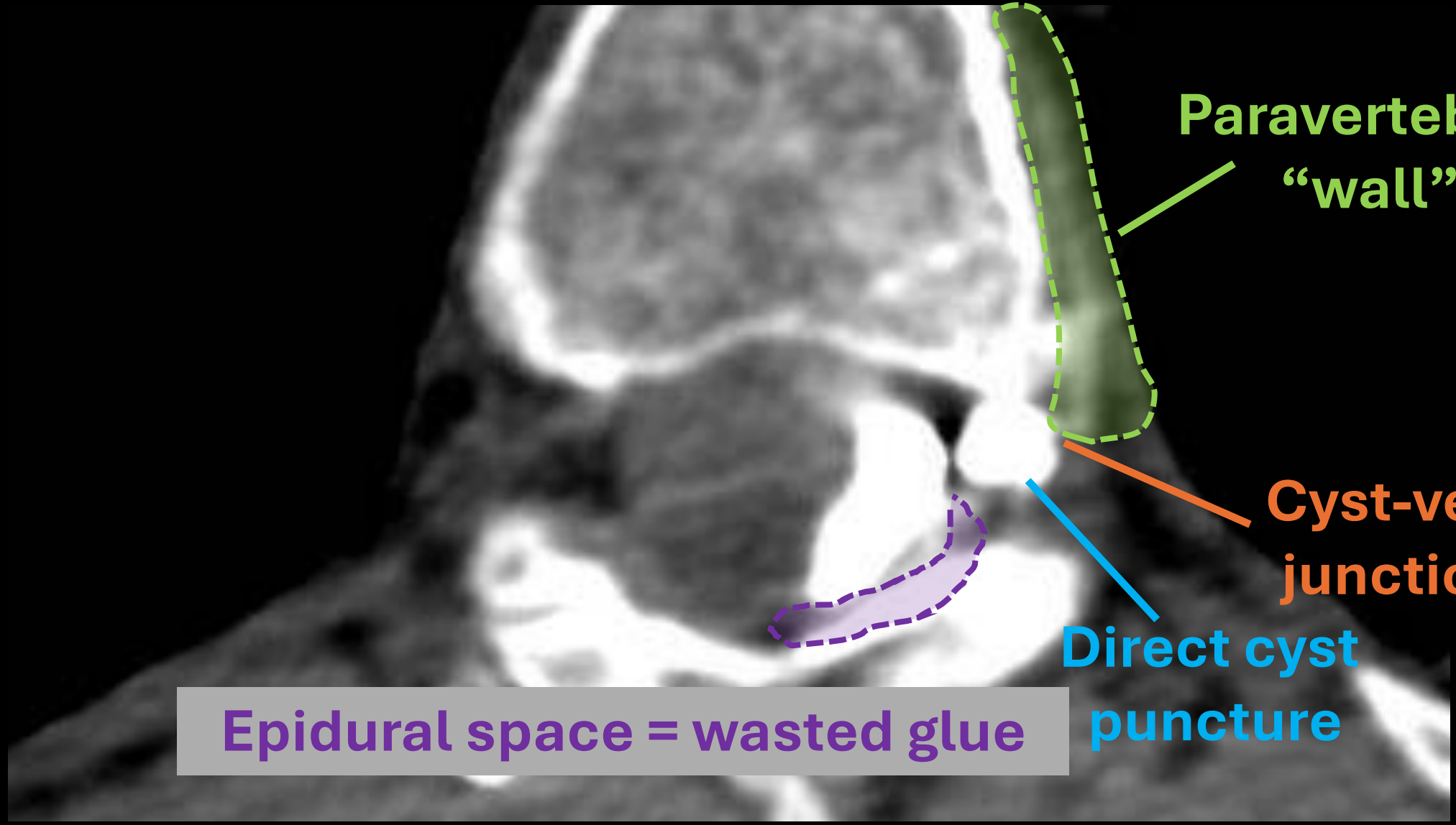
3 Tips for CVF Fibrin Glue Patching

Location
Location
Location

Glue Spread
Matters

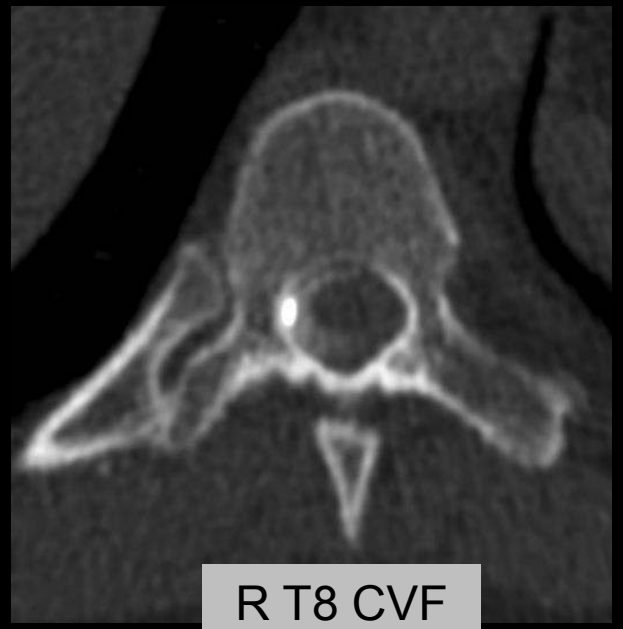
Extrinsic compression
>>> Intravascular

CVF Fibrin Glue Patching Locations



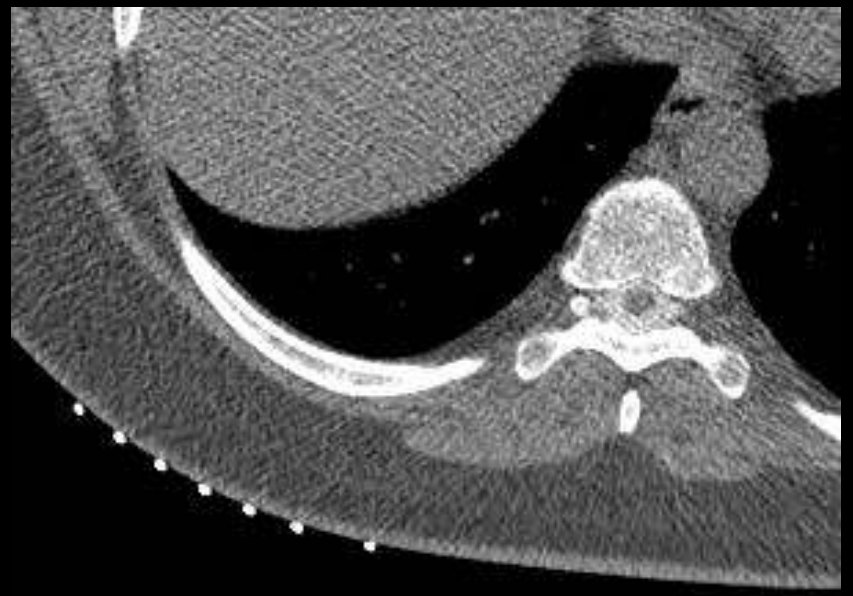
Results: CVF Fibrin Glue Patching: Targeting Cyst-Vein Junction

