

The background features a dark blue field with a pattern of small, light blue dots. Overlaid on this are several circular and semi-circular elements in a light grey color. On the left side, there is a large circular scale with tick marks and numerical labels ranging from 140 to 260 in increments of 10. Other elements include concentric circles, dashed lines, and curved arrows, some pointing clockwise and some counter-clockwise, creating a sense of motion and technical precision.

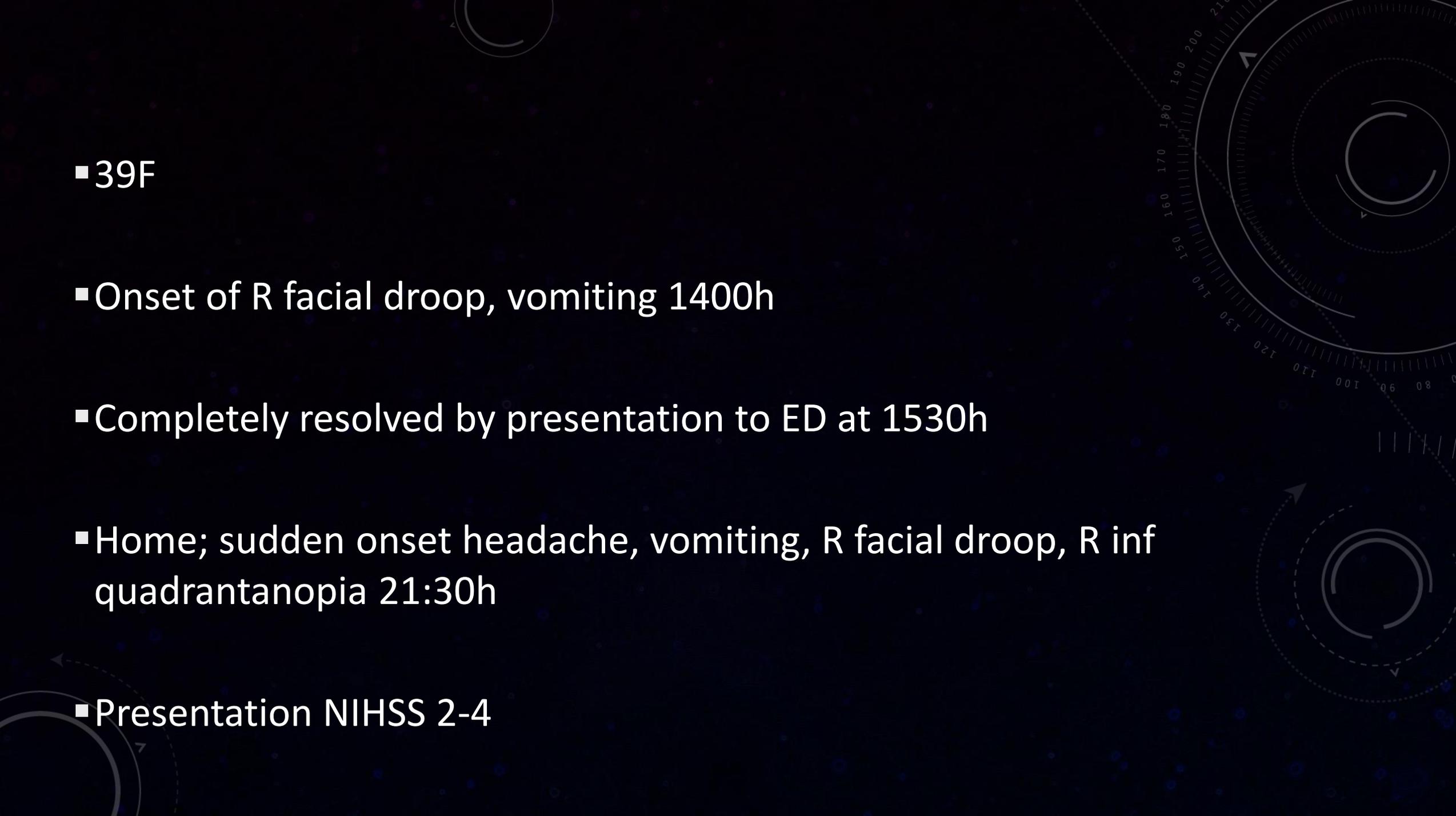
# AN UNUSUAL STROKE

JASON WENDEROTH

PRINCE OF WALES AND LIVERPOOL HOSPITALS

SYDNEY, AUSTRALIA

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■ 39F

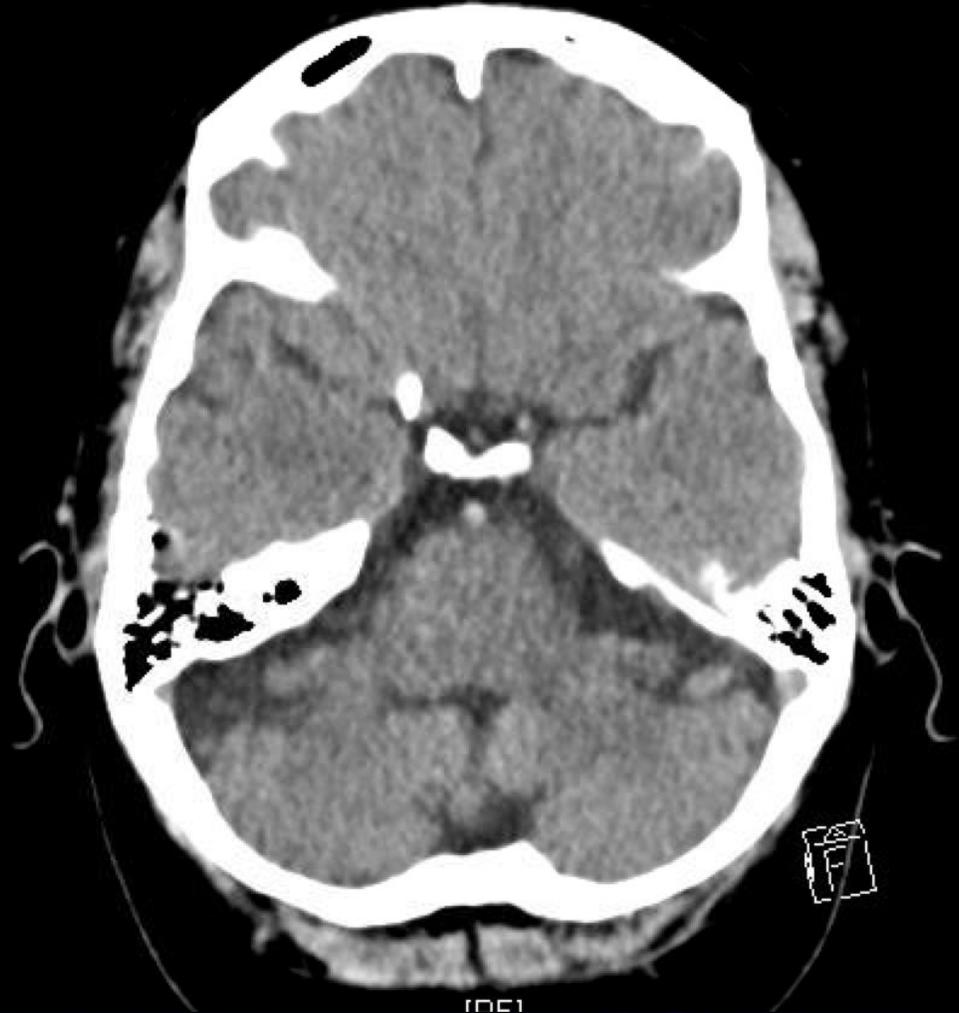
■ Onset of R facial droop, vomiting 1400h

■ Completely resolved by presentation to ED at 1530h

■ Home; sudden onset headache, vomiting, R facial droop, R inf  
quadrantanopia 21:30h

