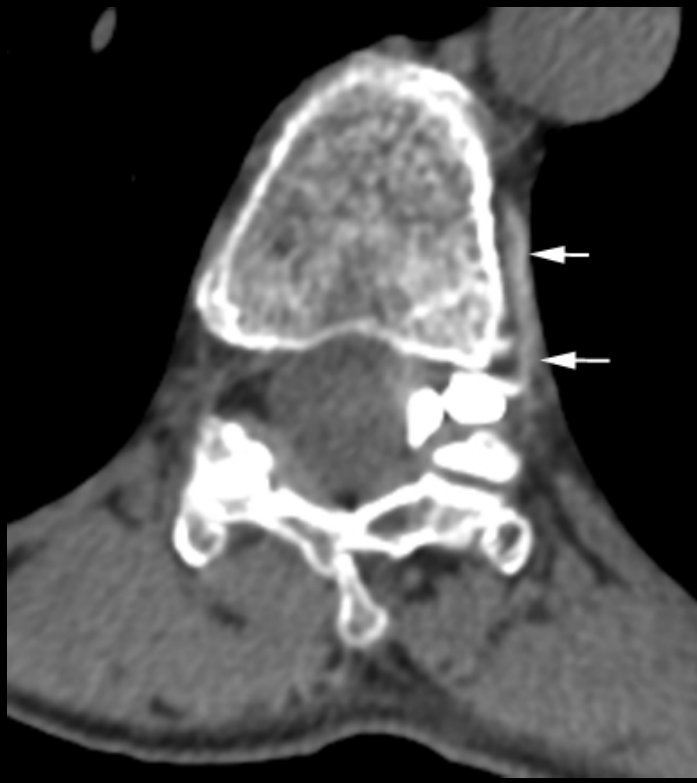
CT-Guided Fibrin Glue for CSF-Venous Fistulas

Mark D. Mamlouk, MD

Regional Neuroradiology Lead, TPMG
Director of Spinal CSF Leak Program
Co-Director of Vascular Anomalies Clinic
Kaiser Permanente, Santa Clara, CA

Assistant Clinical Professor – Volunteer
University of California, San Francisco



Learning Objectives on CSF-Venous Fistulas

- Briefly discuss decubitus CT myelography
- Orient how to perform CT fibrin glue occlusion
- Discuss tips for successful treatment

Decubitus CT Myelography

Decubitus CTM Technique

1. Review spine MRI for laterality of meningeal diverticula but usually choose R side to start

1. Position patient decubitus with sponge on CT table

1. Scout total spine & ensure adequate 10-20°Trendelenburg angle

1. Lumbar puncture & check pressure

1. Inject 0.5 cc Omnipaque 300 test dose, followed by 9.5 cc (do not inject saline)

1. Scan immediately total spine with 0.625 mm slice thickness in standard kernel. Repeat PRN at CVF site with inspiration.

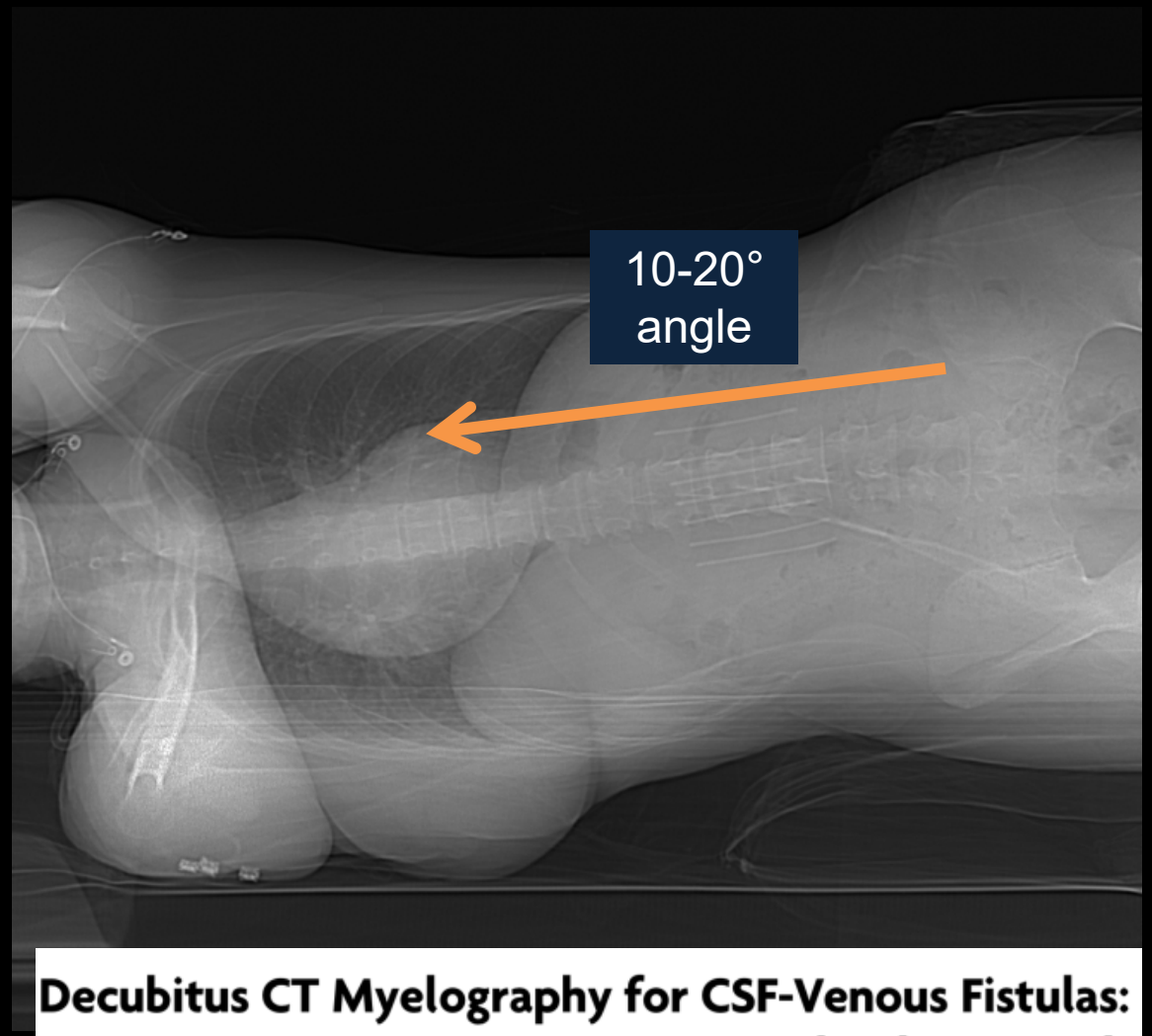
1. If CVF not seen, either scan next day or sometimes flip decub & rescan

Decubitus CTM Patient Positioning

Decubitus CT Myelography for Detecting Subtle CSF Leaks in Spontaneous Intracranial Hypotension