CTM

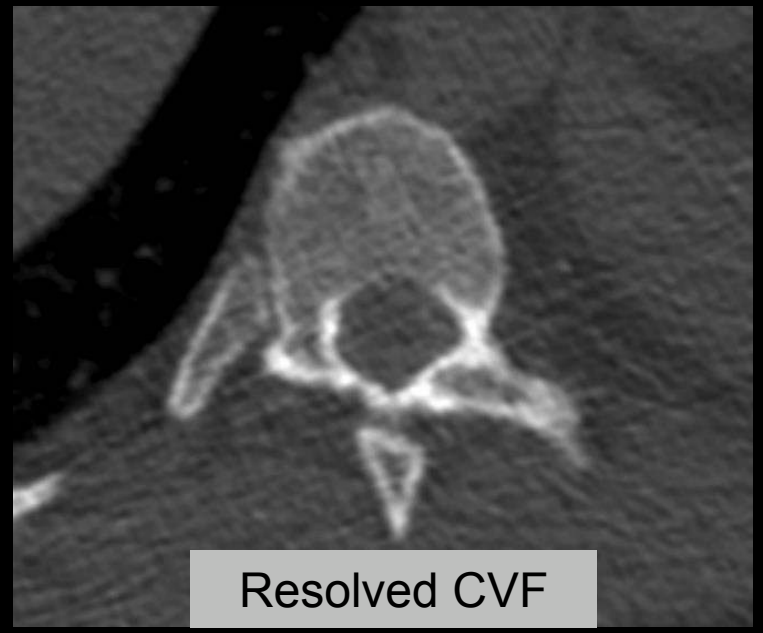


R T8 CVF

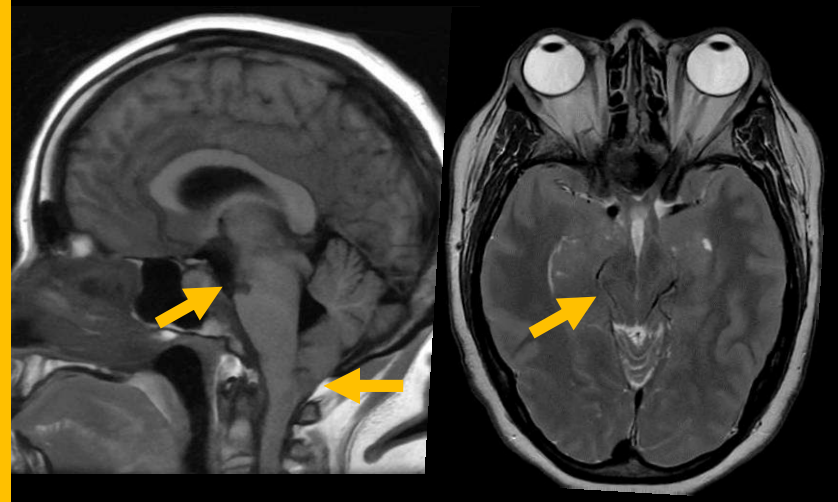
Glue



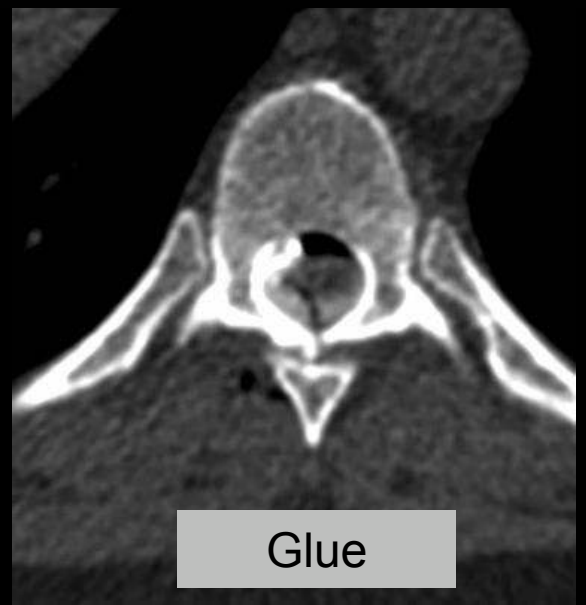
Posttreatment CTM



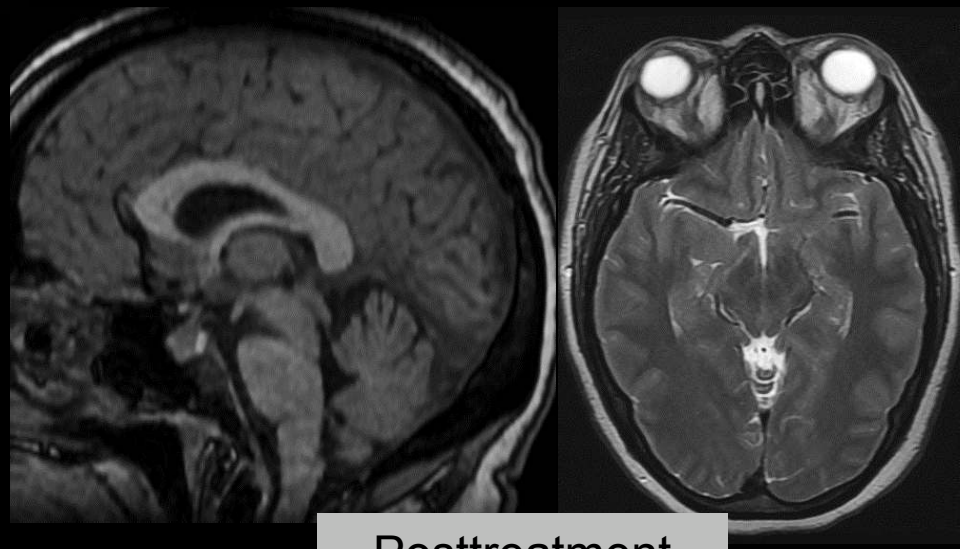
Resolved CVF



Pretreatment



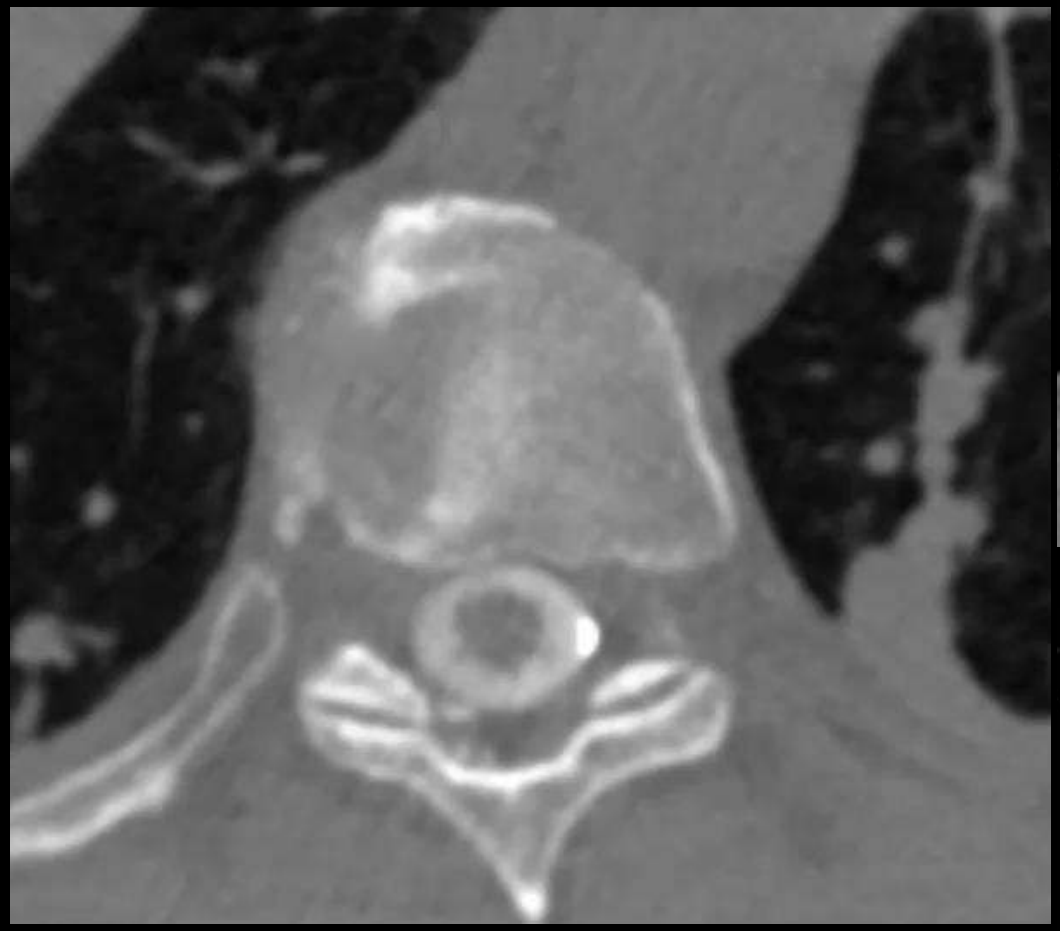
Glue



Posttreatment

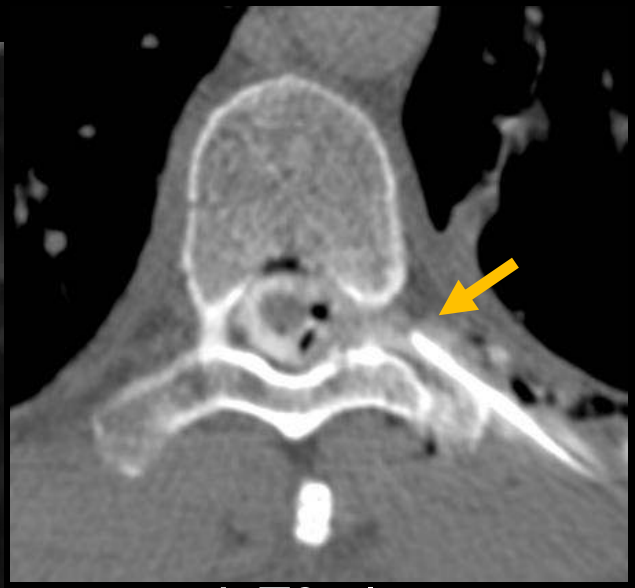
CVF Fibrin Glue Occlusion: Two Levels

CTM

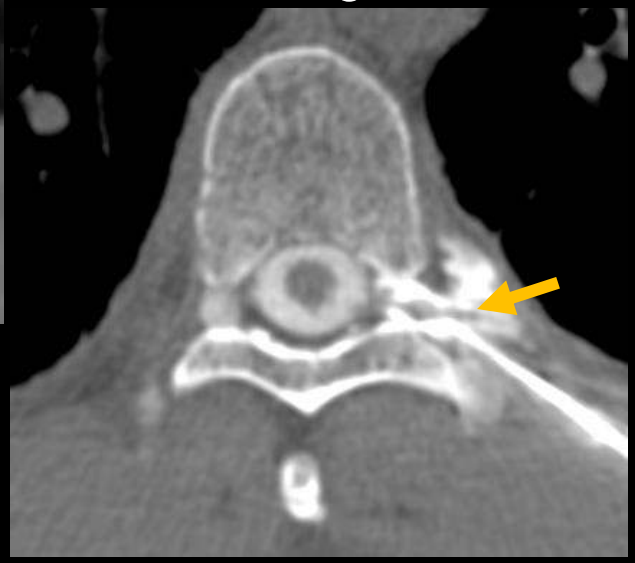


L T9 CVF that extends cranial and exits at T8 level

Glue

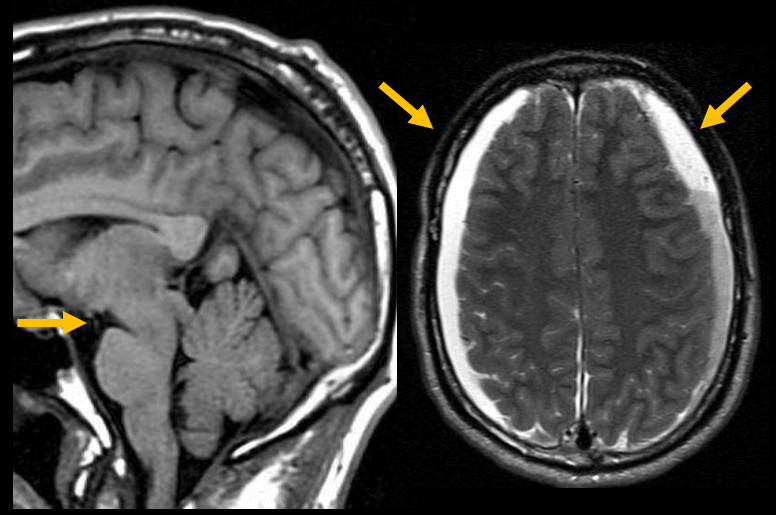


L T9 glue