■ Presentation NIHSS 2-4

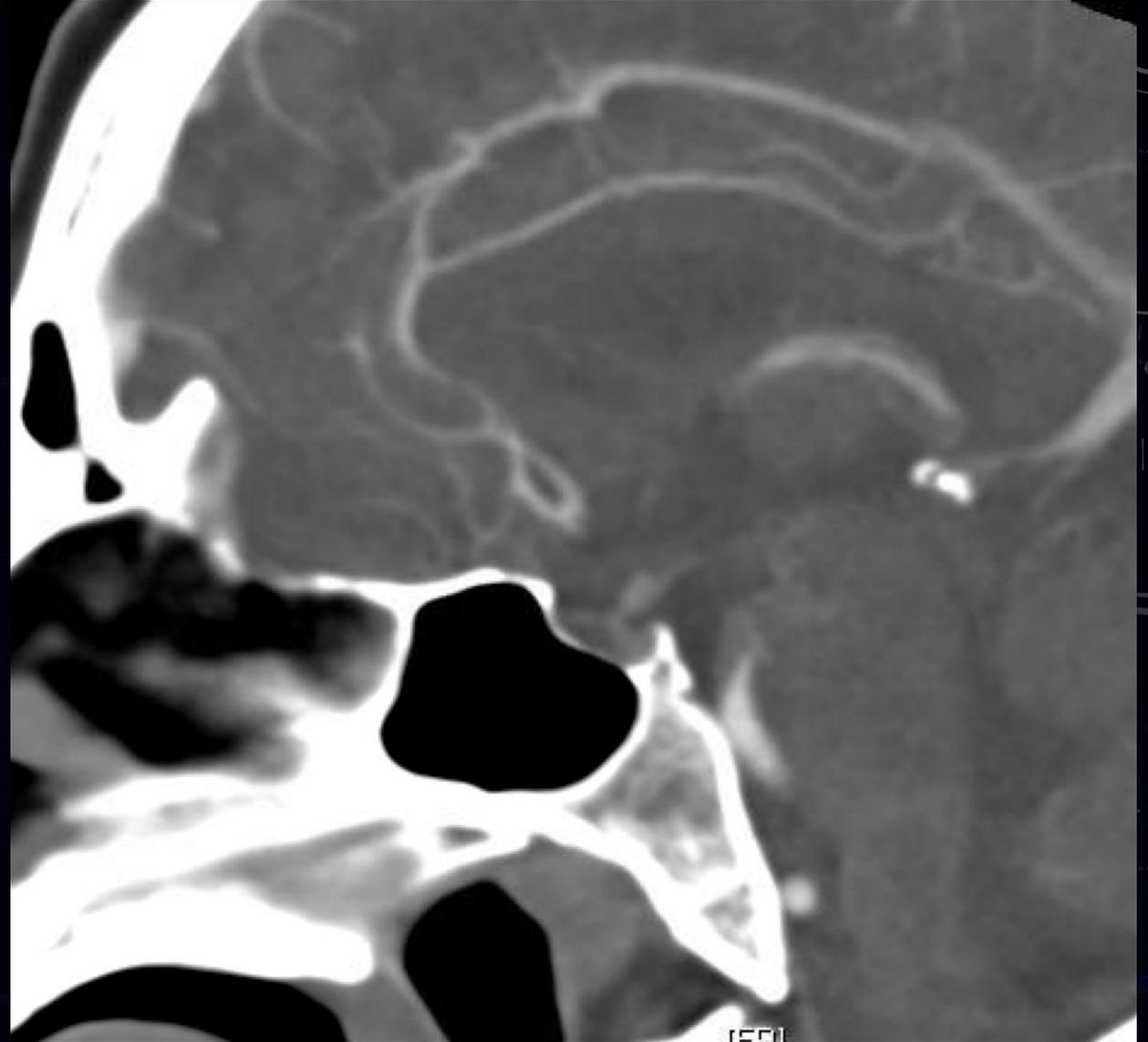