AJNR 2019

P.G. Kranz, L. Gray, and T.J. Amrhein



Decubitus CT Myelography for CSF-Venous Fistulas: A Procedural Approach

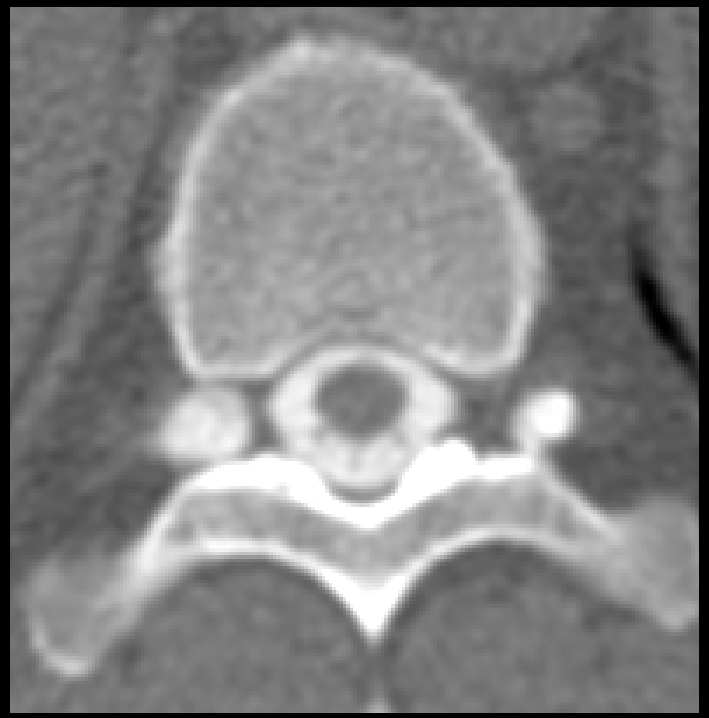
AJNR 2020

M.D. Mamlouk, R.P. Ochi, P. Jun, and P.Y. Shen

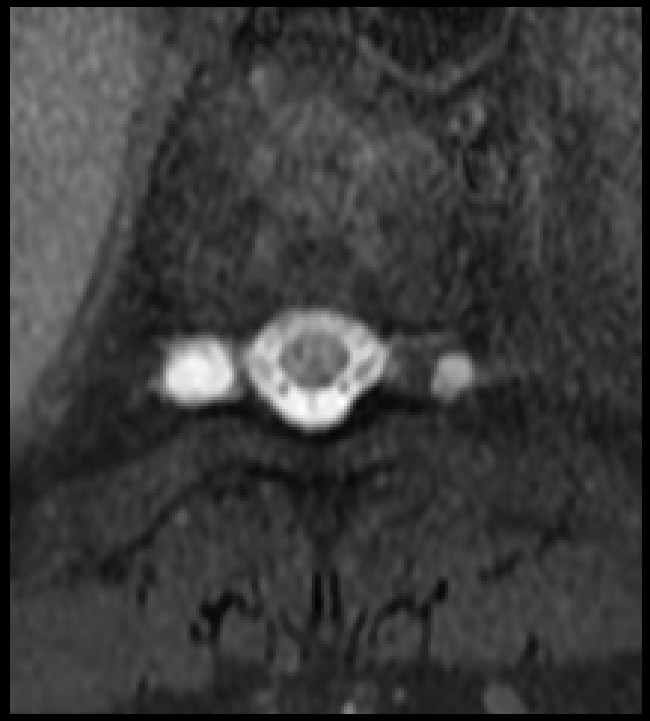
CSF-Venous Fistula on Decubitus CTM

46F, SIH symptoms for 4 years

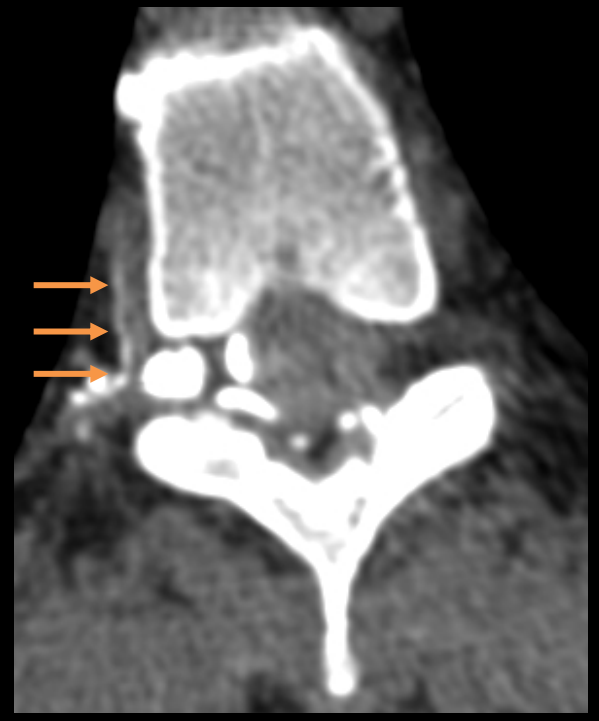
T10-T11 level

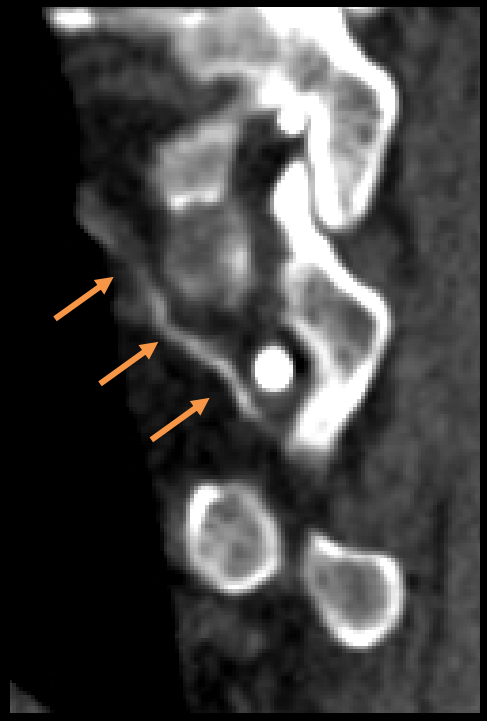


Conventional CT myelogram



MRI myelo + gad

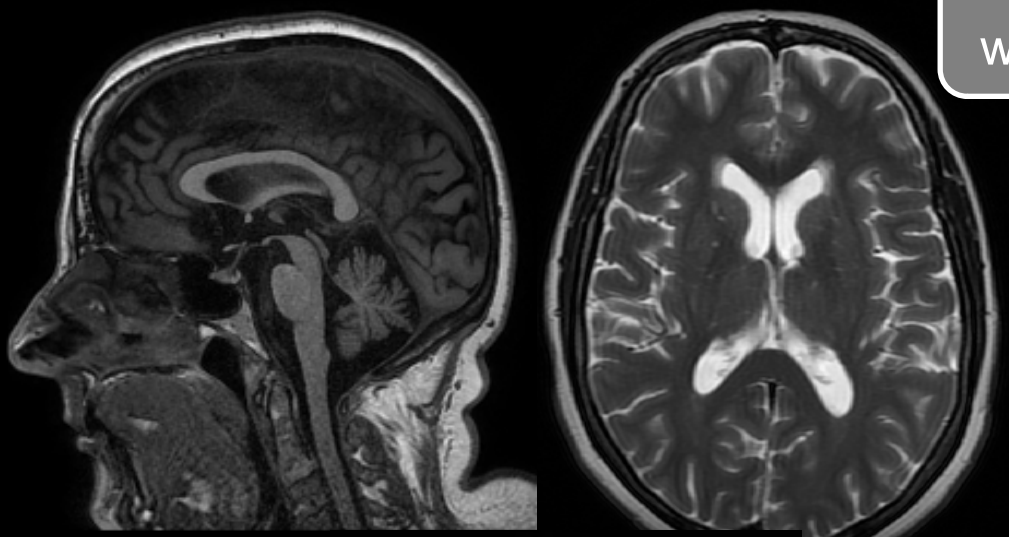


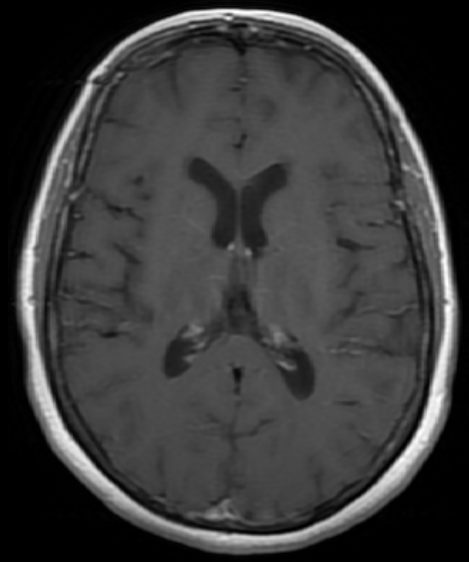


Right decubitus CT myelogram

CSF-Venous Fistula with Normal Brain MRI

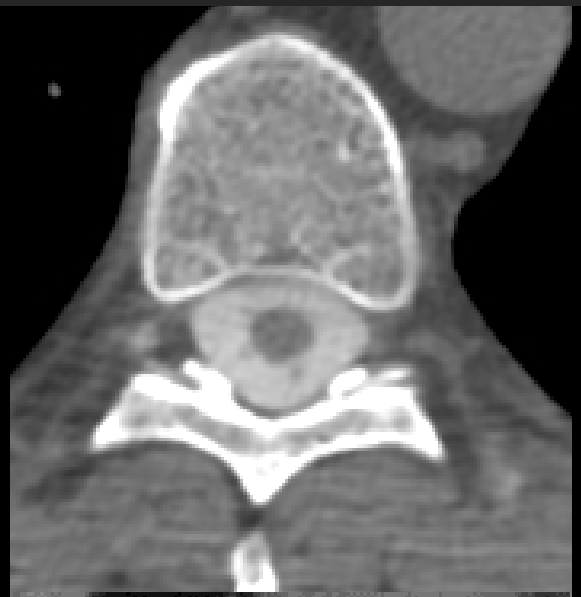
Normal brain MRI



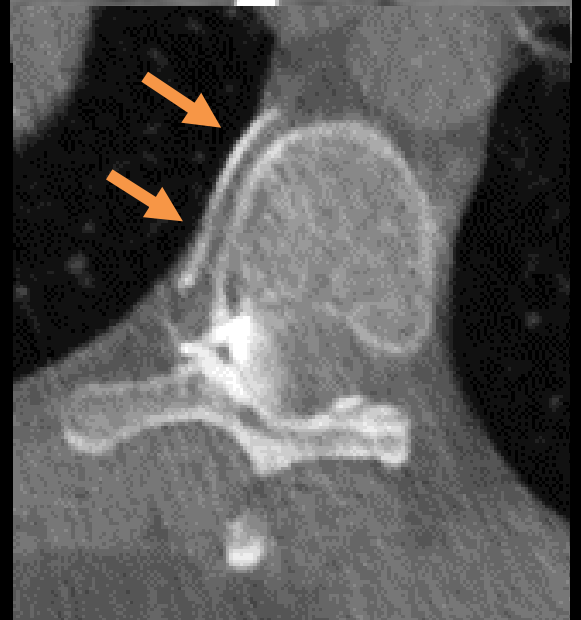


Clinical history: 56F, headaches worse with coughing and sneezing

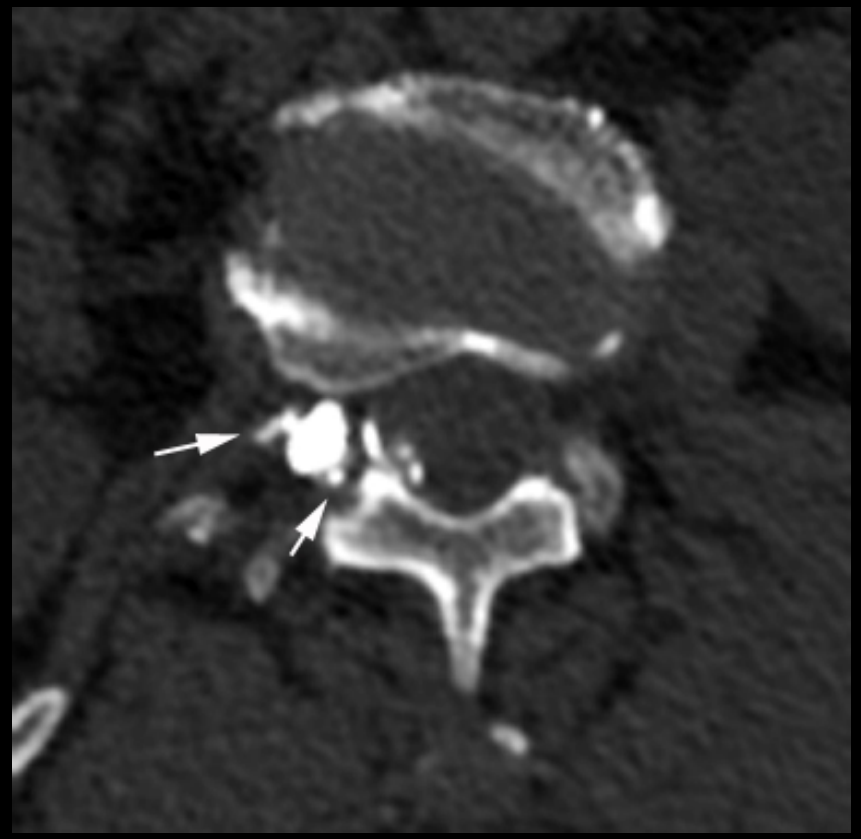
Conventional CT Myelogram
T9-T10 level. Normal.



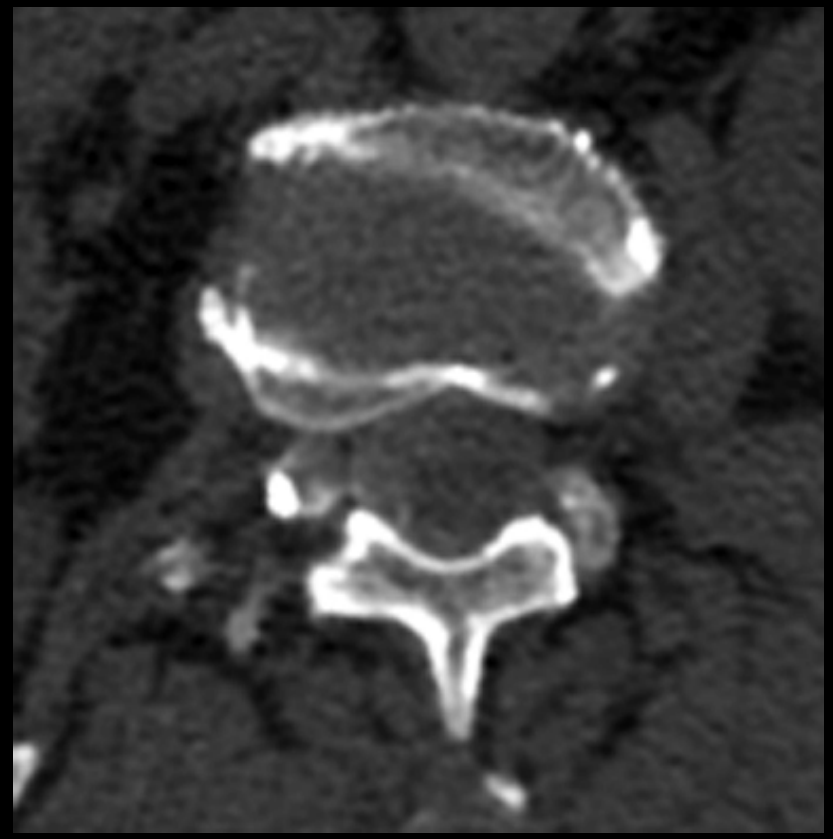
Decubitus CT Myelogram
Right T9-T10 CSF-venous fistula



Importance of Prompt Imaging



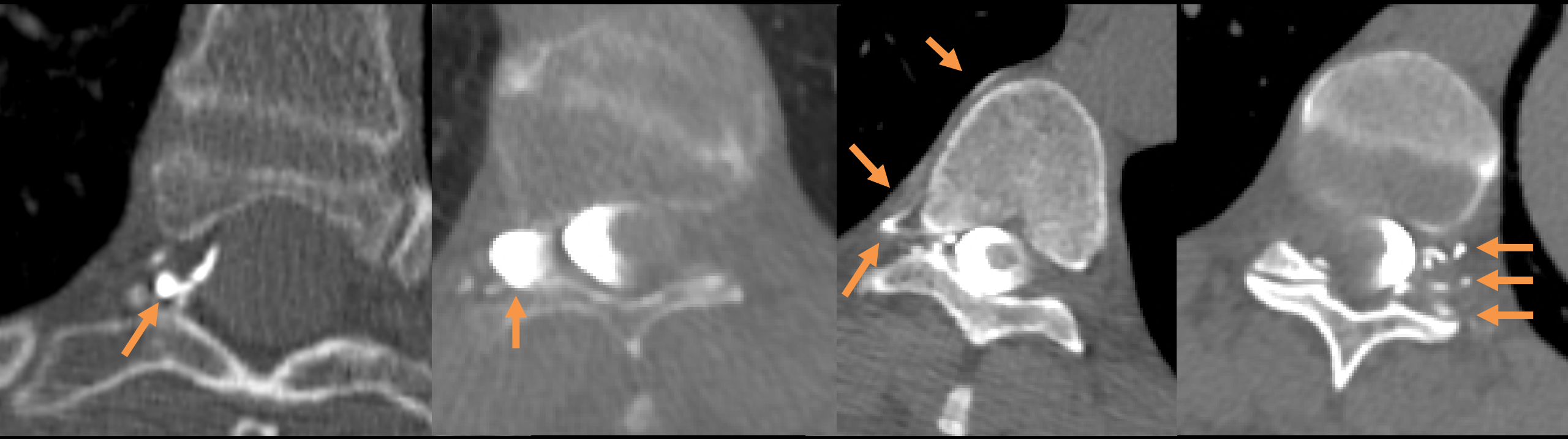
CSF-venous fistula scanned immediately after contrast administration