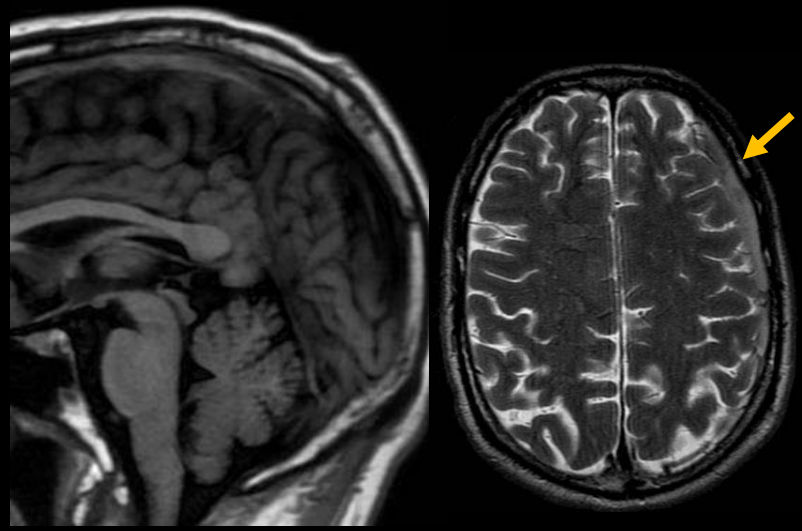


L T8 glue

MRI

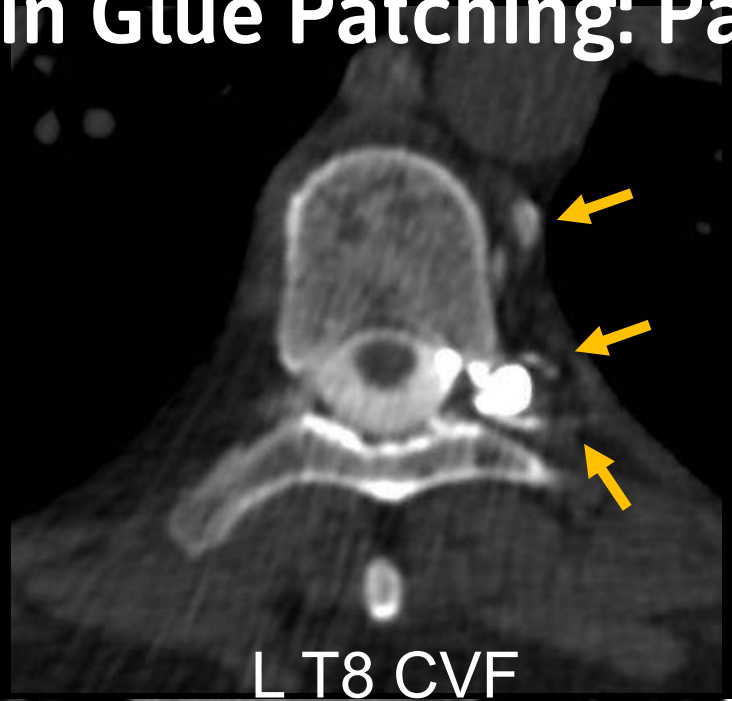


Pretreatment

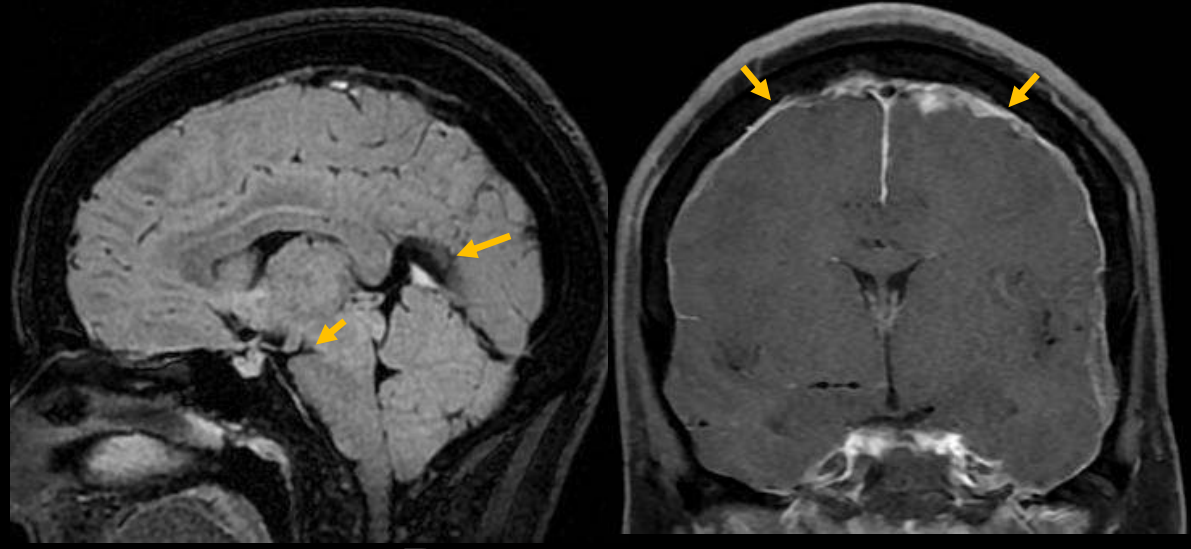


1 Month Posttreatment

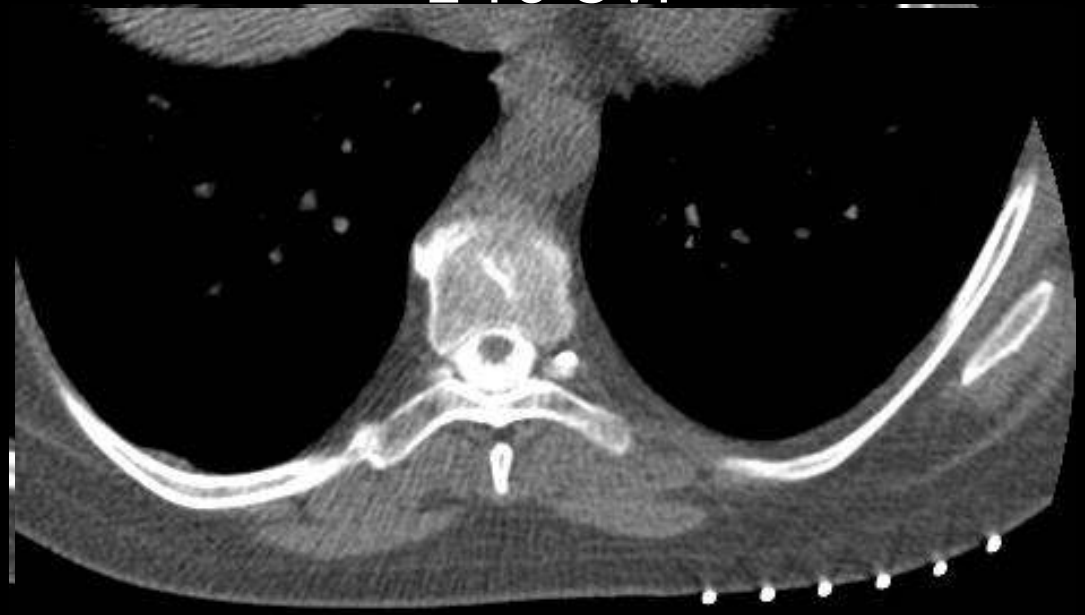
CVF Fibrin Glue Patching: Paravertebral "Wall" Technique



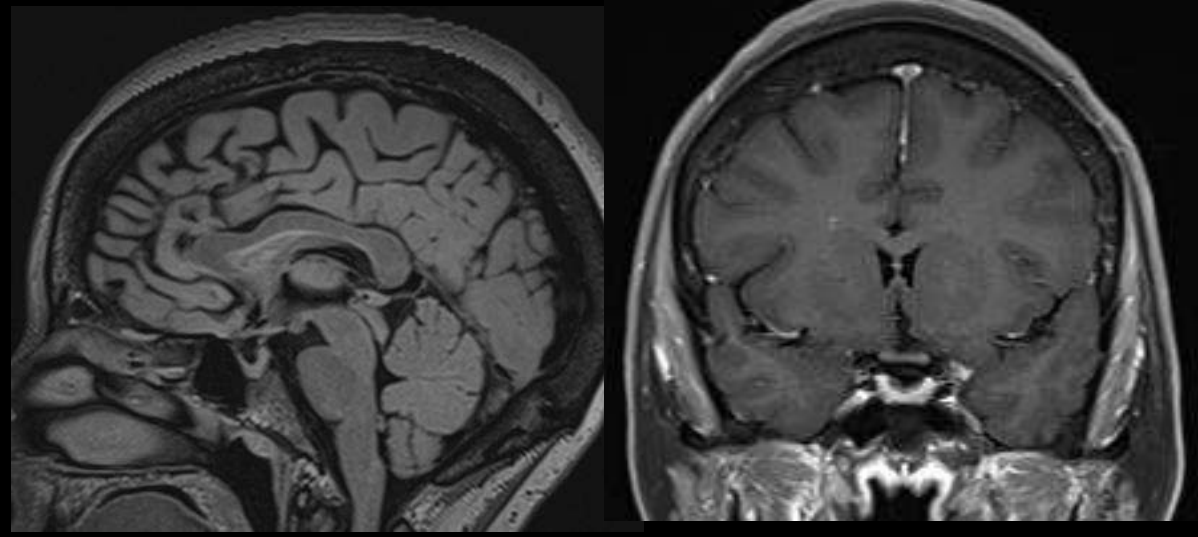
L T8 CVF



Pretreatment



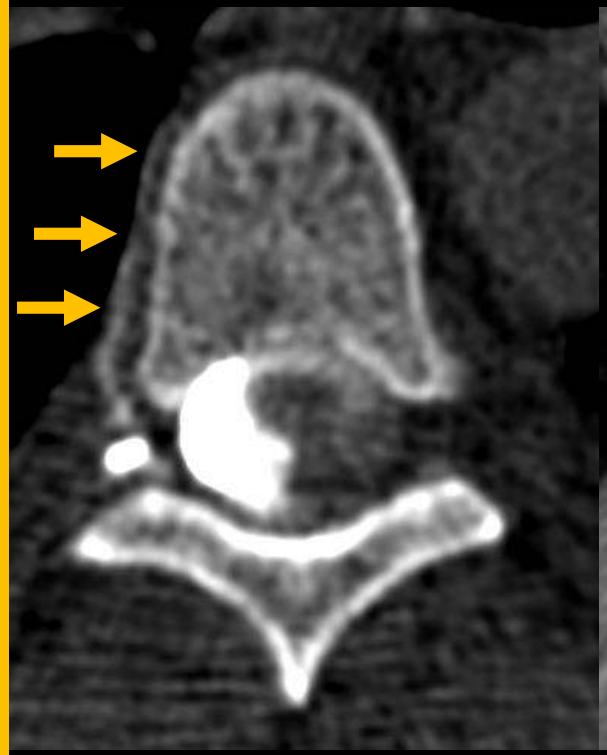
2-needle "wall" approach



Posttreatment (1 month)

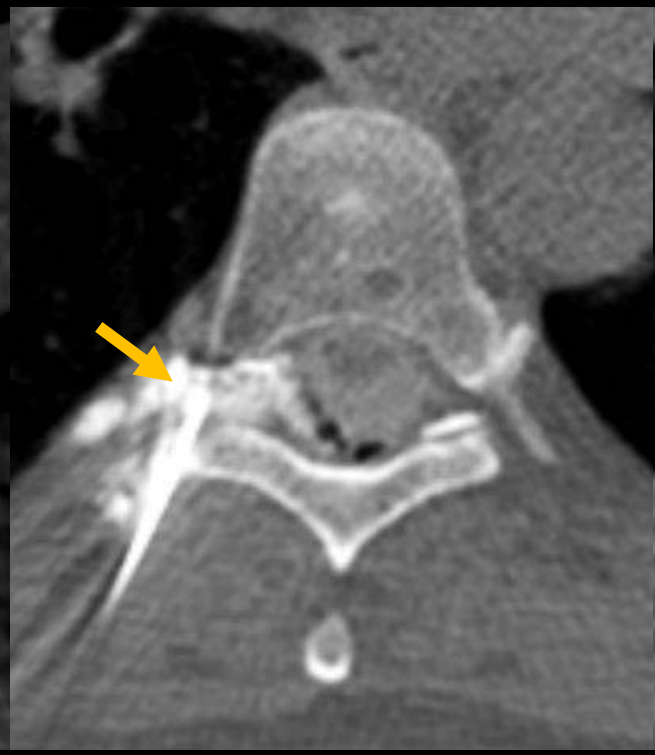
CVF Fibrin Glue Occlusion: Real-Time Needle Readjustment