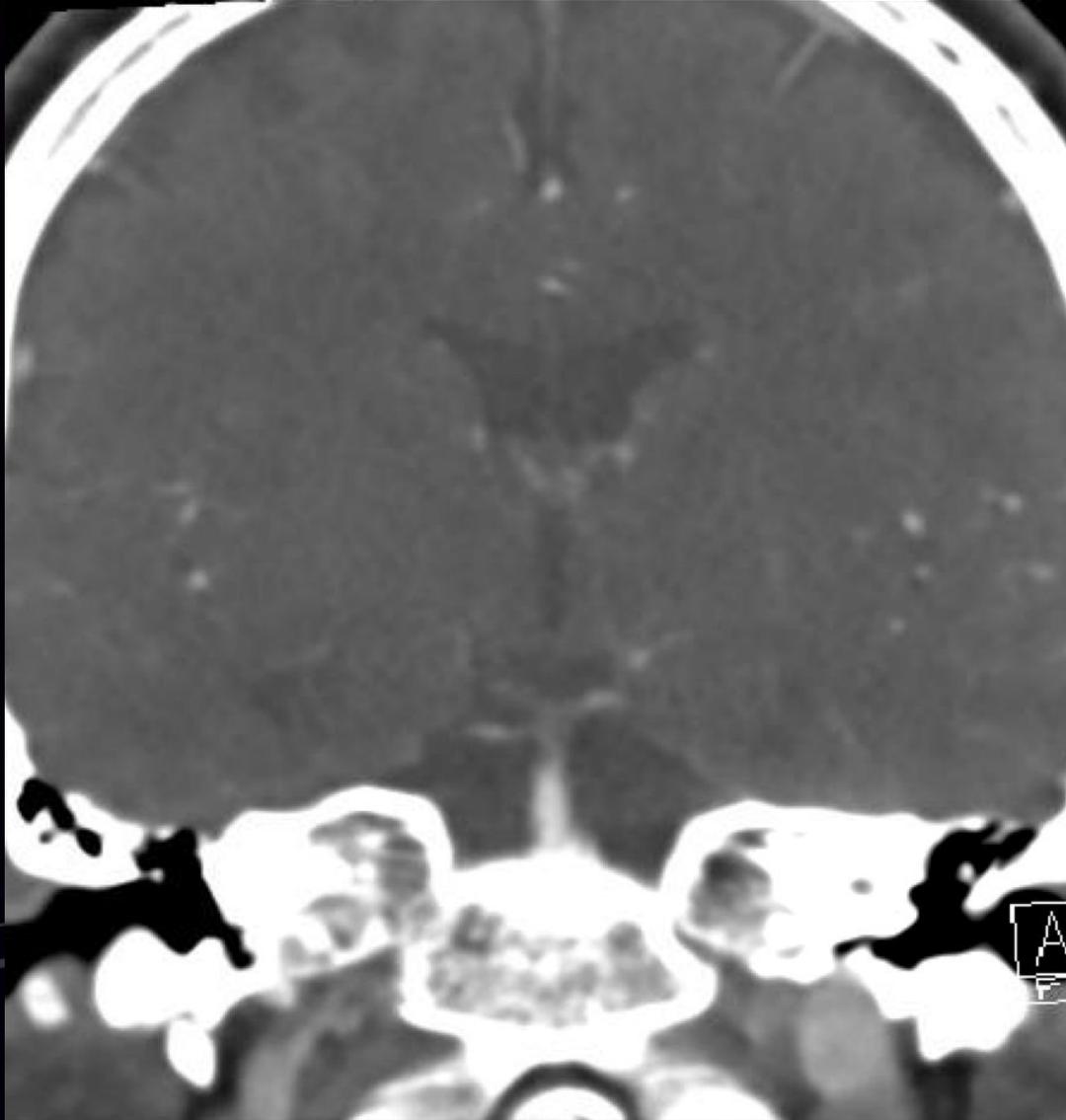
CT 22:30