Fistula is absent on 3 minute scan

Various Flavors of CSF-Venous Fistulas

CVF course affects treatment planning



Small diverticulum

Large diverticulum

Long venous course

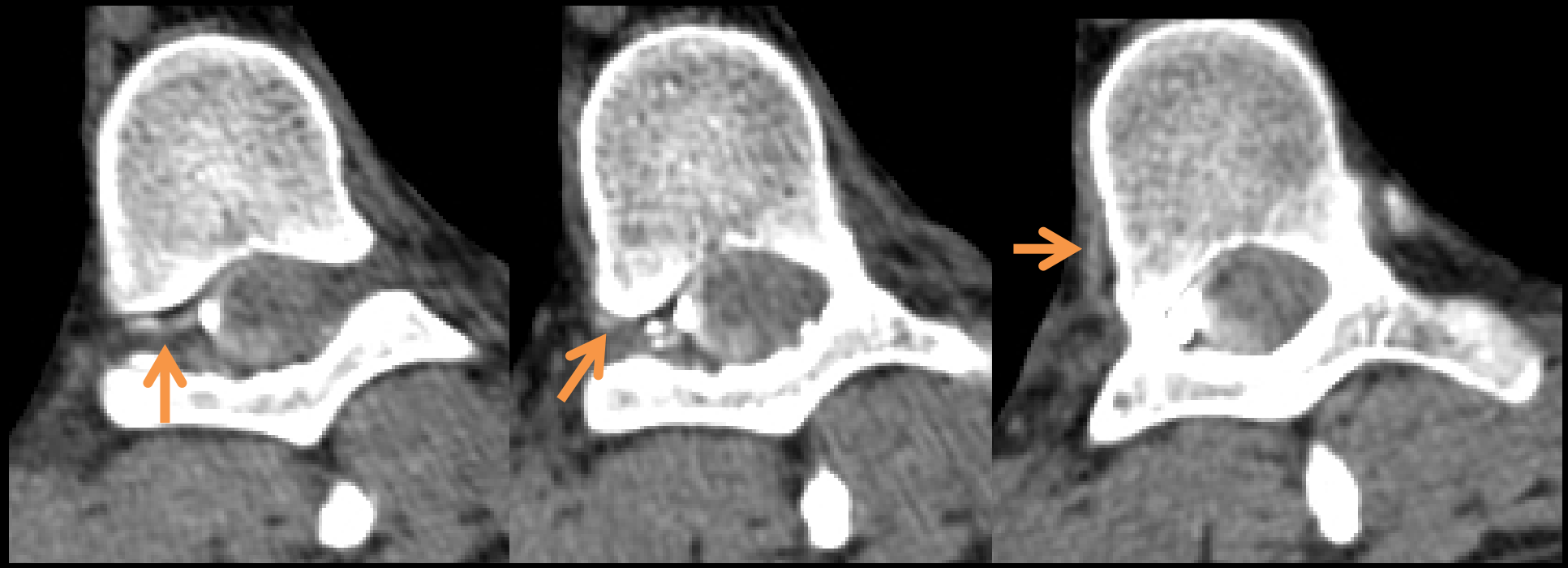
Multiple veins

Advantages of Decubitus CTM

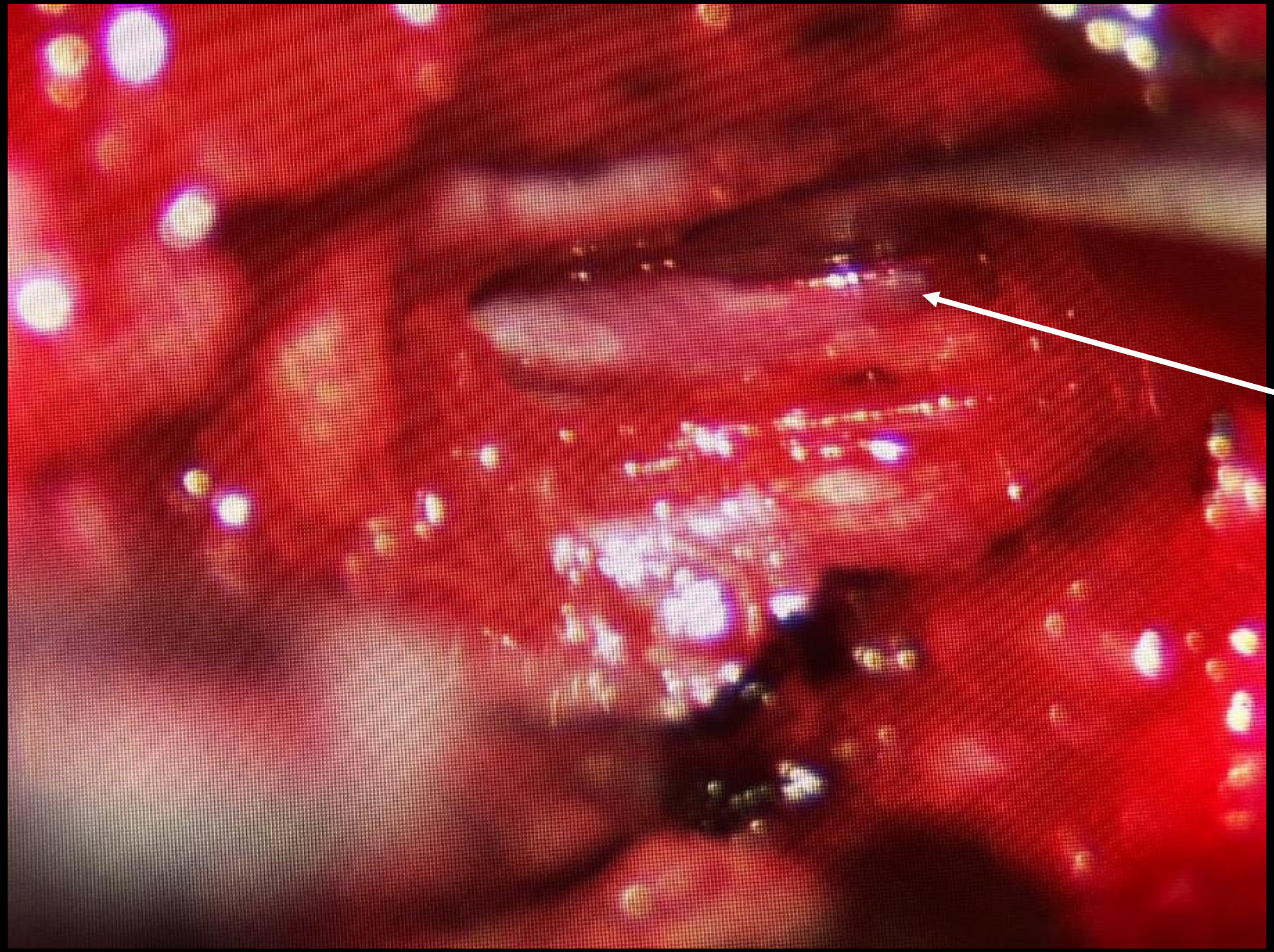
- Moderate sedation vs none needed
- Can image entire spine
- Easy learning curve
- 3D localization helps plan CT-guided glue treatment

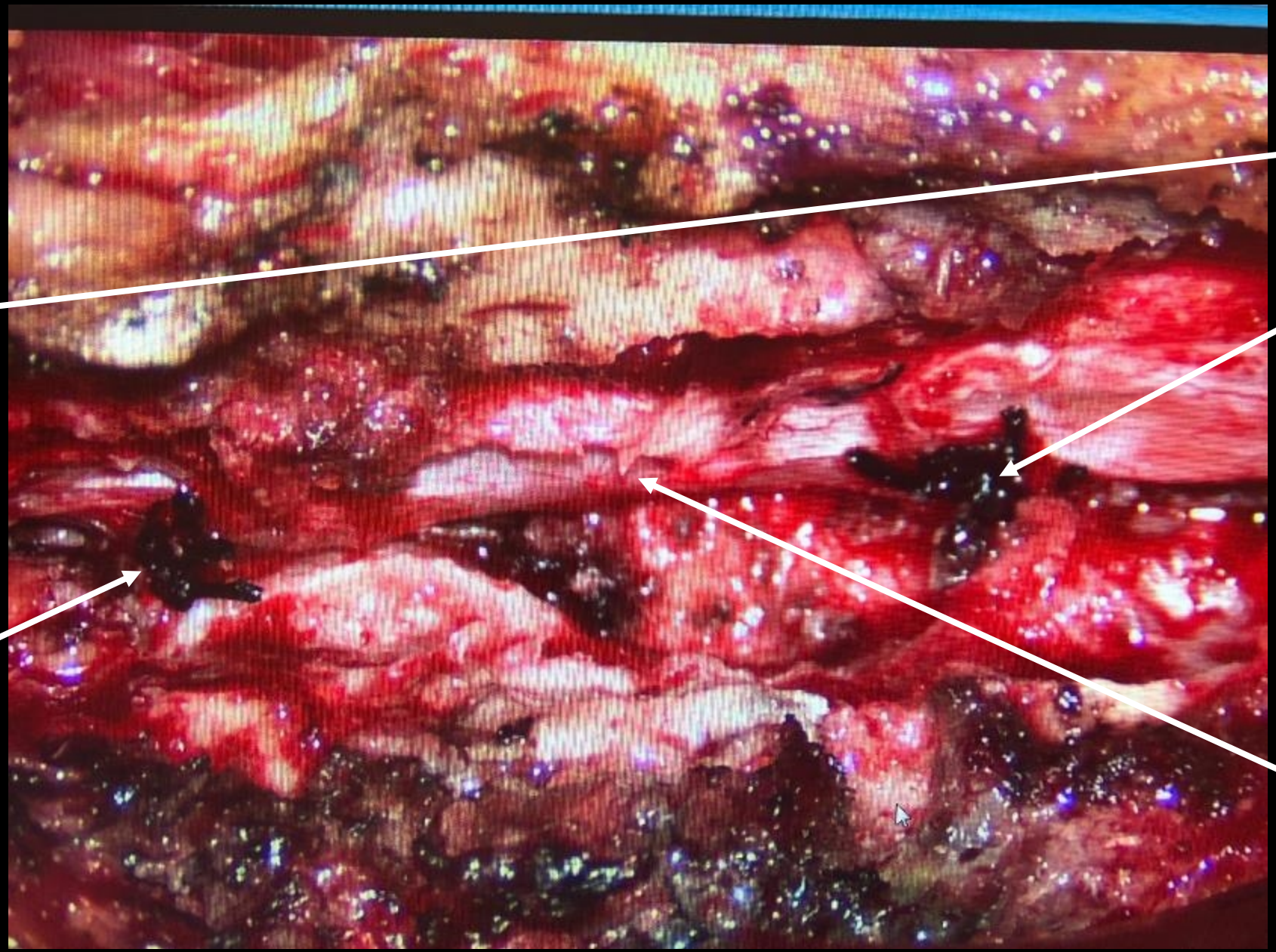
CVF Treatment

CSF-Venous Fistula Treated with Surgery



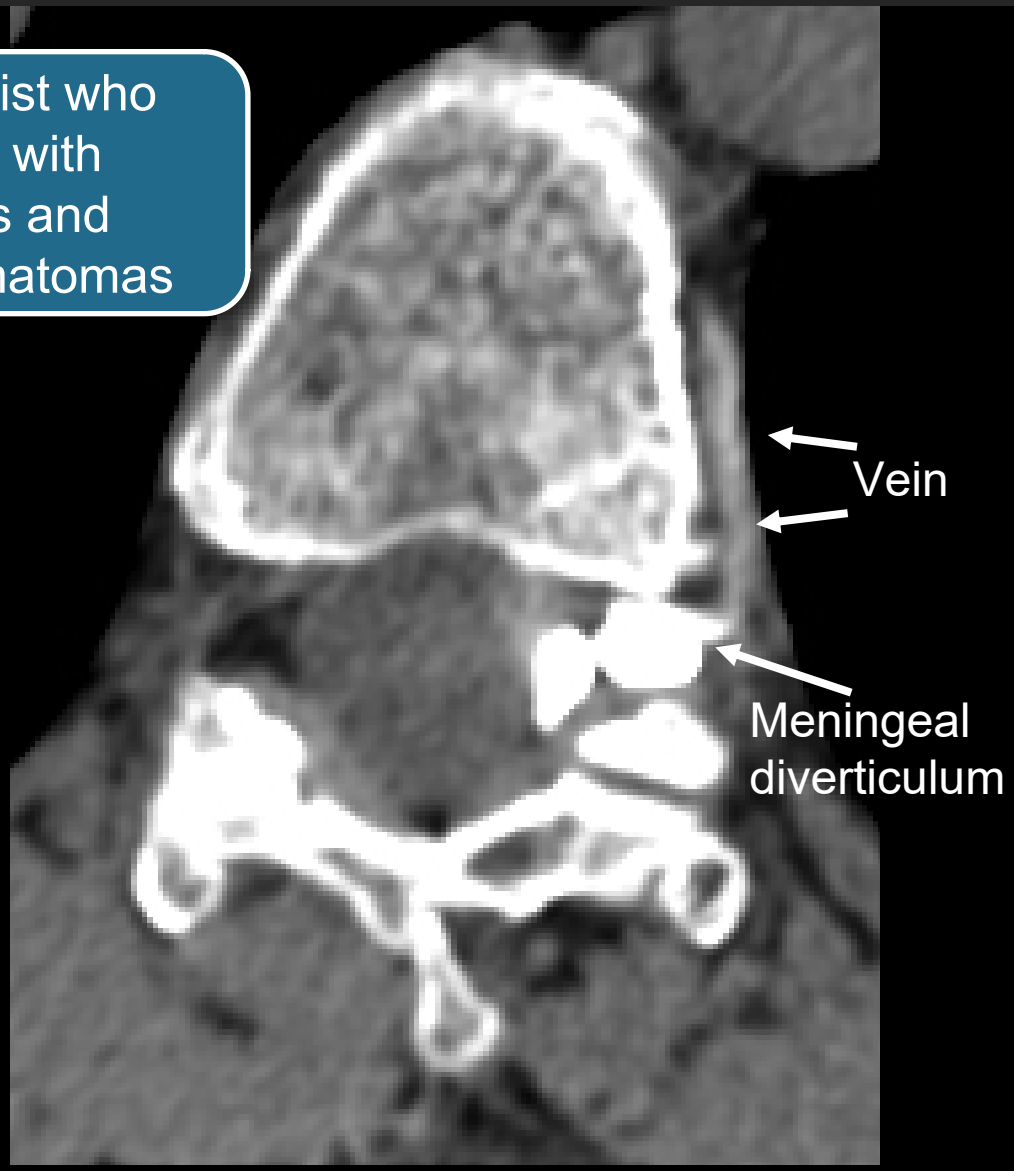
R T9-T10

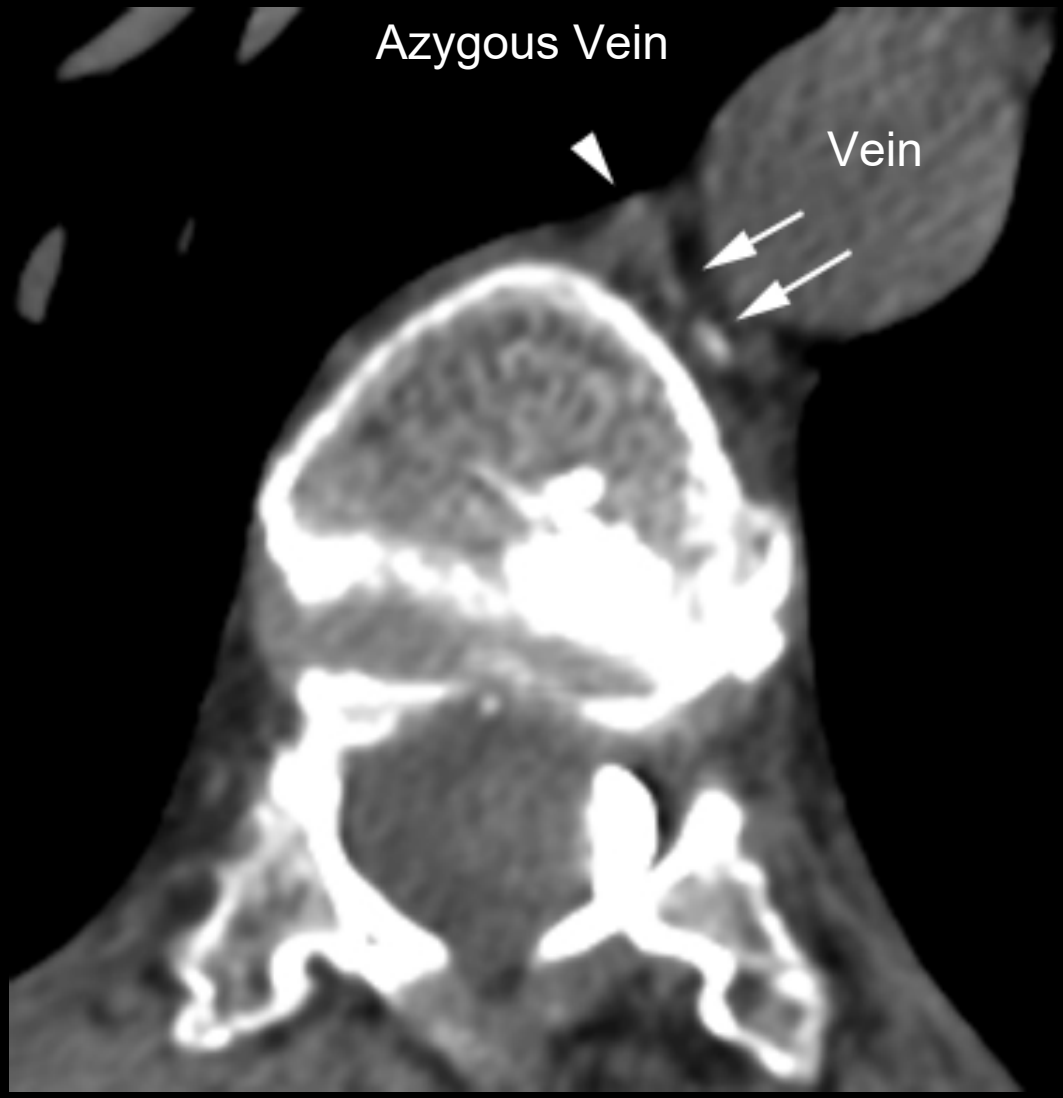

Vein
Between T9
And T10


Midline
T9 Nerve Roo
Ligated
T9 Nerve Root
Ligated
Right Side of Dur

Other Treatment Options?