CTM



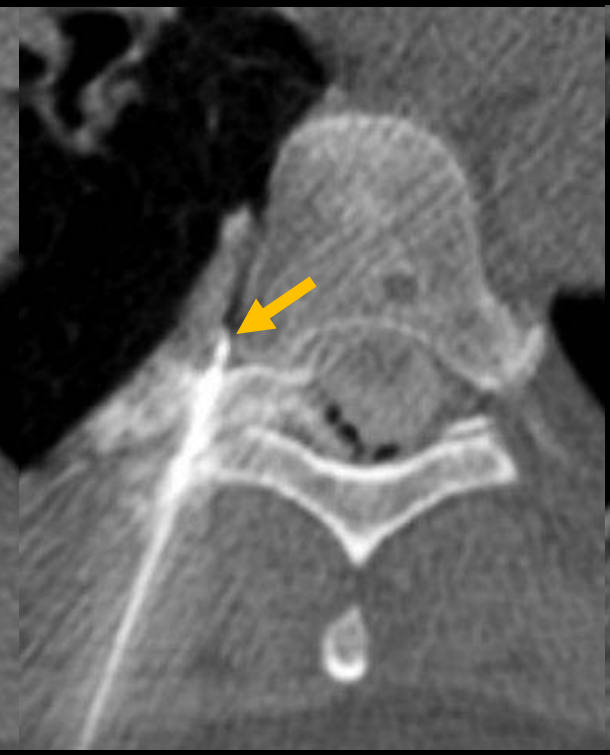
R T6 CVF

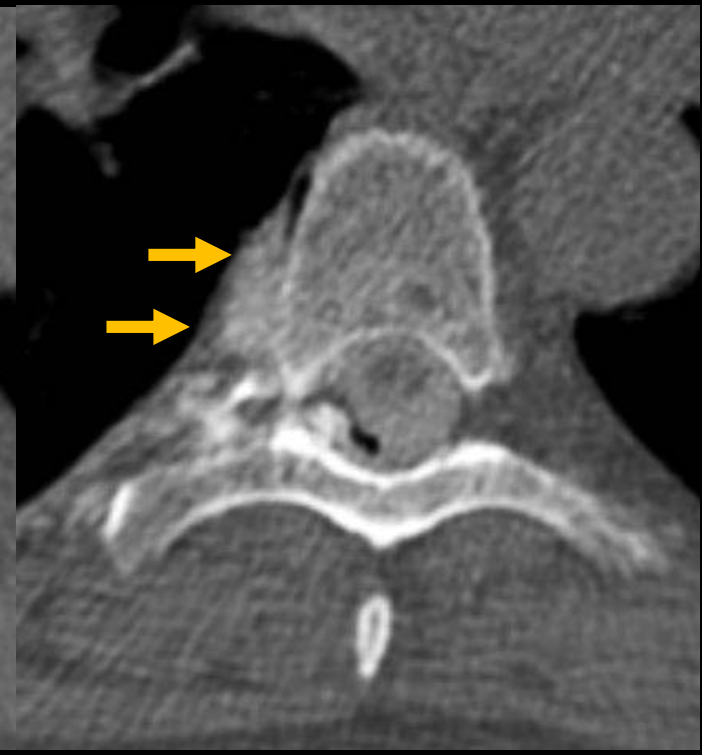
Initial Glue



Needle at cyst-vein junction

Needle Readjustment

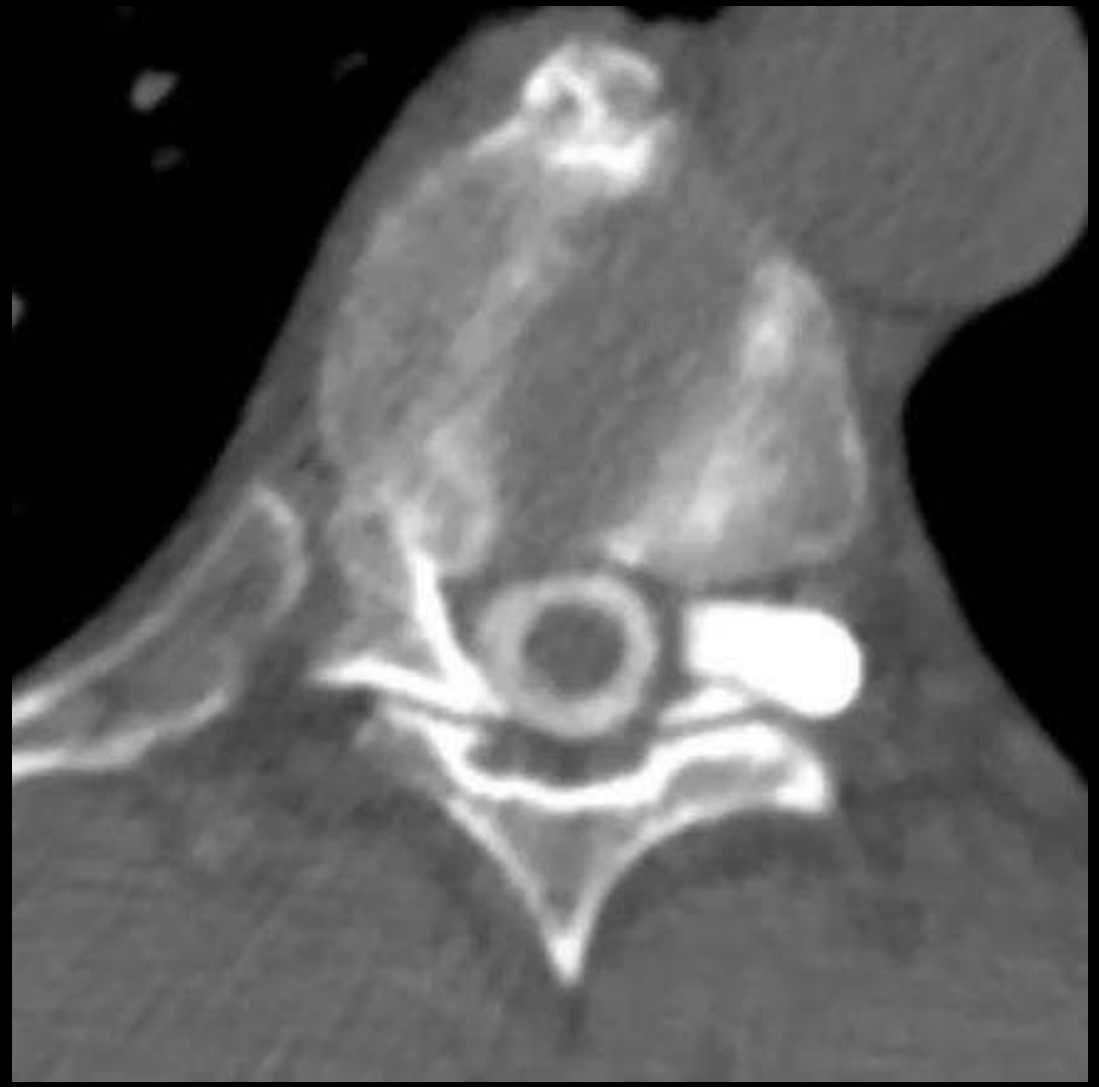




Needle repositioned to build paravertebral wall

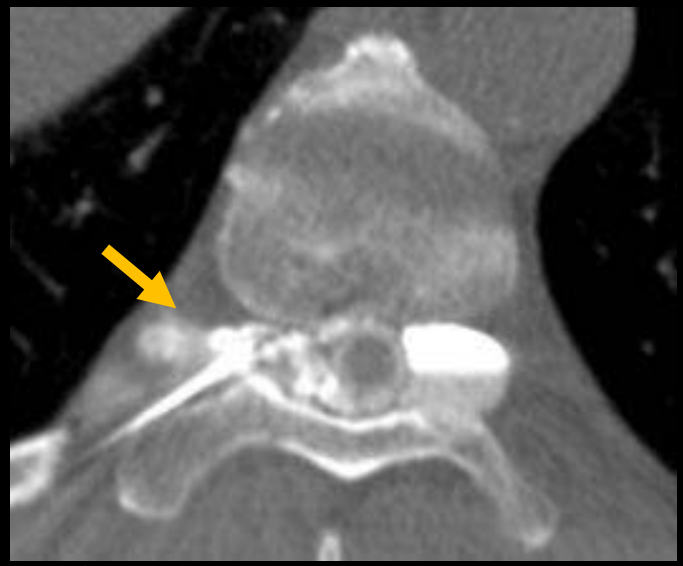
CVF Fibrin Glue Occlusion: Direct Cyst Puncture

CTM

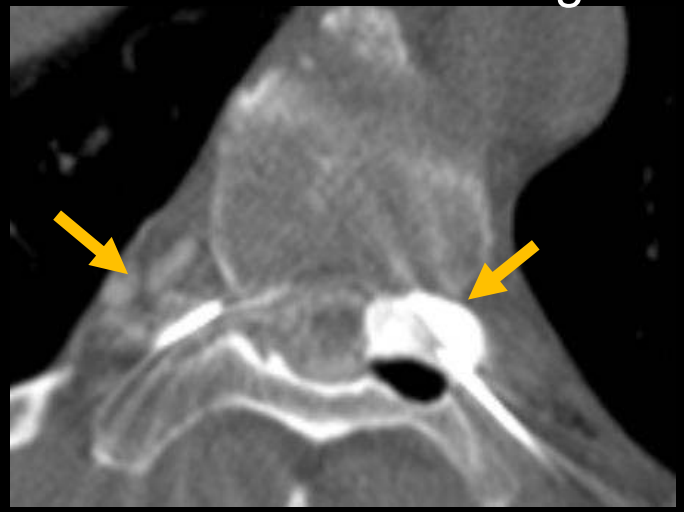


L T10 CVF

Glue

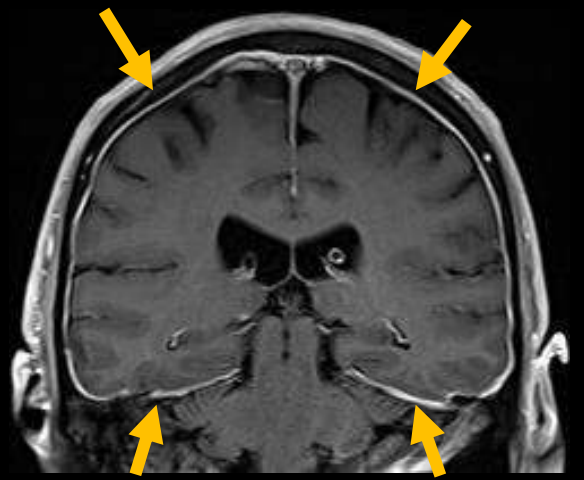


1st Patch: R foraminal glue

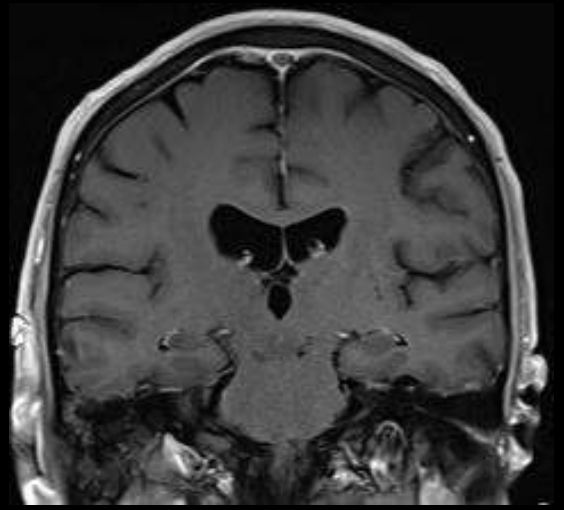


2nd Patch: Direct cyst puncture + R foraminal glue

MRI



Pretreatment



Posttreatment

Efficacy of CVF Glue Patching

Factors Predictive of Treatment Success in CT-Guided Fibrin Occlusion of CSF-Venous Fistulas: A Multicenter Retrospective Cross-Sectional Study