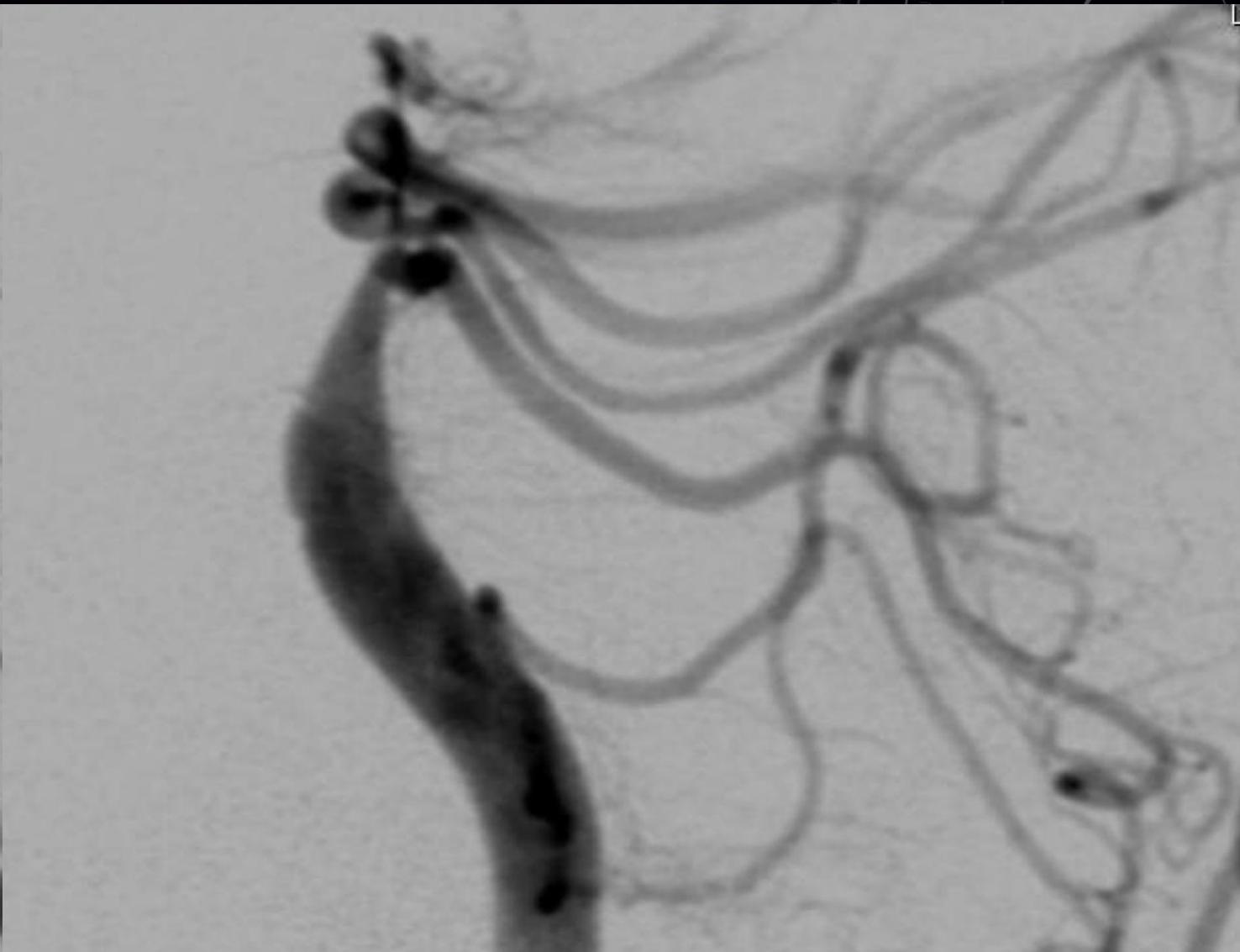
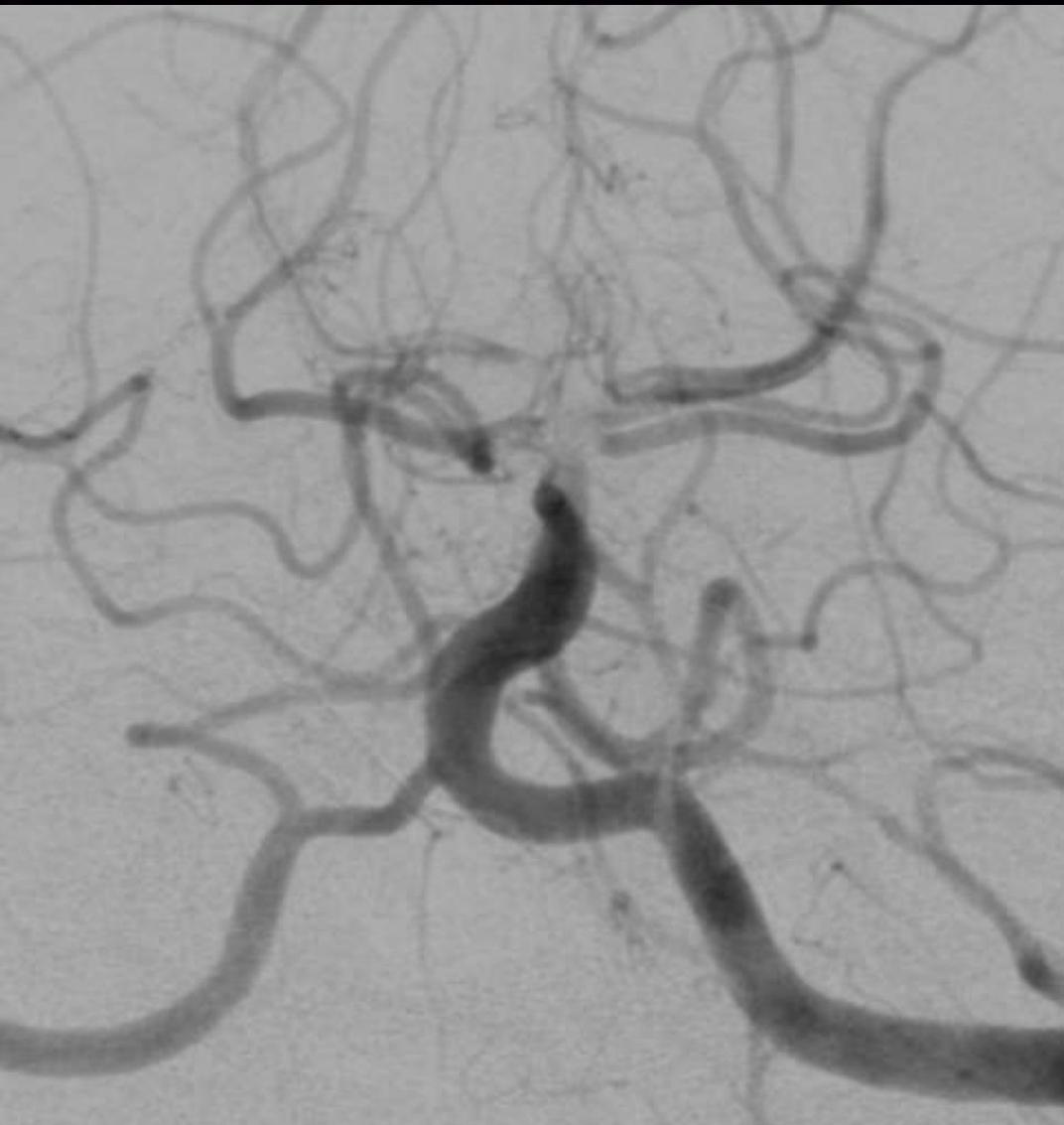
1051