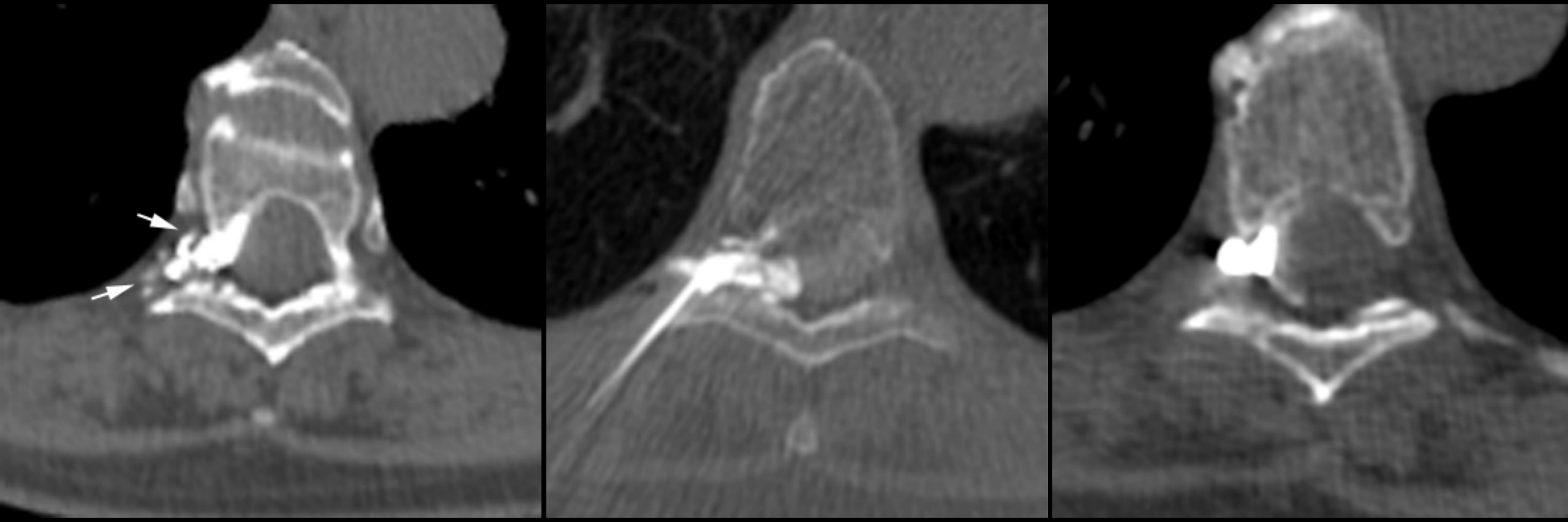
72F radiologist who presented with headaches and subdural hematomas





Blood or Fibrin Glue?

Fibrin Glue for CSF-Venous Fistula



CSF-Venous fistula

Fibrin glue injected into neural foramen

Resolved fistula

Fibrin Glue for CSF-Venous Fistula w/ Glue in Vein

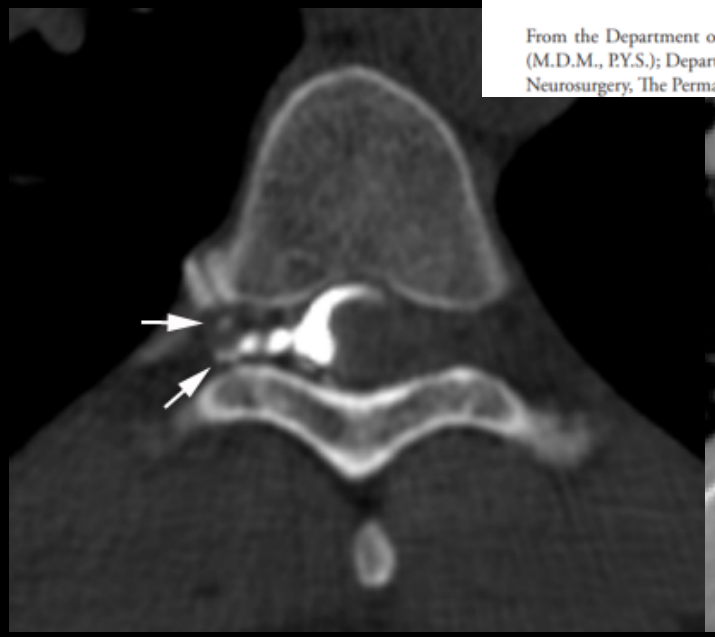
Radiology

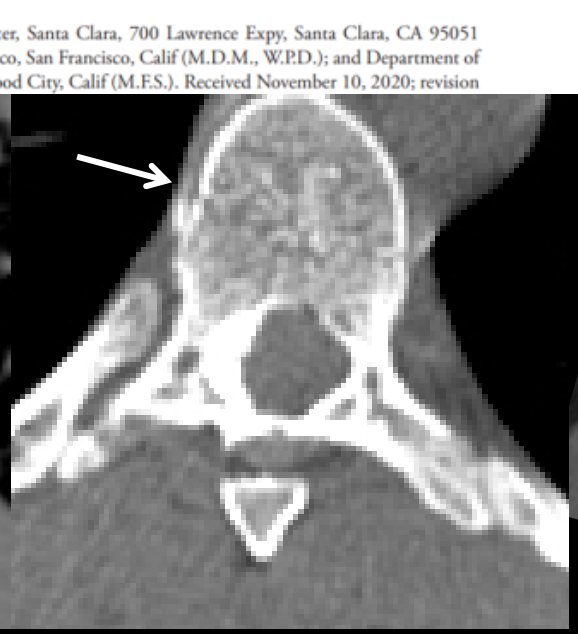
ORIGINAL RESEARCH • NEURORADIOLOGY

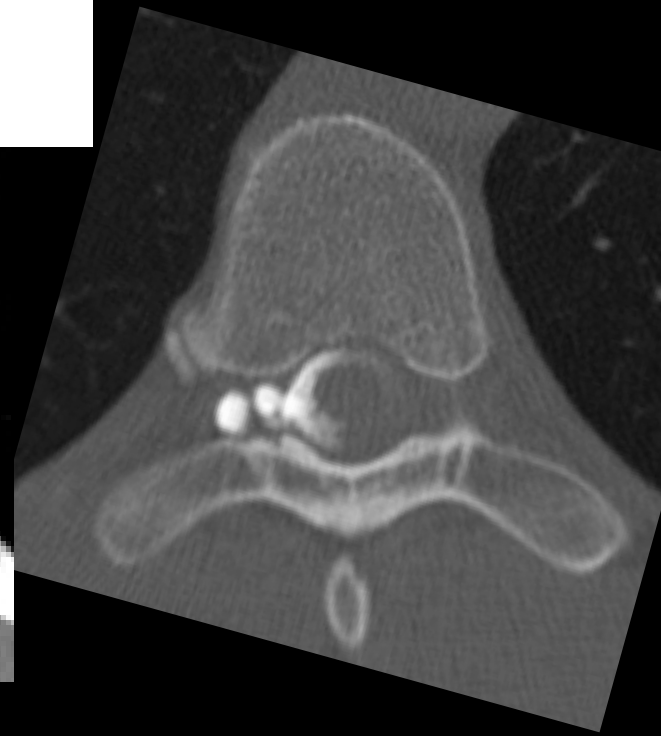
CT-guided Fibrin Glue Occlusion of Cerebrospinal Fluid–Venous Fistulas

Mark D. Mamlouk, MD • Peter Y. Shen, MD • Mark F. Sedrak, MD • William P. Dillon, MD

From the Department of Radiology, The Permanente Medical Group, Kaiser Permanente Medical Center, Santa Clara, 700 Lawrence Expy, Santa Clara, CA 95051 (M.D.M., P.Y.S.); Department of Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, Calif (M.D.M., W.P.D.); and Department of Neurosurgery, The Permanente Medical Group, Kaiser Permanente Medical Center, Redwood City, Redwood City, Calif (M.F.S.). Received November 10, 2020; revision







CSF-Venous fistula

Fibrin glue injected into neural foramen

Fibrin glue within CVF

Resolved fistula

CT Fibrin Glue Technique

1. Position patient prone and scan at CVF level

1. Place 20g spinal needle at *junction of meningeal diverticulum & vein*, using anatomic landmarks

1. Test dose with air or iodine contrast

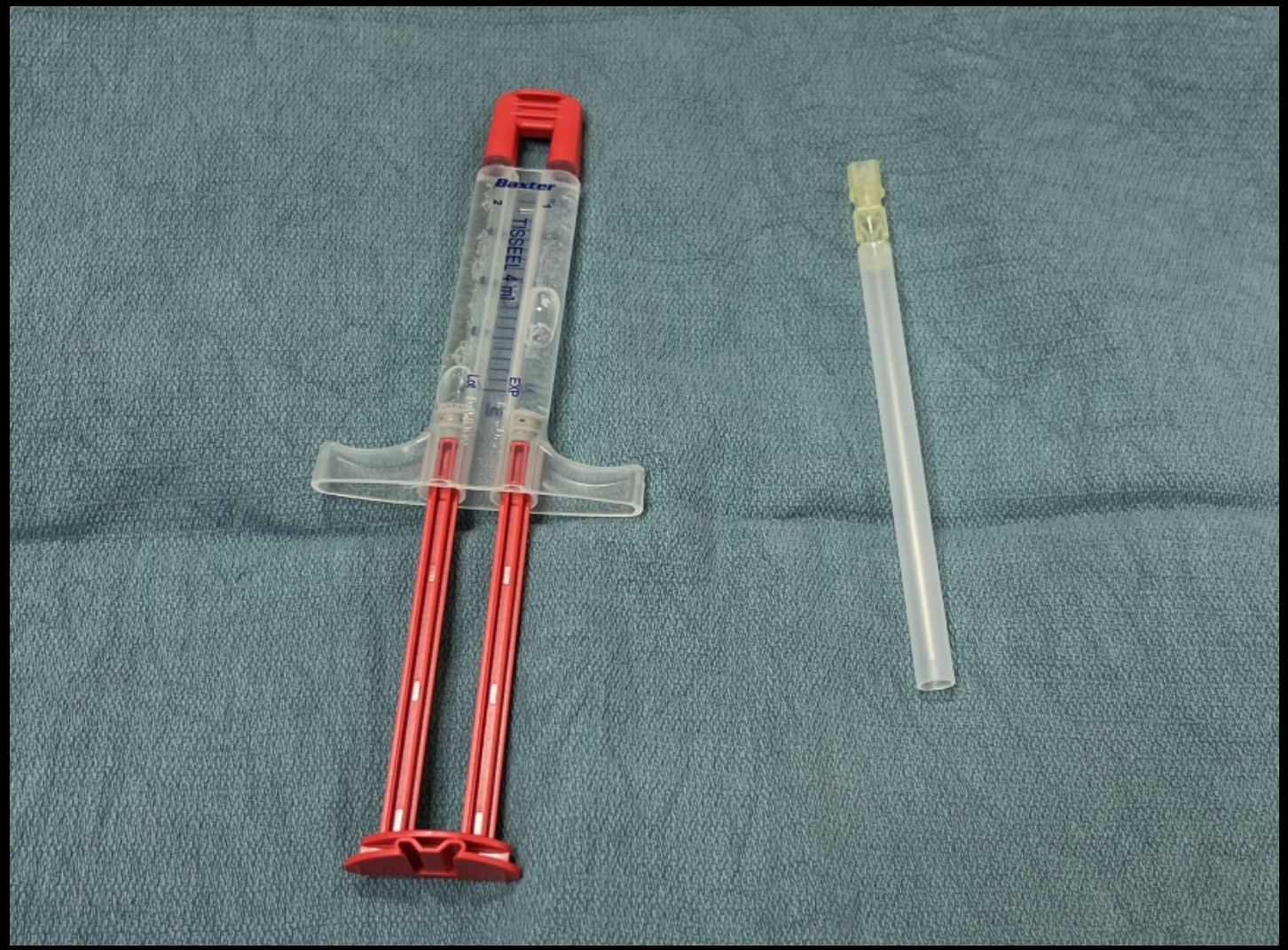
1. Add 0.2 cc Omnipaque 300 into both hubs of glue

1. Inject 2 cc of glue. Scan. Inject 1-2 cc more, if needed.*

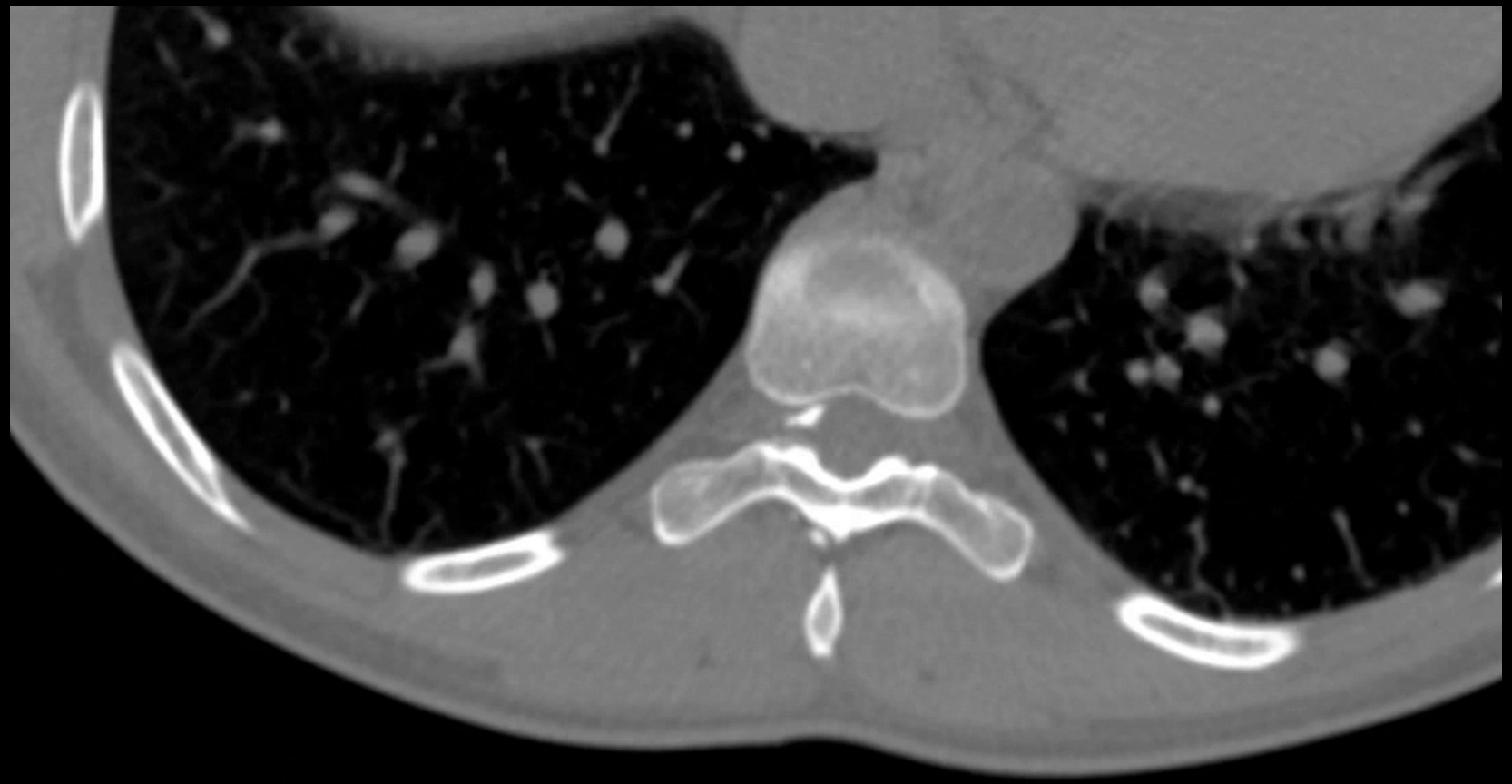
*If repeat fibrin glue, administer 50 mg Benadryl IV