2023

Andrew L. Callen, Lalani Carlton Jones, Vincent M. Timpone, Jack Pattee, Daniel J. Scoffings, David Butteriss, Thien Huynh, Peter Y. Shen, and Mark D. Mamlouk

Clinical Improvement

- 59.7% complete
- 34.5% partial
- 5.9% none

Statistically Significant

Glue spread matching CVF drainage pattern

Similar to

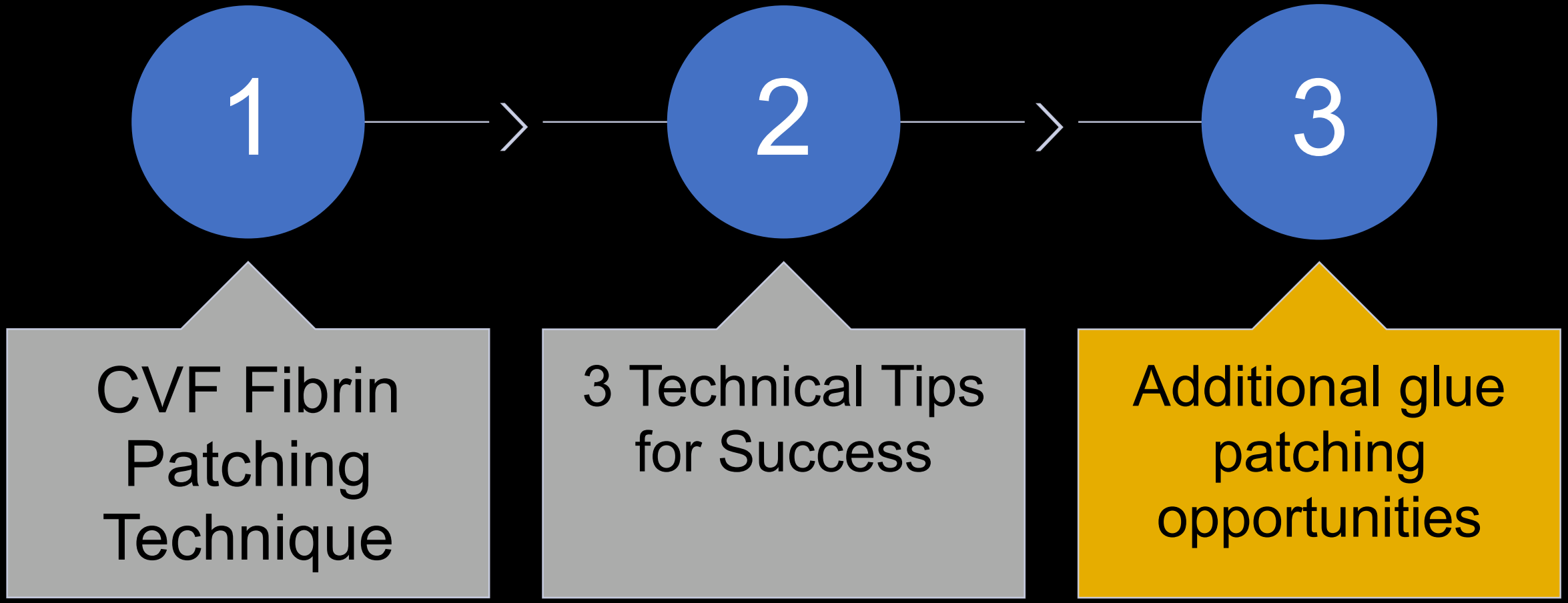
The impact of CSF venous fistula embolization on patient's quality of life, a longitudinal clinical-radiological exploration

2025

64% complete HA response

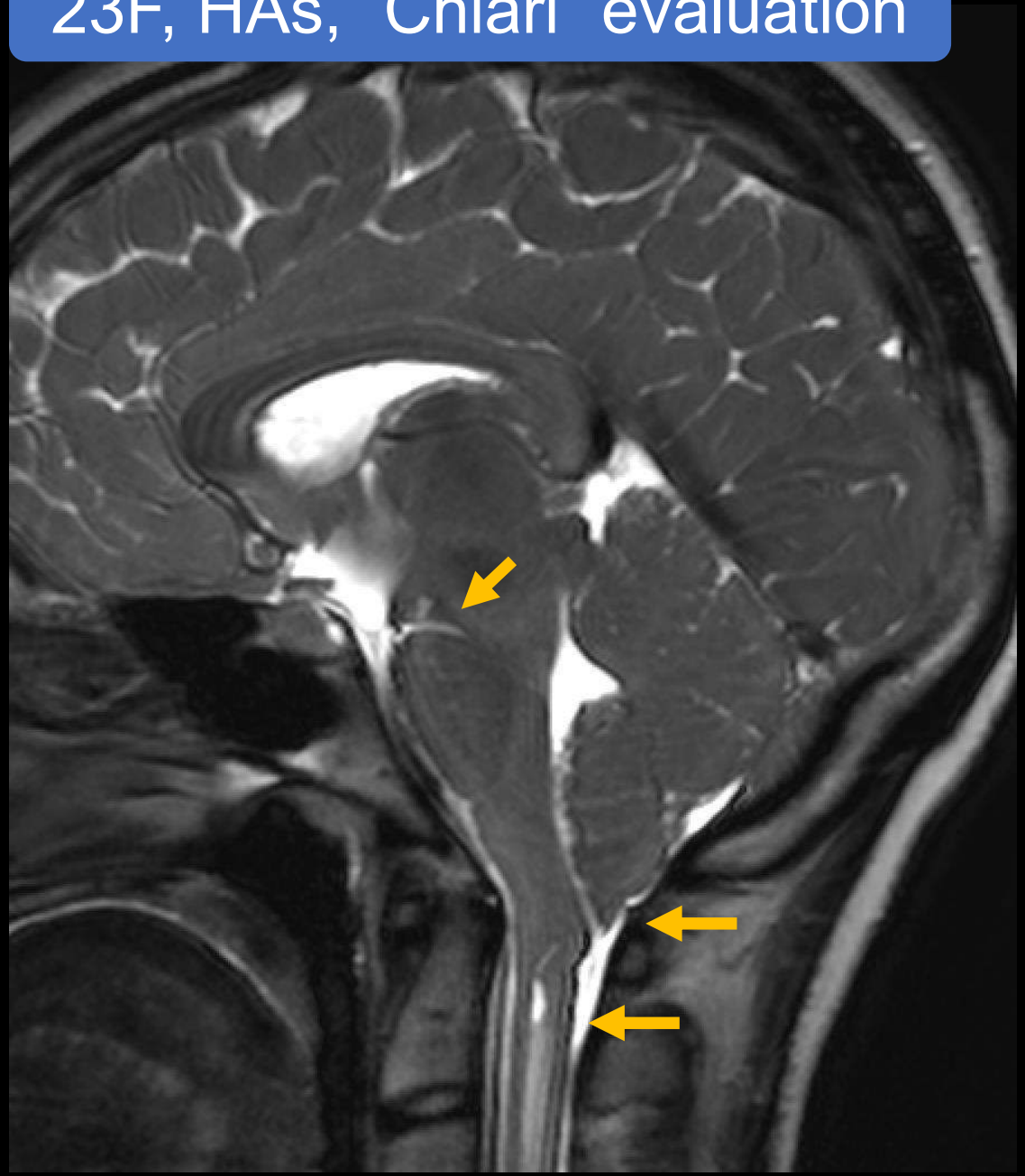
Malo Goapper[1], Liesjet E.H. van Dokkum[1], Vincent Costalat[1], Gaetano Risi[1], Lucas Corti[2], Olivia Portalier[1], Nicolas Lonjon[3], Emmanuelle Le Bars[4], Anne Ducros[2] and Federico Cagnazzo[1*]