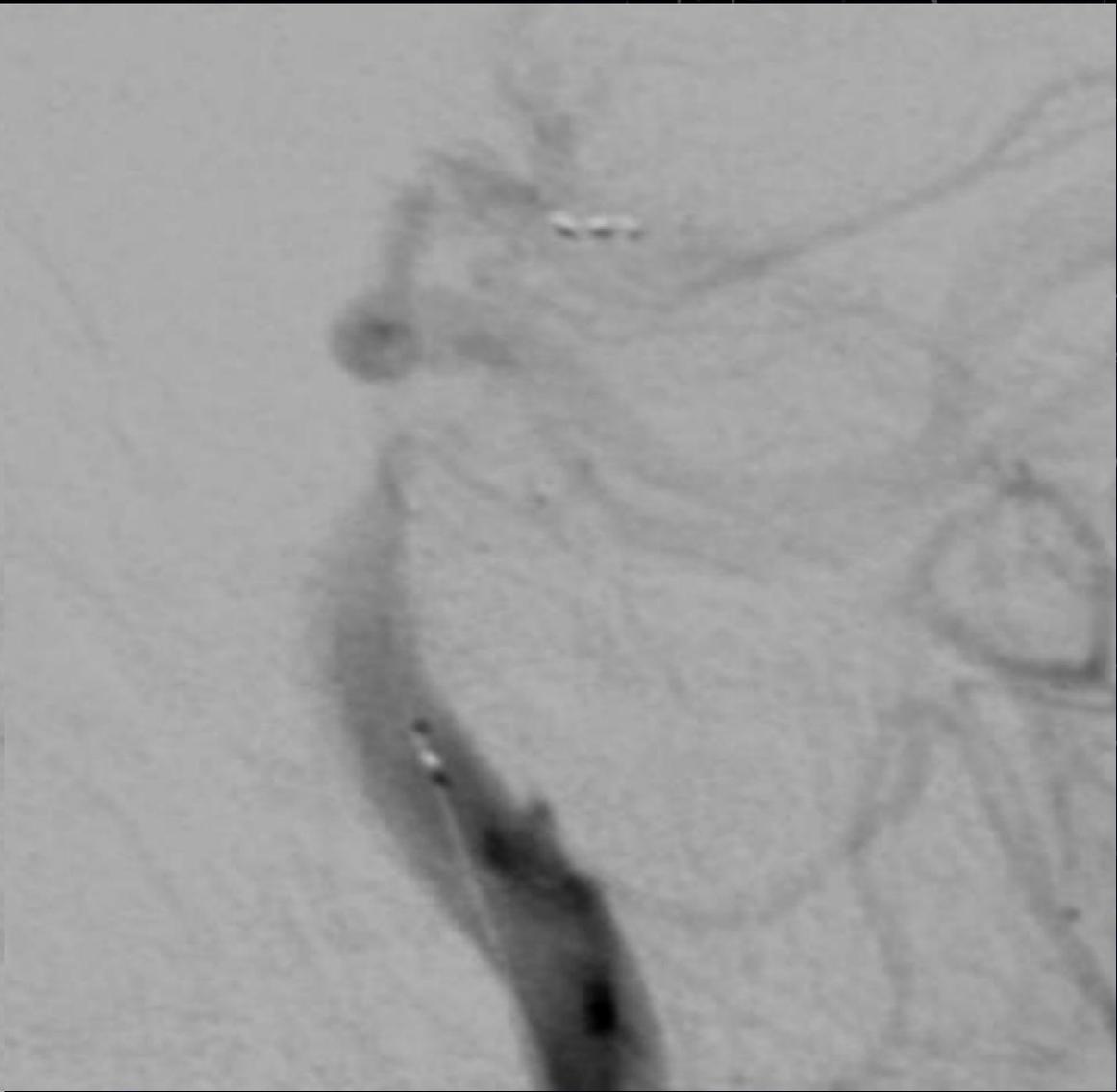
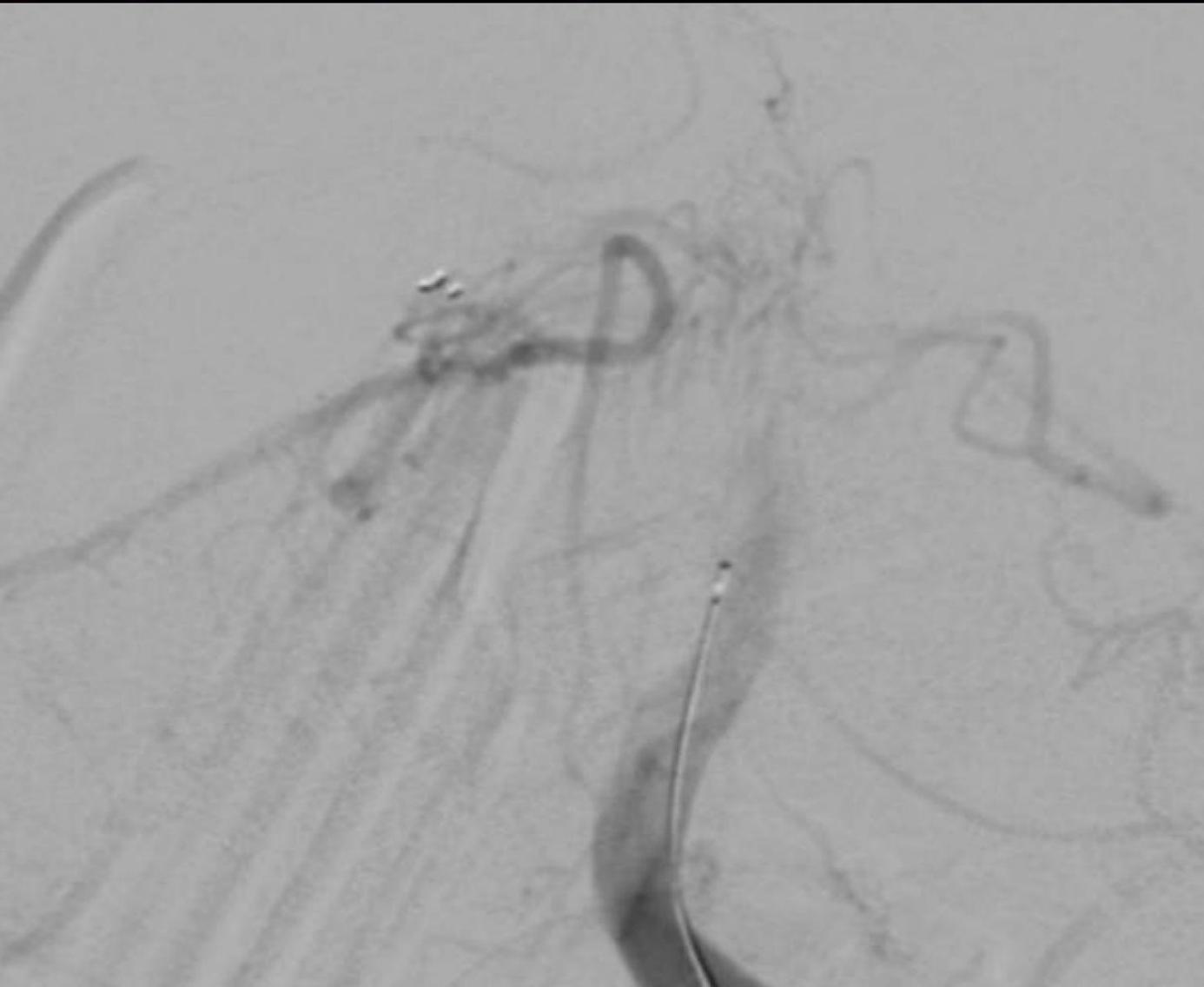
CTA 22:30