Off-label use

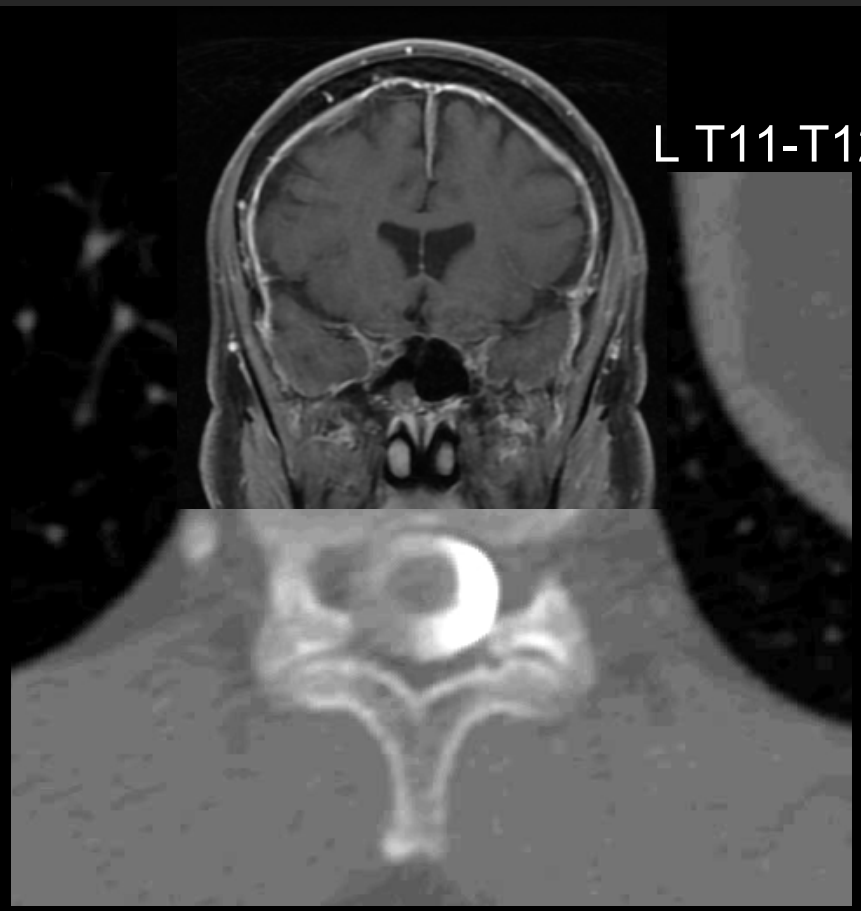
All the Supplies Needed



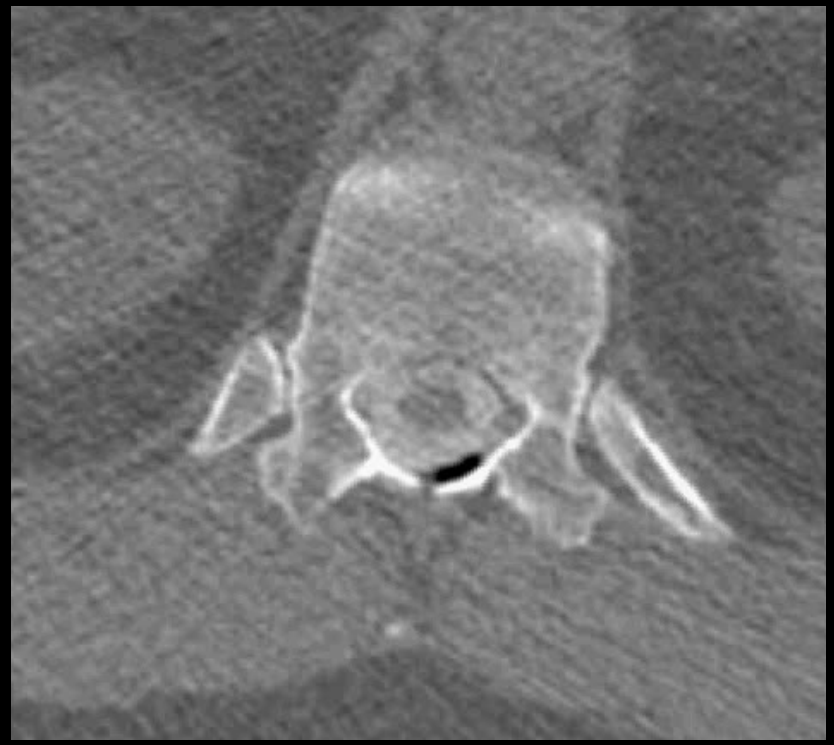
Fibrin Glue for CSF-Venous Fistula w/ Glue in Vein

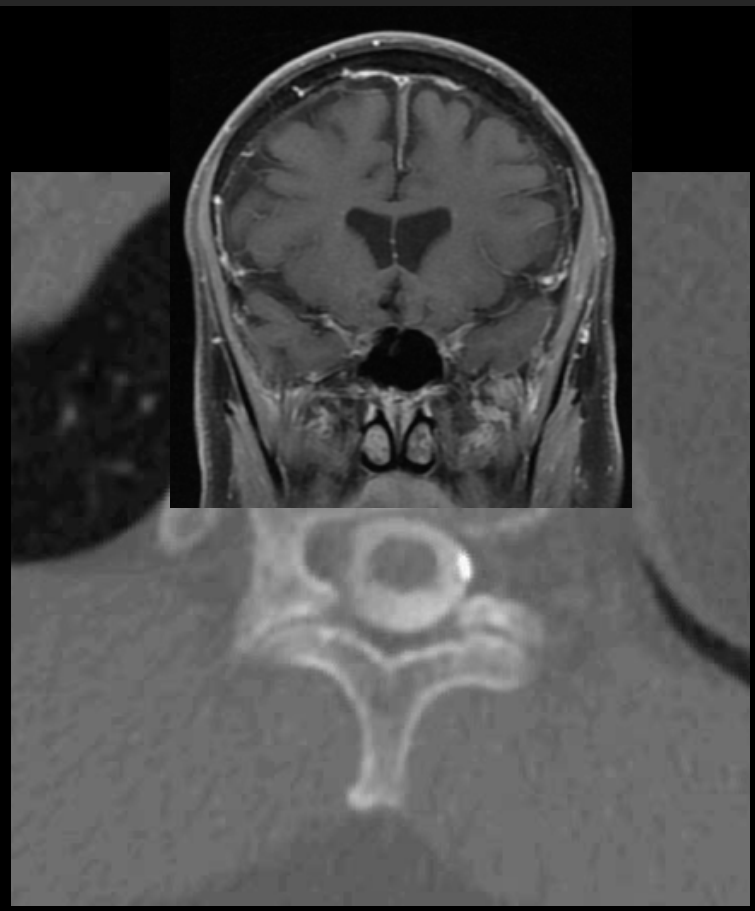


Fibrin Glue for CSF-Venous Fistula



L T11-T12 level





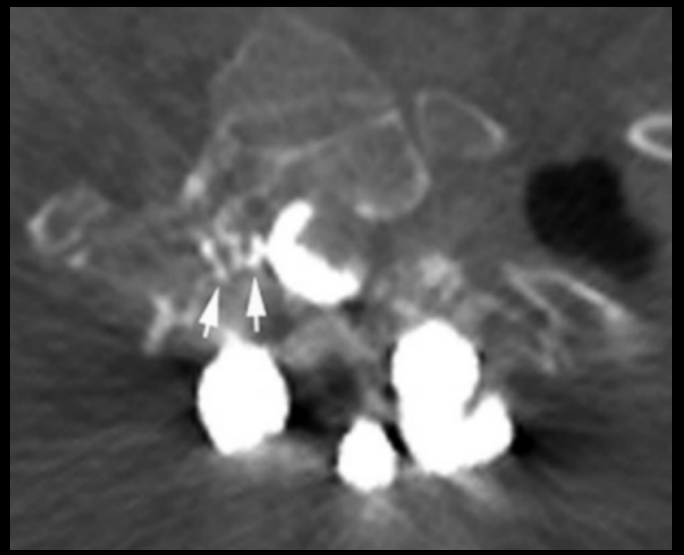
CSF-Venous fistula

Fibrin glue injected into neural foramen

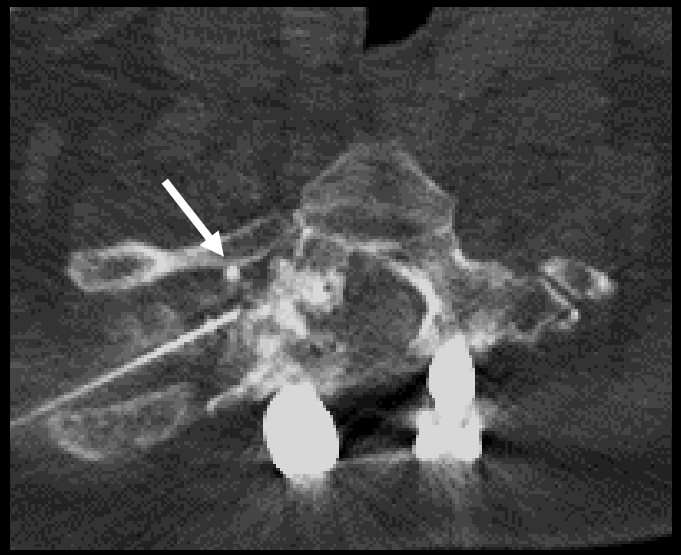
Resolved fistula

CVF Occlusion High Thoracic Level

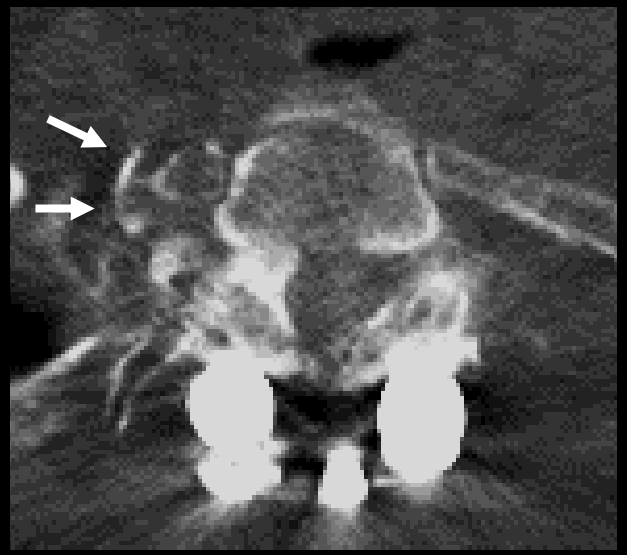
Right T1-T2 level



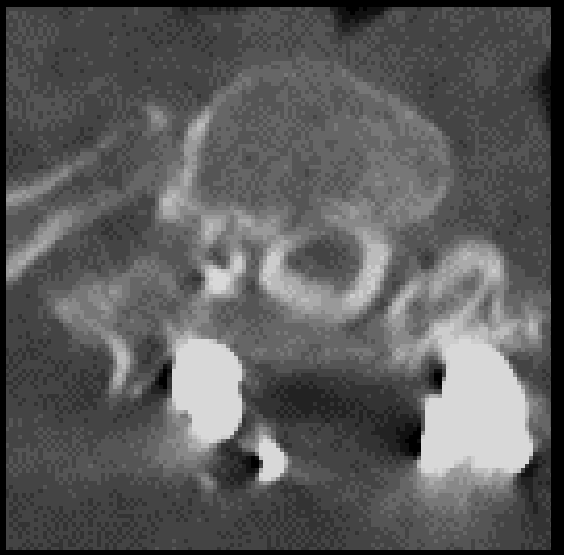
CSF-Venous fistula



Fibrin glue injected into neural foramen



Fibrin glue within CVF

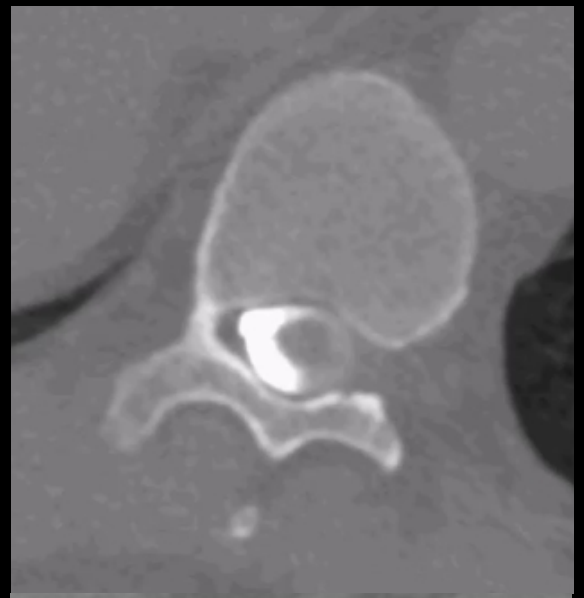


Resolved fistula

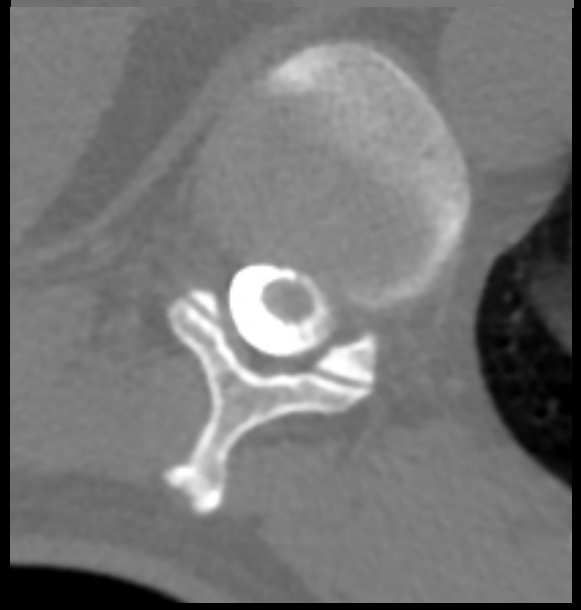
CVF Glue Occlusion in Emergent Setting for Coma & Central Herniation