Our Spinal Leak Journey

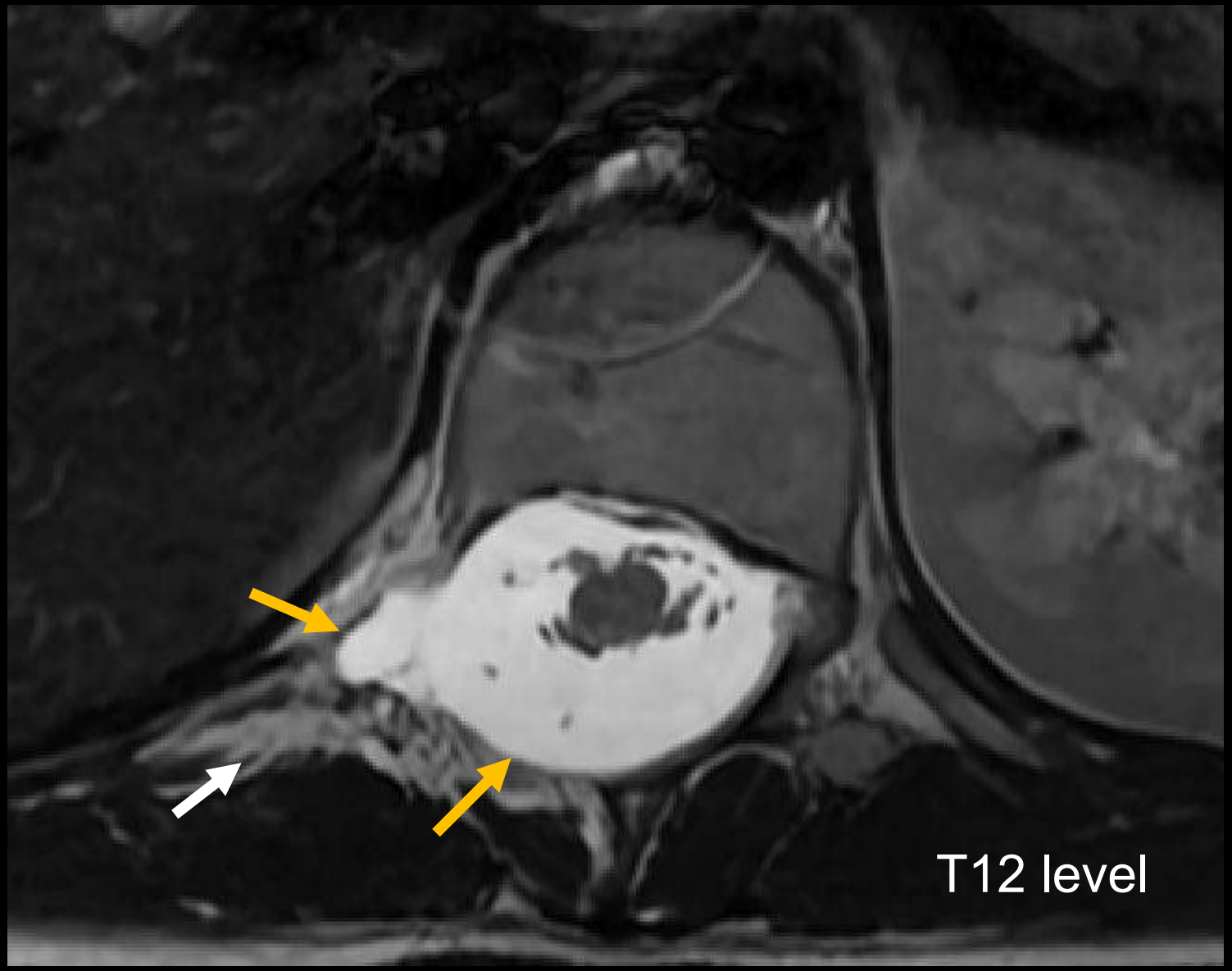


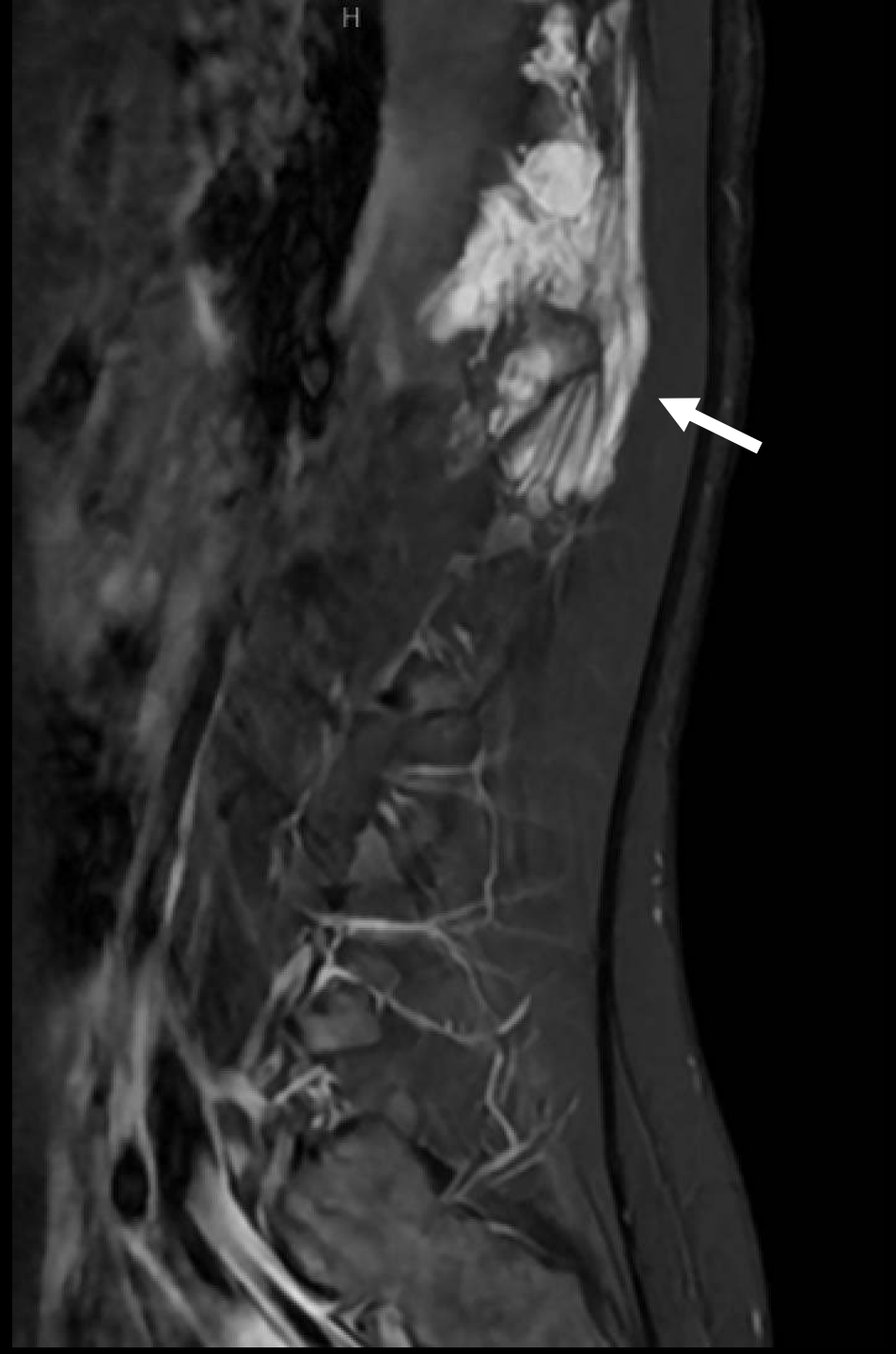
Other Glue Patching Opportunities

23F, HAs, ”Chiari” evaluation