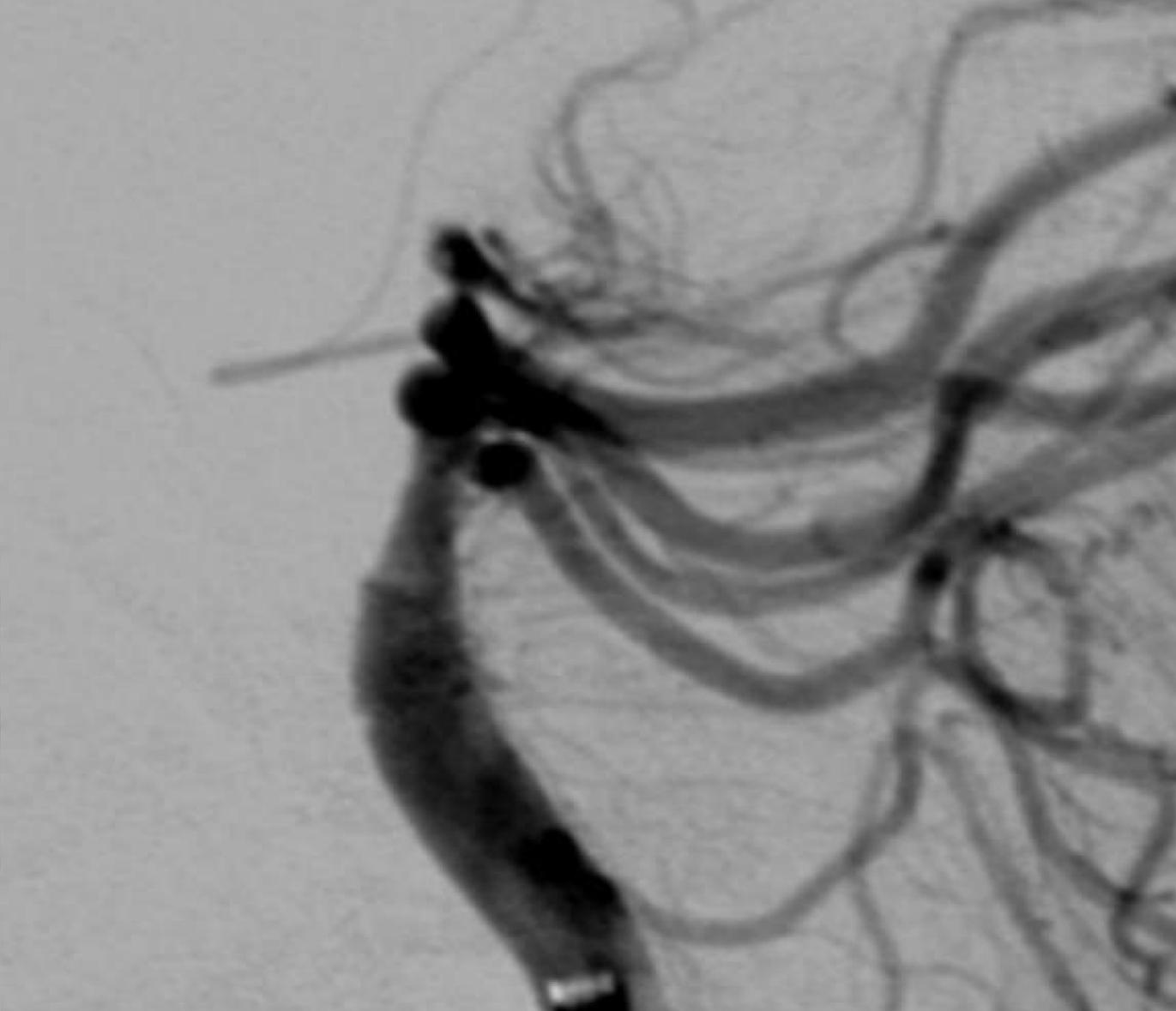
DSA 23:15