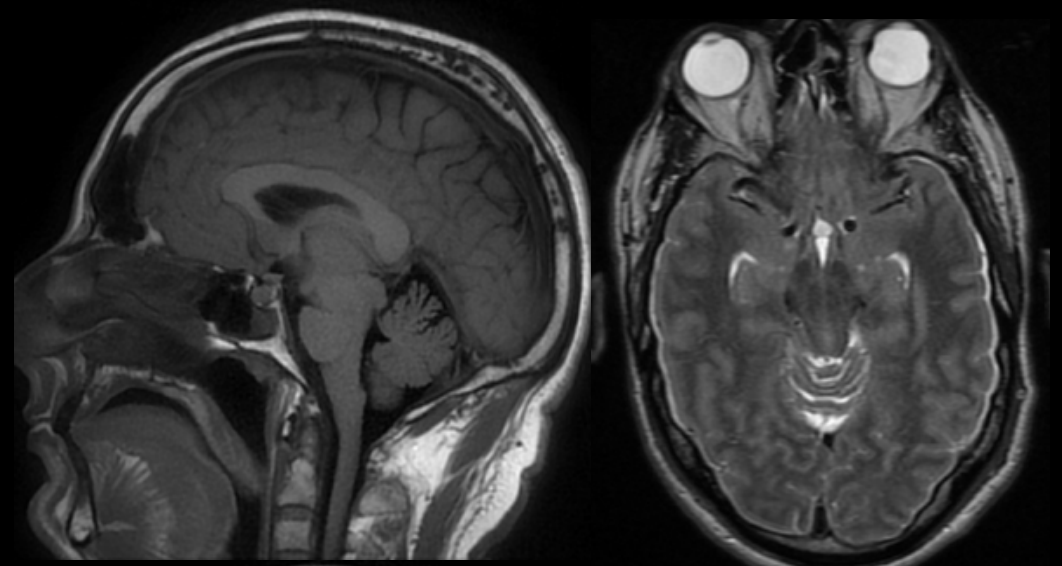
Before

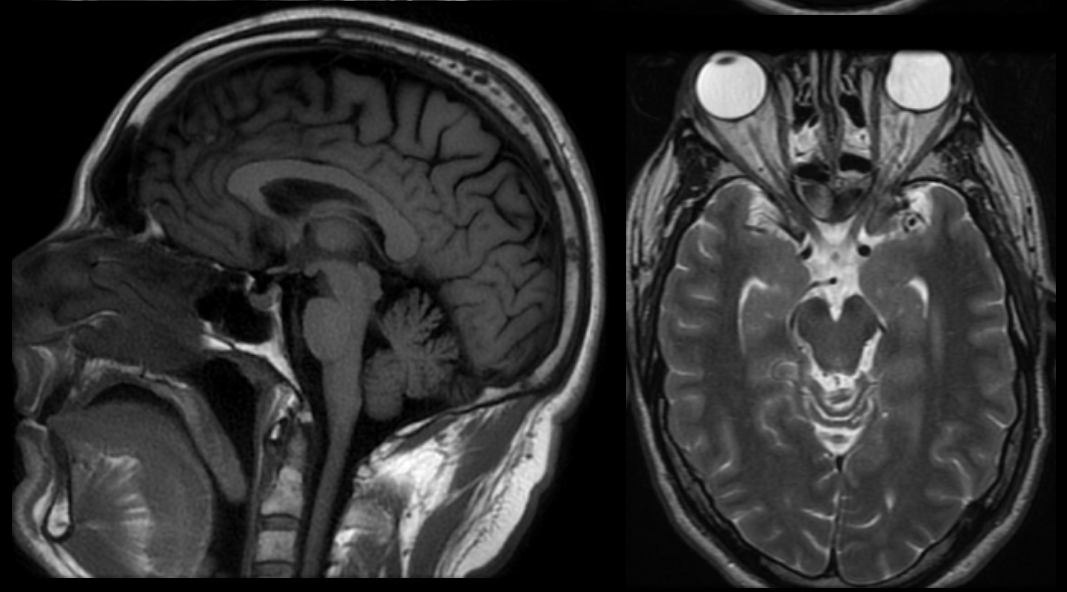
R T11-T12

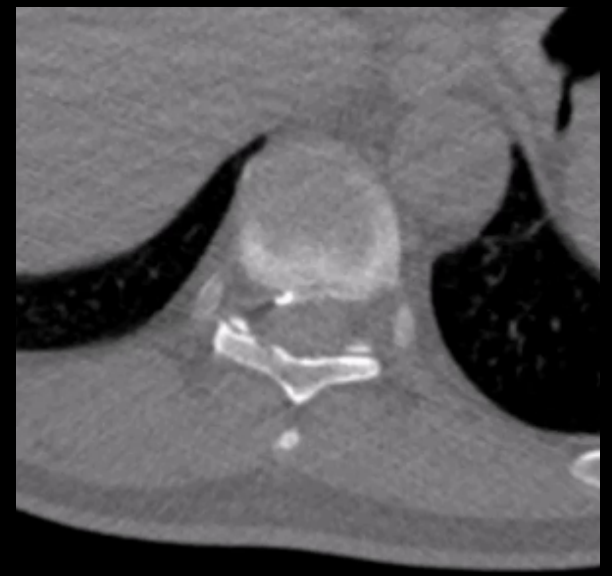


After







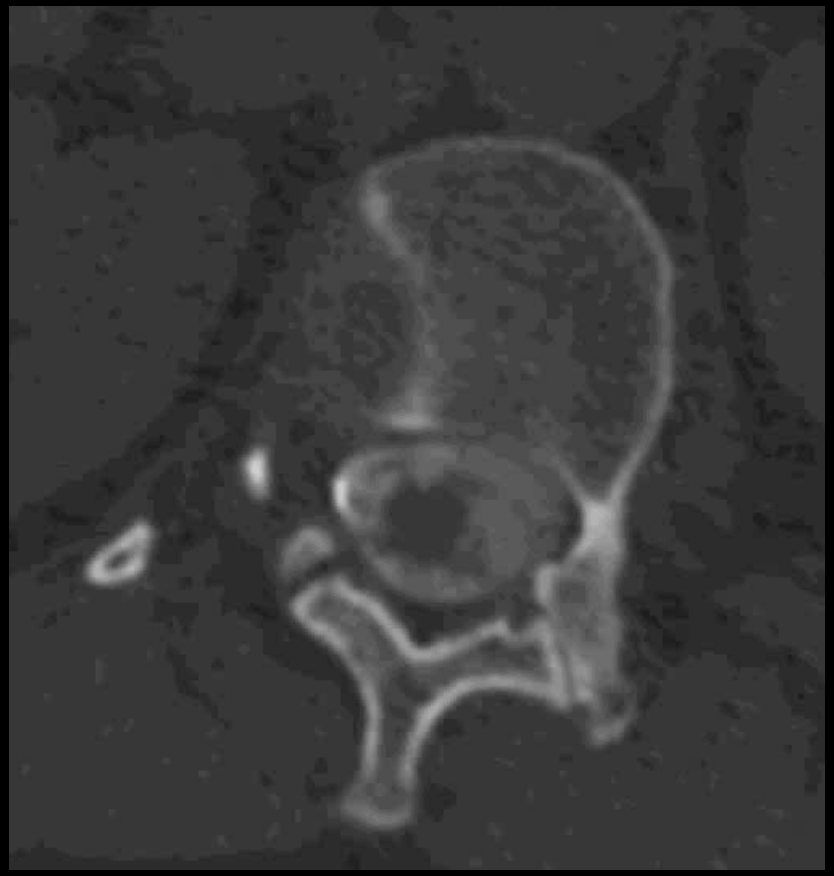


Spontaneous Intracranial Hypotension in the Critical Patient

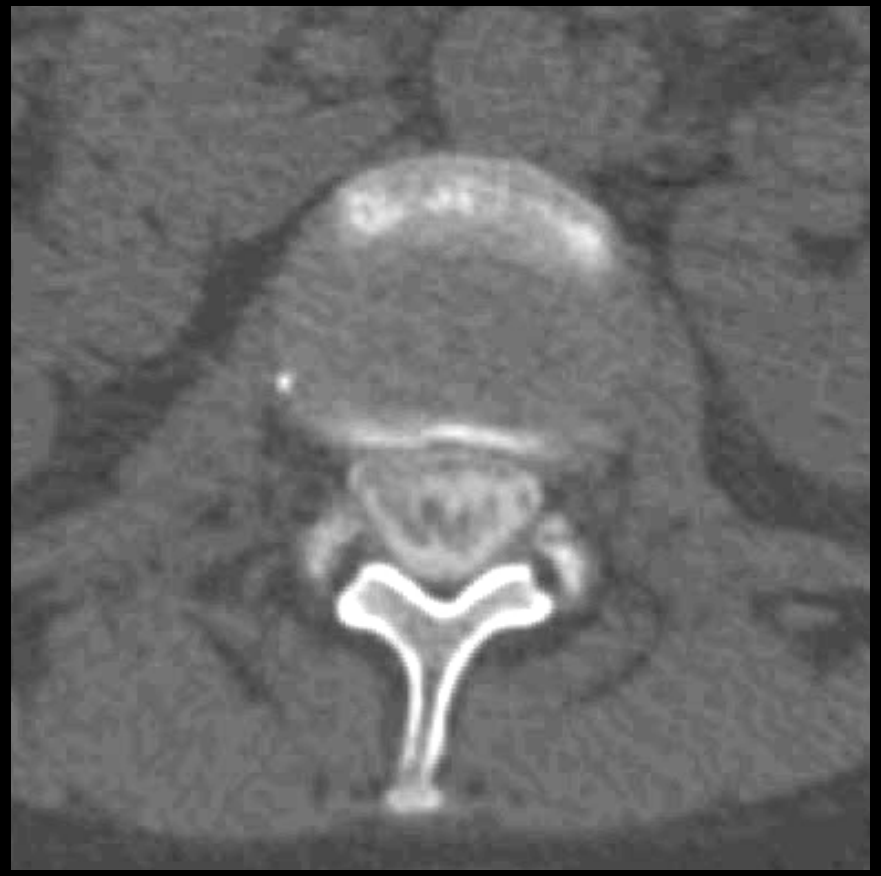
Mark D. Mamlouk, MD[1,2], Peter Y. Shen, MD[1], and Mark F. Sedrak, MD[3]

CVF Occlusion with Glue in Intraosseous Vein

R T12-L1



Decubitus Myelogram



Fibrin Glue Occlusion

10 Advantages of CT Fibrin Glue Treatment

1. 45 min outpatient procedure
2. 1 needle (>95% of time)
3. Moderate sedation
4. May be done anywhere in the spine, including high thoracic/cervical
5. Can target the various forms of CSF-venous fistulas
6. Can be performed in same setting as CTM
7. Can be repeated if initially not effective
8. Embolic material does not result in artifact on subsequent CT exams
9. Very inexpensive
10. Now that we know patients can develop additional fistulas, easier than having >1 spine surgery

Our Follow-up After Fibrin Glue Occlusion

- Decubitus CT myelography in 1-2 months (if possible)
- Contrast brain MRI in 1-2 months
- Clinical follow-up in 1-2 months

Our Fibrin Glue Occlusion Cases to Date (1.5 years)

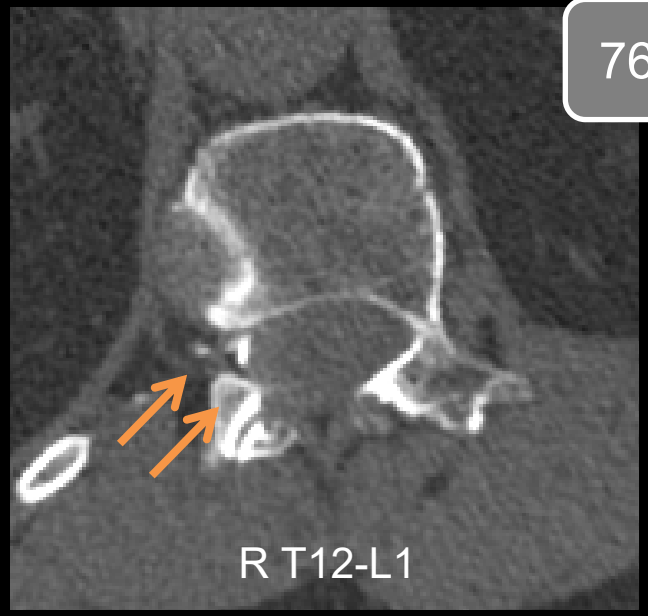
- 28 patients (closed healthcare network)
  - Number of Sessions: 1 (18 pts); 2 (8); 3 (1)
  - 19/19 patients: final post-treatment myelograms showed resolution
  - Post-treatment MRI showed improvement in all patients with abnormal pretreatment MRIs
  - Clinical improvement/resolution (e.g. HA, coma, FTD) in all symptomatic patients except 1
  - Fibrin glue within vein of CVF is good predictor of treatment success
  - No major complications (nerve/cord injury, anaphylaxis, PE)
  - 0 patients needing surgery since advent of fibrin glue occlusion
  - 0 patients requiring re-treatment after fistula resolution

Why Our Results Differs From Others

1. CT vs Flouro-guided technique
2. Test injection with air or iodine contrast prior to glue
3. Mixing contrast with the glue for visualization
4. More obtuse needle position to permit filling of neural foramen
5. Needle targeting the fistula nidus at the diverticulum-vein junction