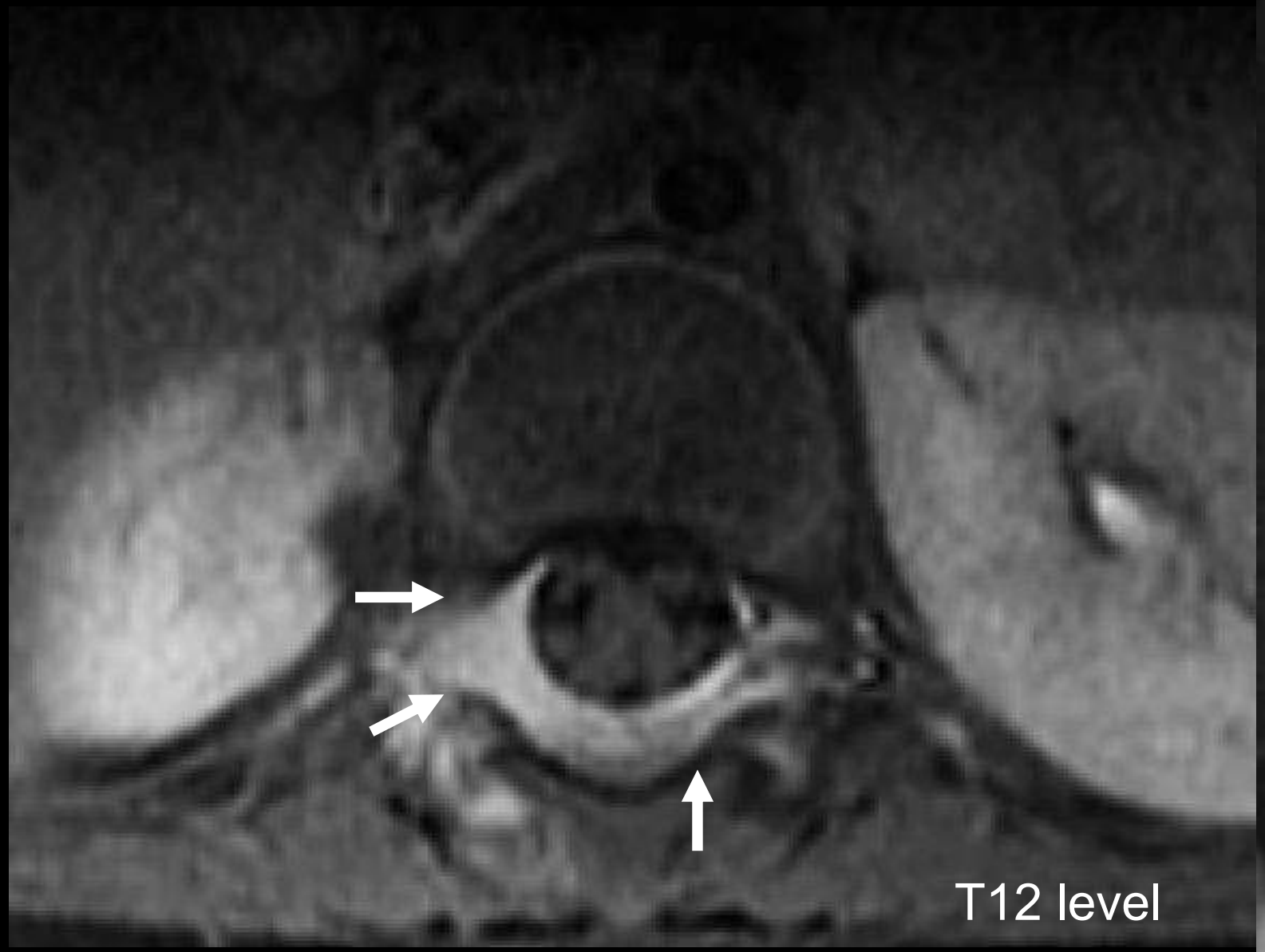


Recent Outside Spine MRI

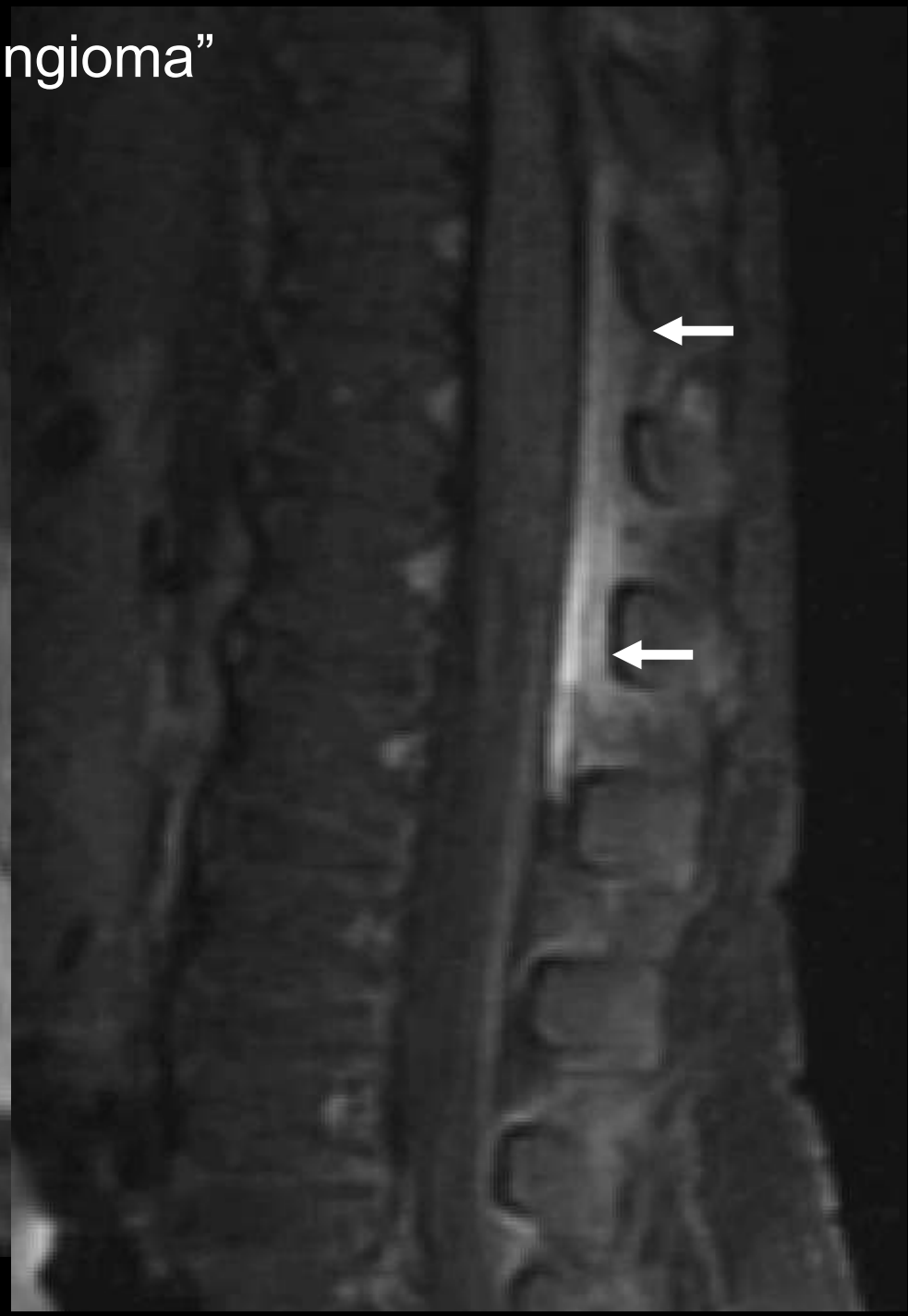




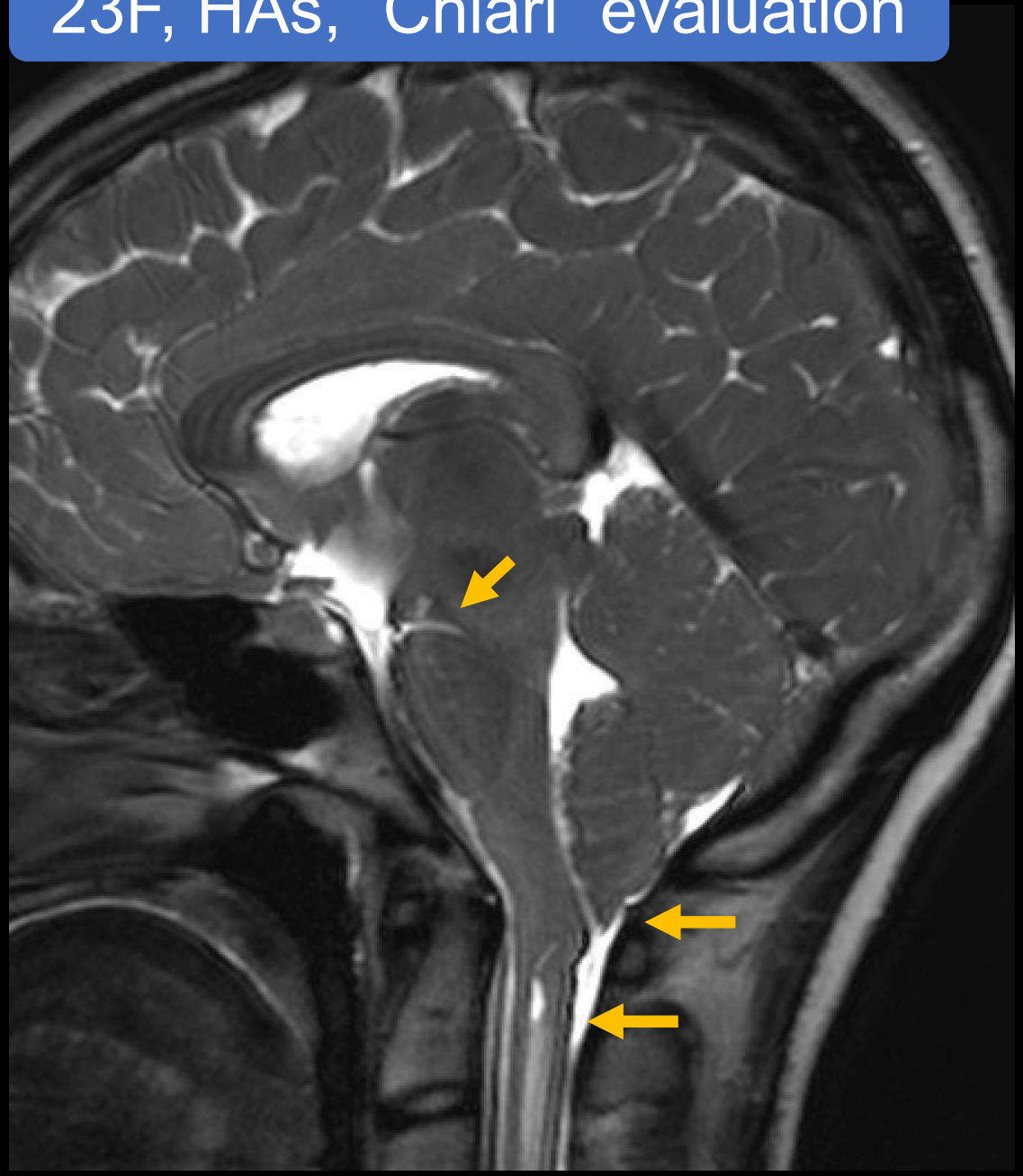
MRI 22 years prior "Epidural hematoma or hemangioma"