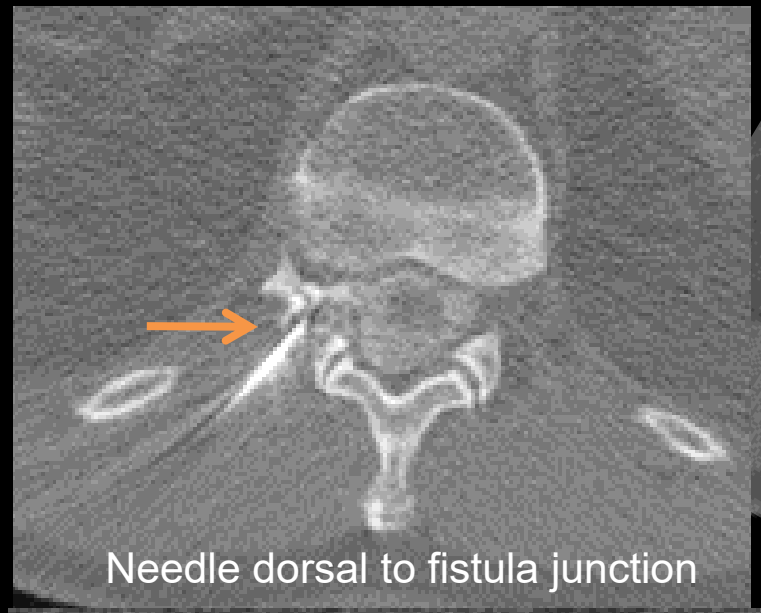
Fibrin Glue Needle Position Matters

76M, large SDHs

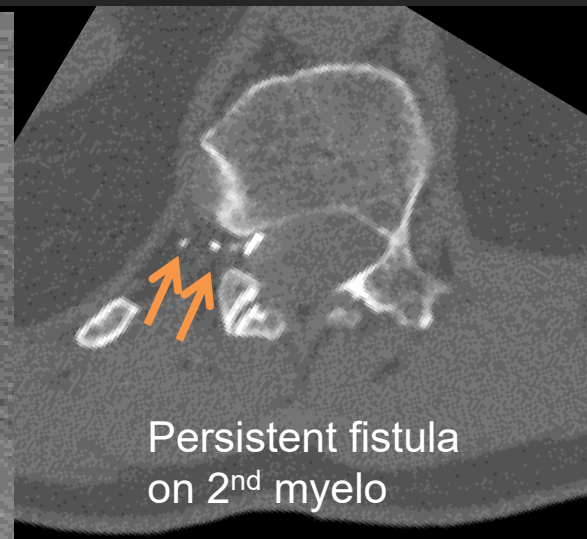


R T12-L1

Suboptimal needle position

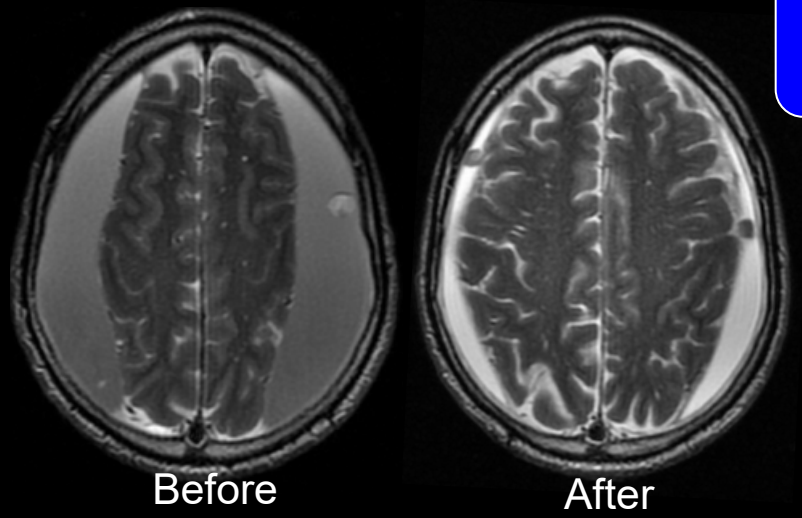


Needle dorsal to fistula junction



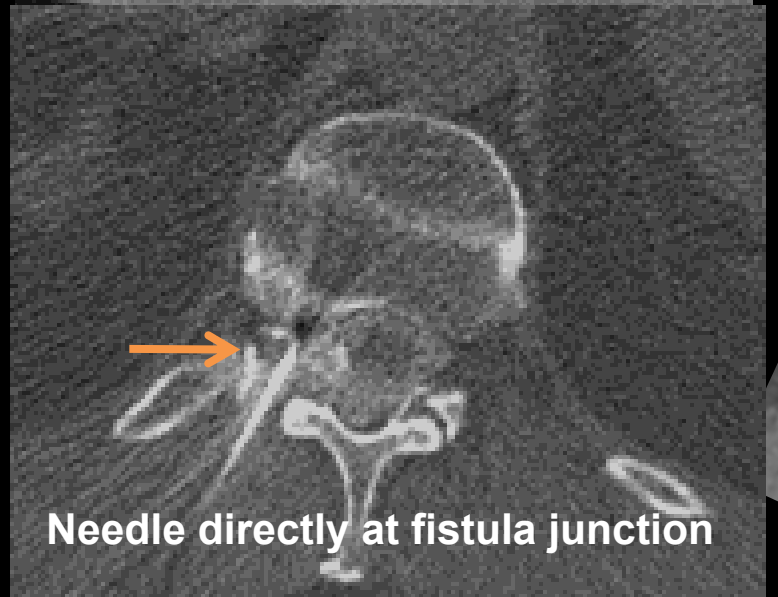
Persistent fistula on 2nd myelo

Optimal needle position

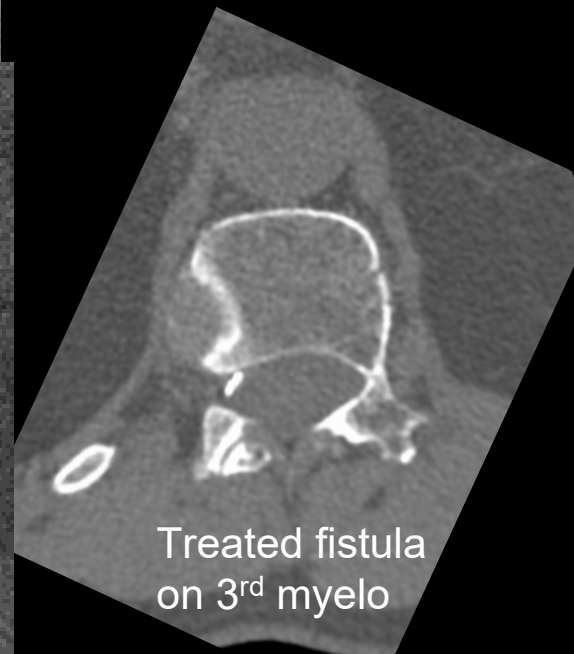


Before

After



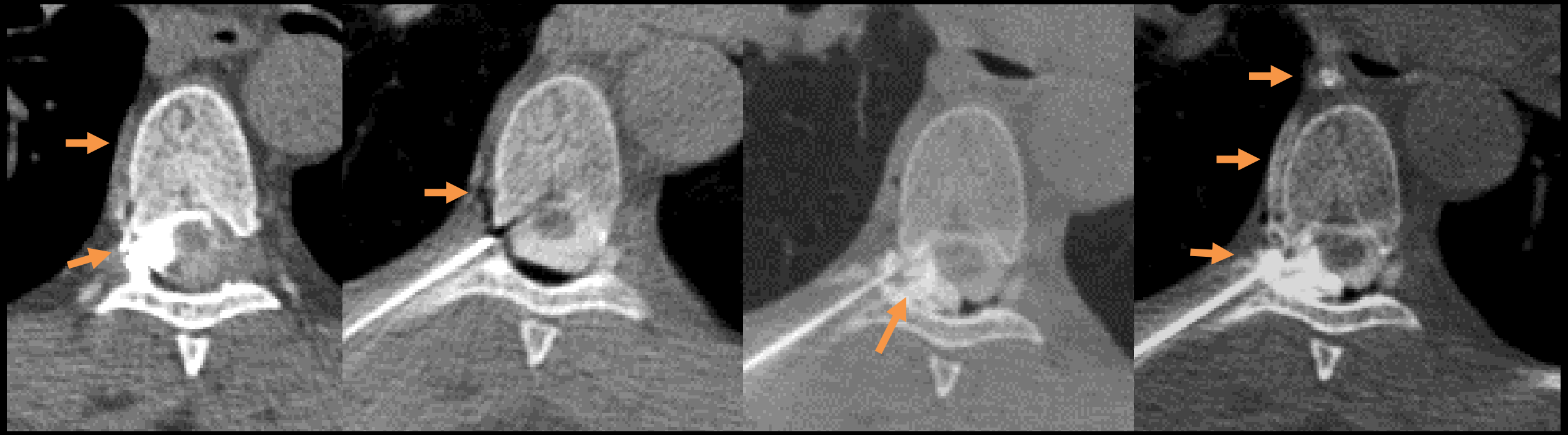
Needle directly at fistula junction



Treated fistula on 3rd myelo

Real-Time Fibrin Glue Needle Manipulation Helpful

R T6-T7 level



Needle rotated 90º & reinjected

CSF-Venous fistula

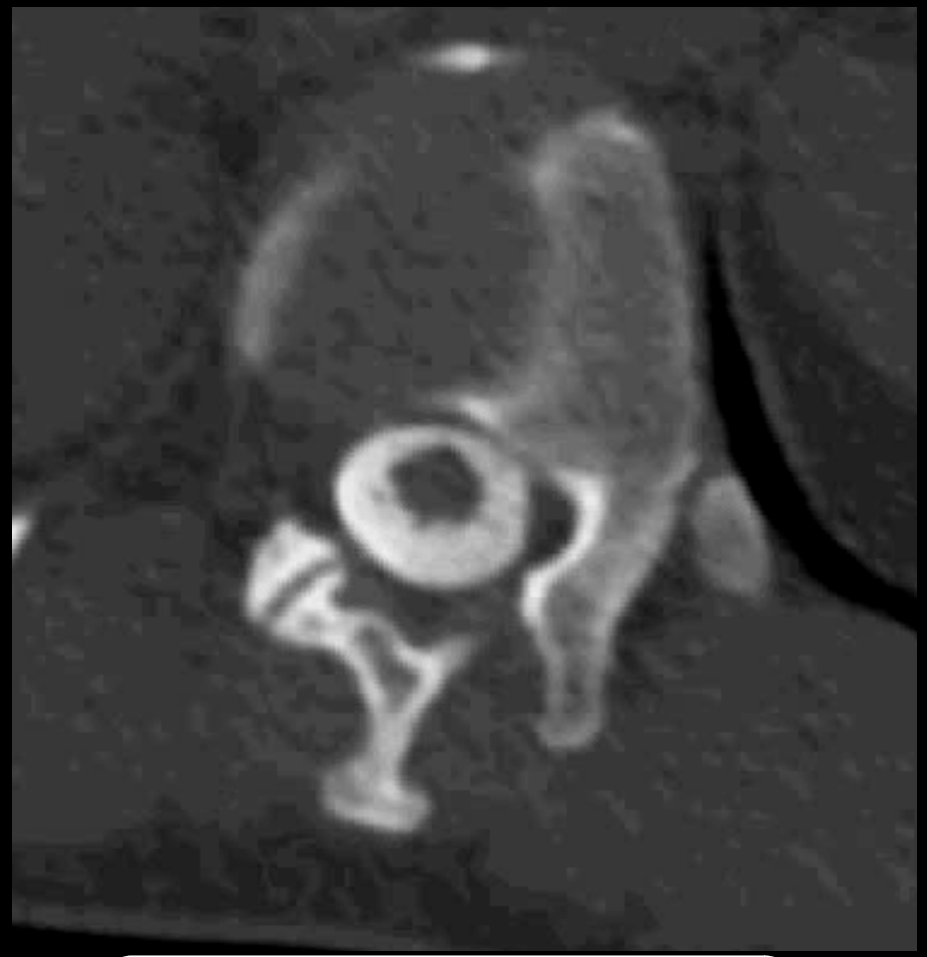
Air Epidurogram with air in vein

Fibrin Glue in neural foramen

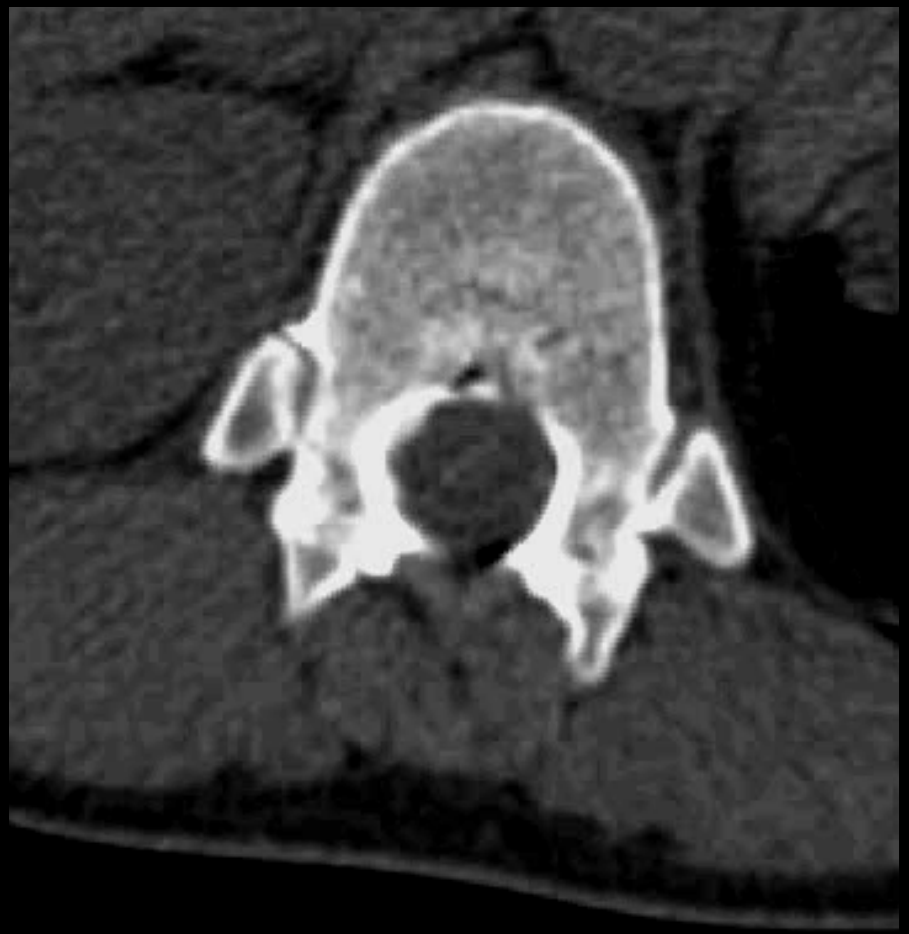
Fibrin Glue in vein of CVF

Glue Occlusion for Complex CVF (1/2)