T12 level

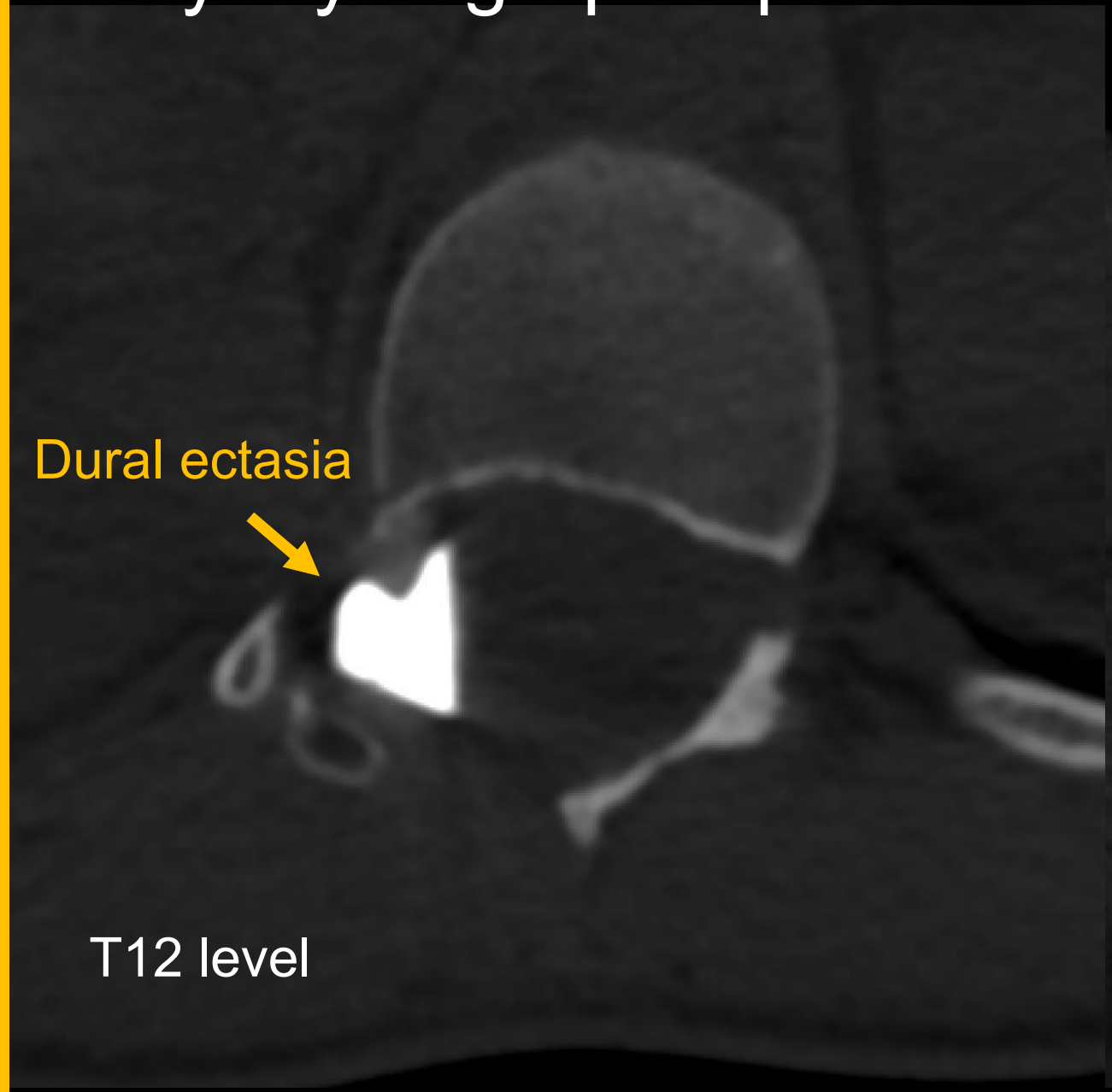


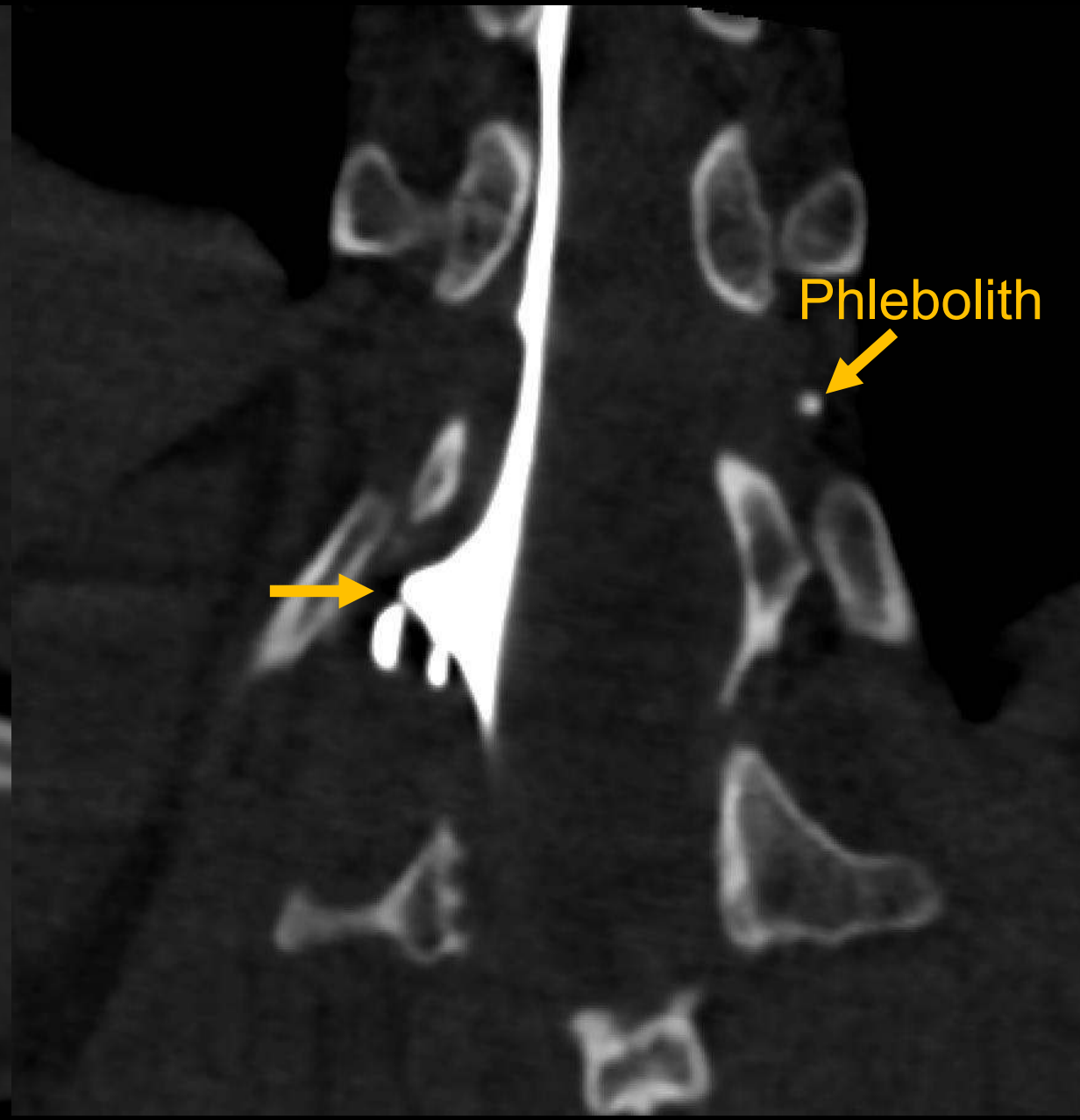
23F, HAs, ”Chiari” evaluation



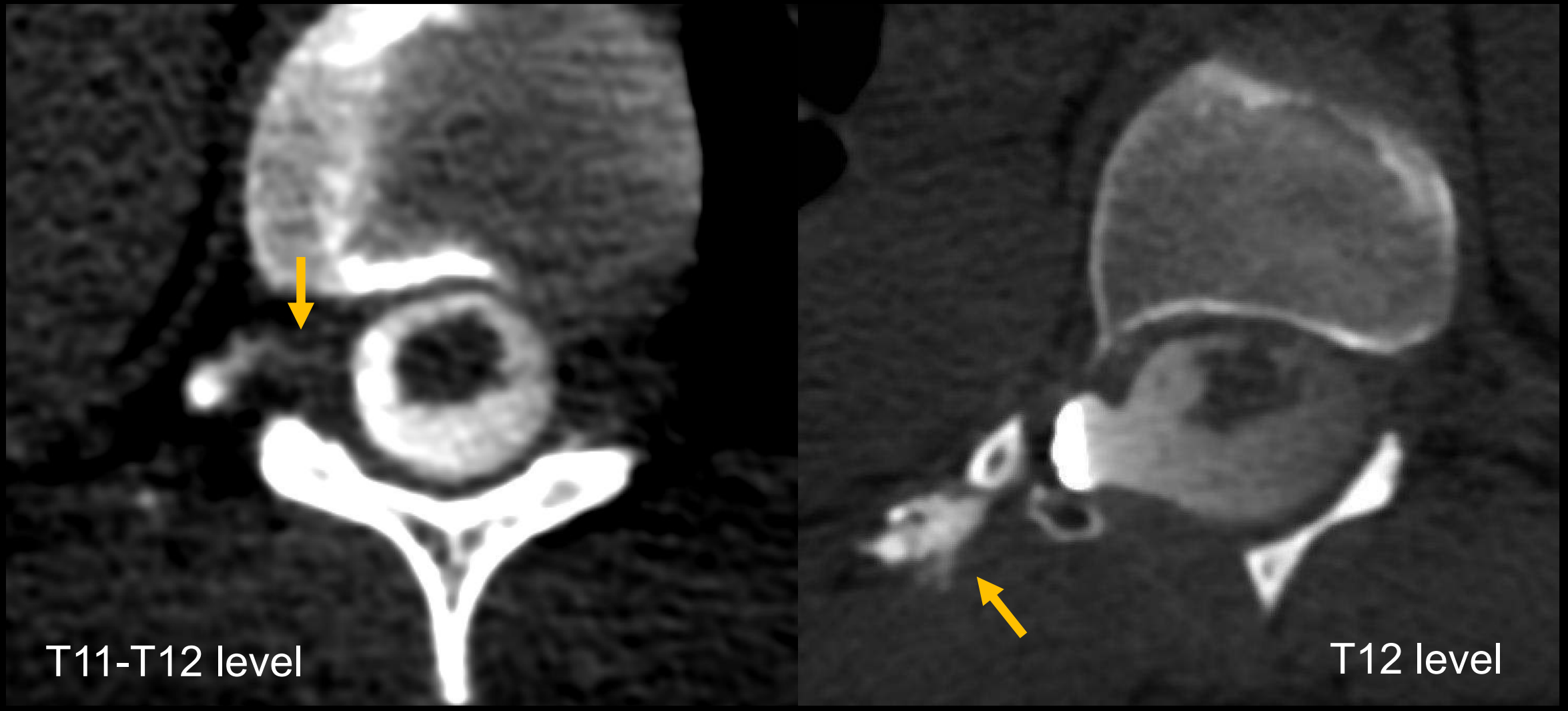
Impression:
Imaging findings concerning for SIH from a venous malformation fistula. Recommend right decubitus CT myelogram

Early myelographic phase





Delayed myelographic phase



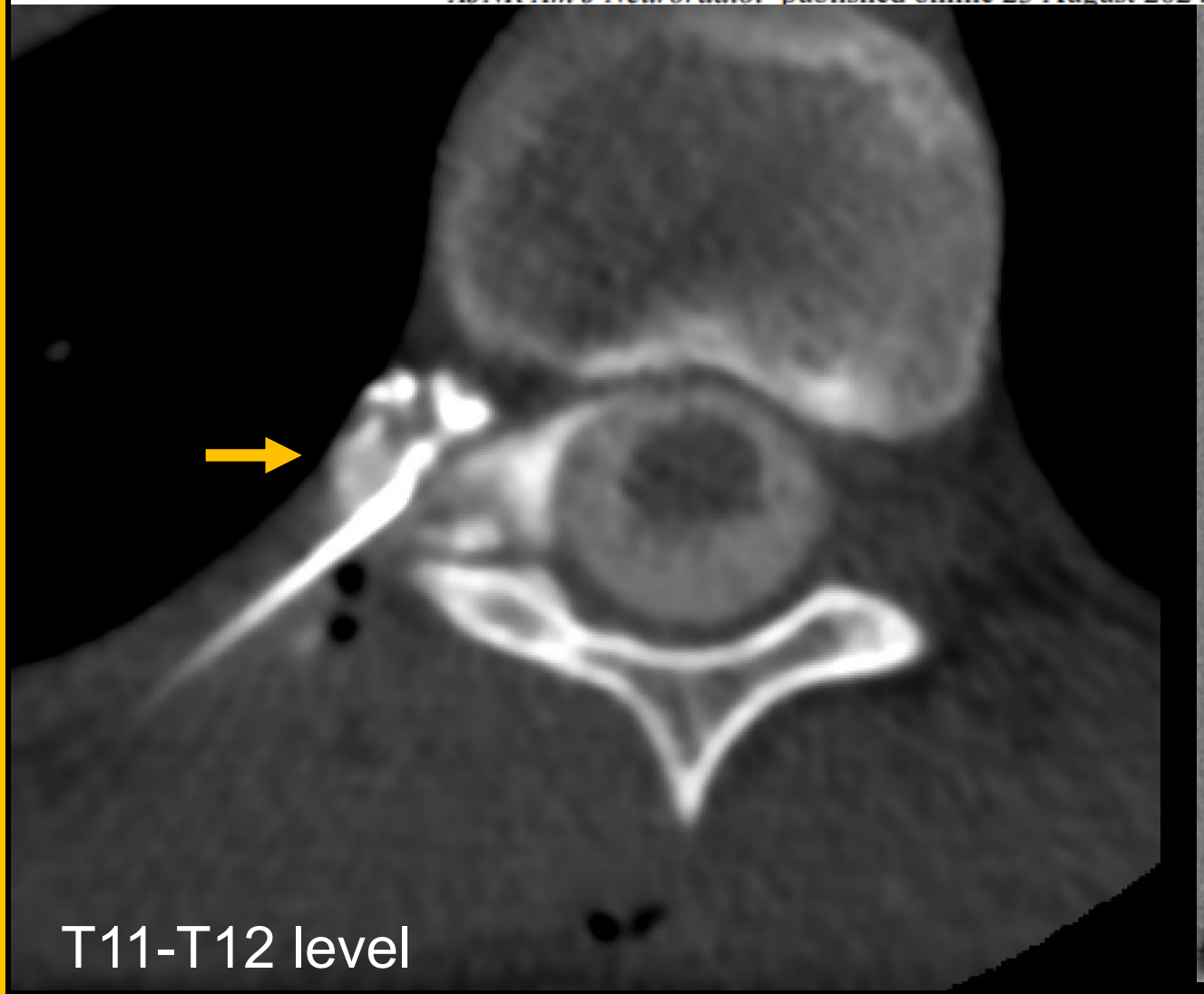
CSF-Venous Malformation Fistula

AJNR

Spontaneous Intracranial Hypotension Associated With Vascular Malformations

Mark D. Mamlouk, Adriana Gutierrez and William P. Dillon

AJNR Am J Neuroradiol published online 23 August 2024



Fibrin Glue Patch

Sclerotherapy

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