Right T11-T12 level

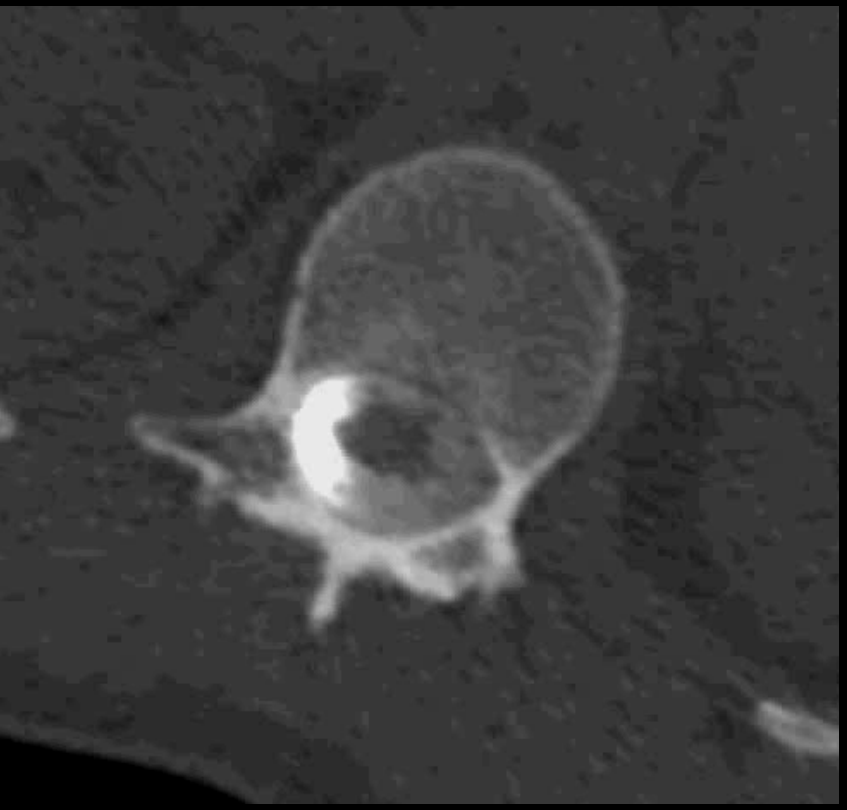


Decubitus Myelogram

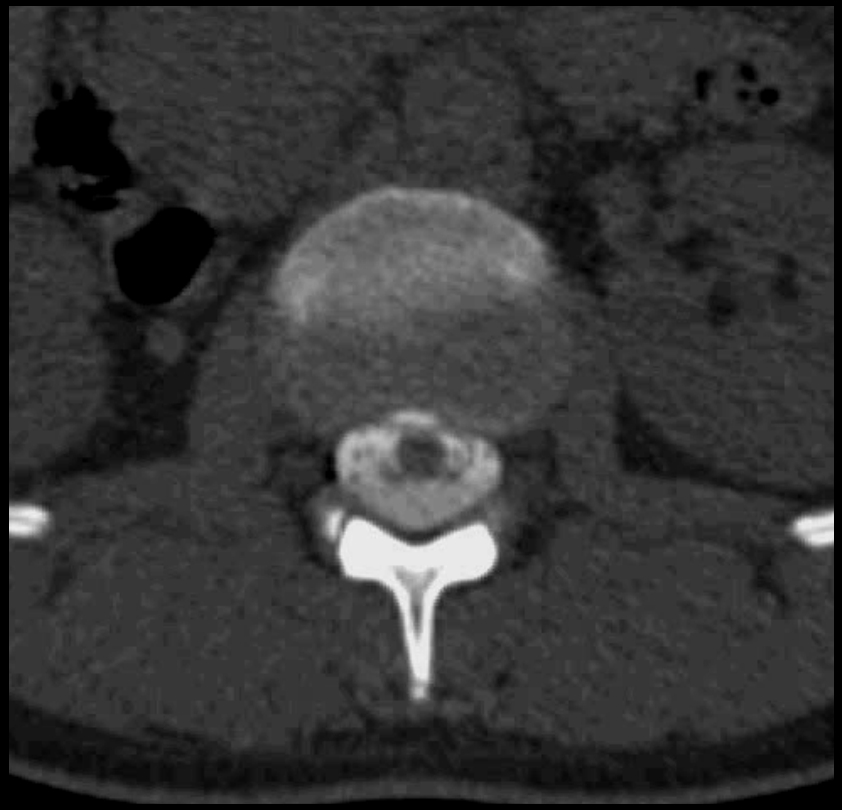


Fibrin Glue Occlusion

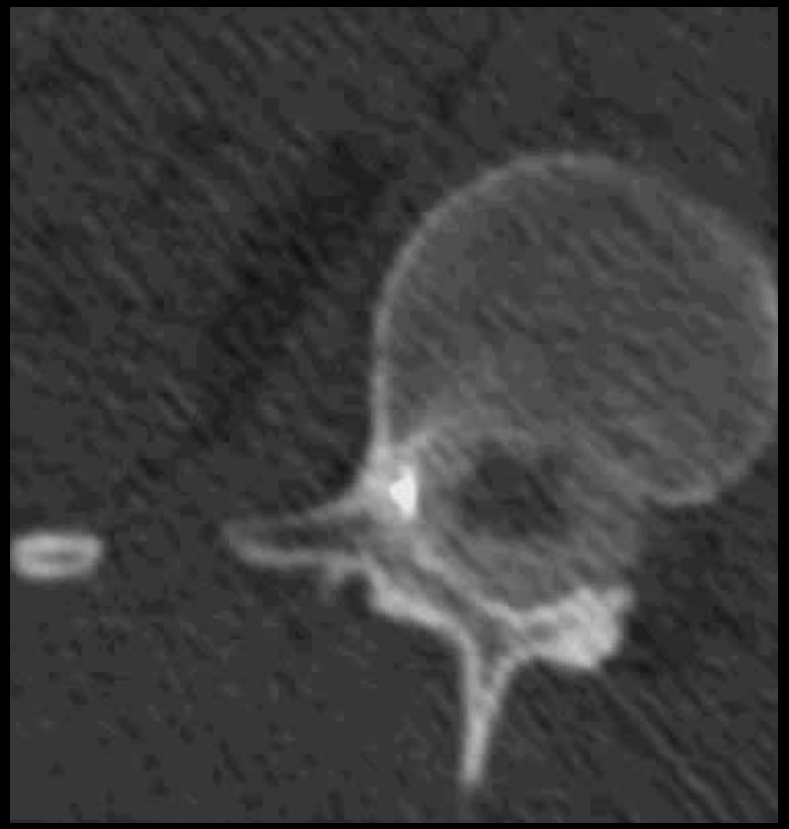
Glue Occlusion for Complex CVF (2/2)



2nd Decubitus Myelogram



2nd Fibrin Glue Occlusion (3 needles)

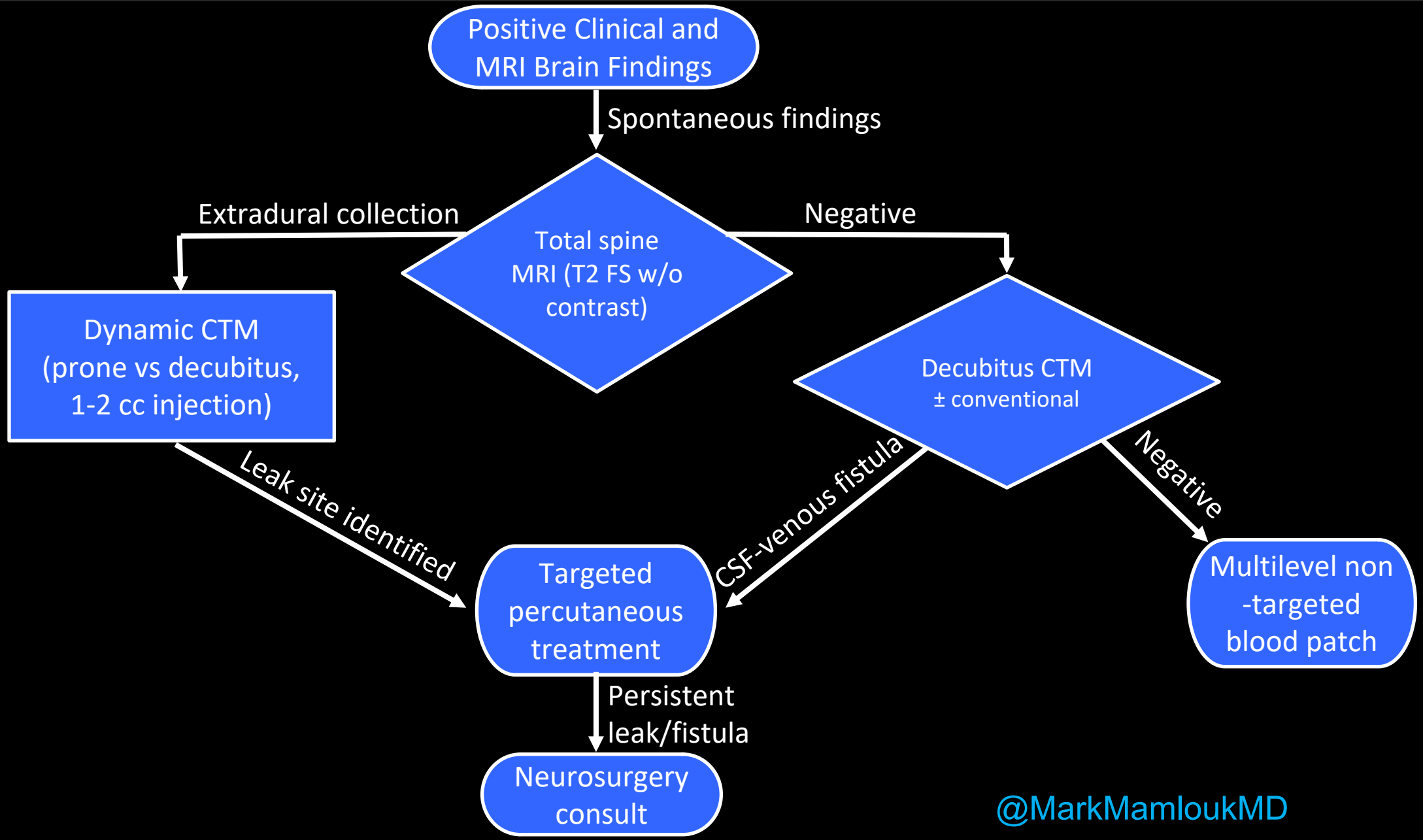


3rd Decubitus Myelogram

Future Directions

- Obtain longer clinical follow-up
- Establish multicenter prospective trials

Northern CA Kaiser SIH Clinical Workflow (2021)

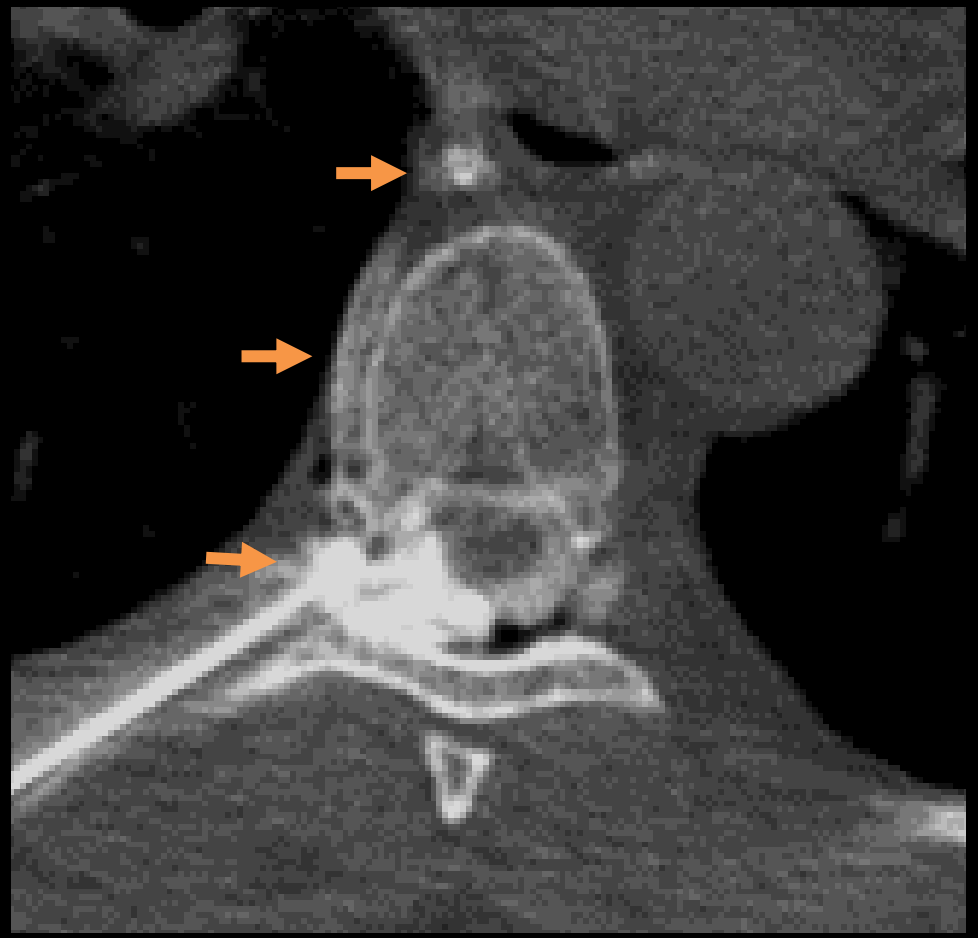


@MarkMamloukMD

Conclusions

Fibrin glue occlusion is an effective, easy, and inexpensive treatment option for CSF-venous fistulas.

Targeting the needle position directly at the fistula junction is the main key to success.



Fibrin Glue occlusion of CVF

Thank You

mark.d.mamlouk@kp.org

mark.mamlouk@ucsf.edu

@MarkMamloukMD