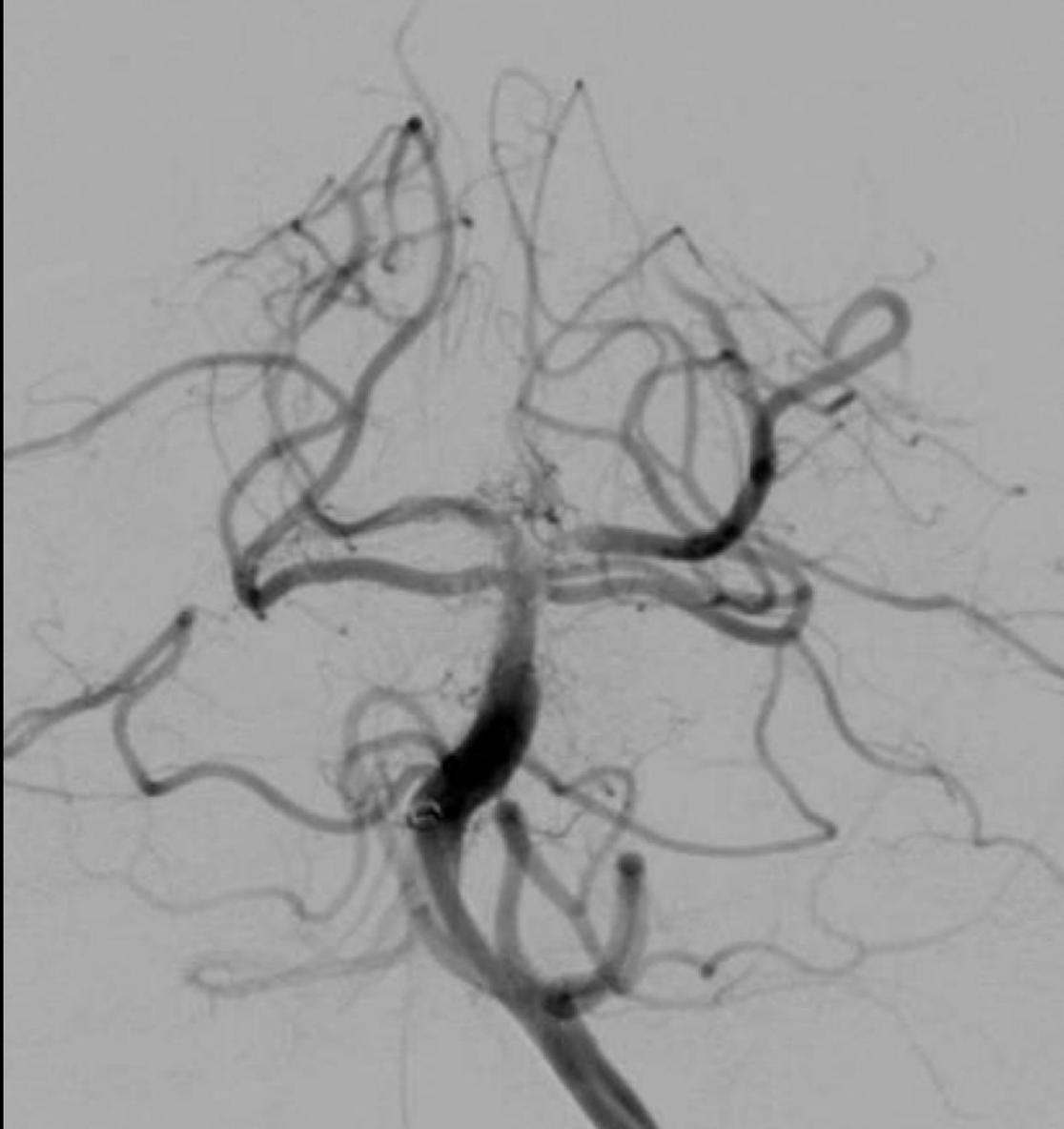
Solitaire 4 x 15mm



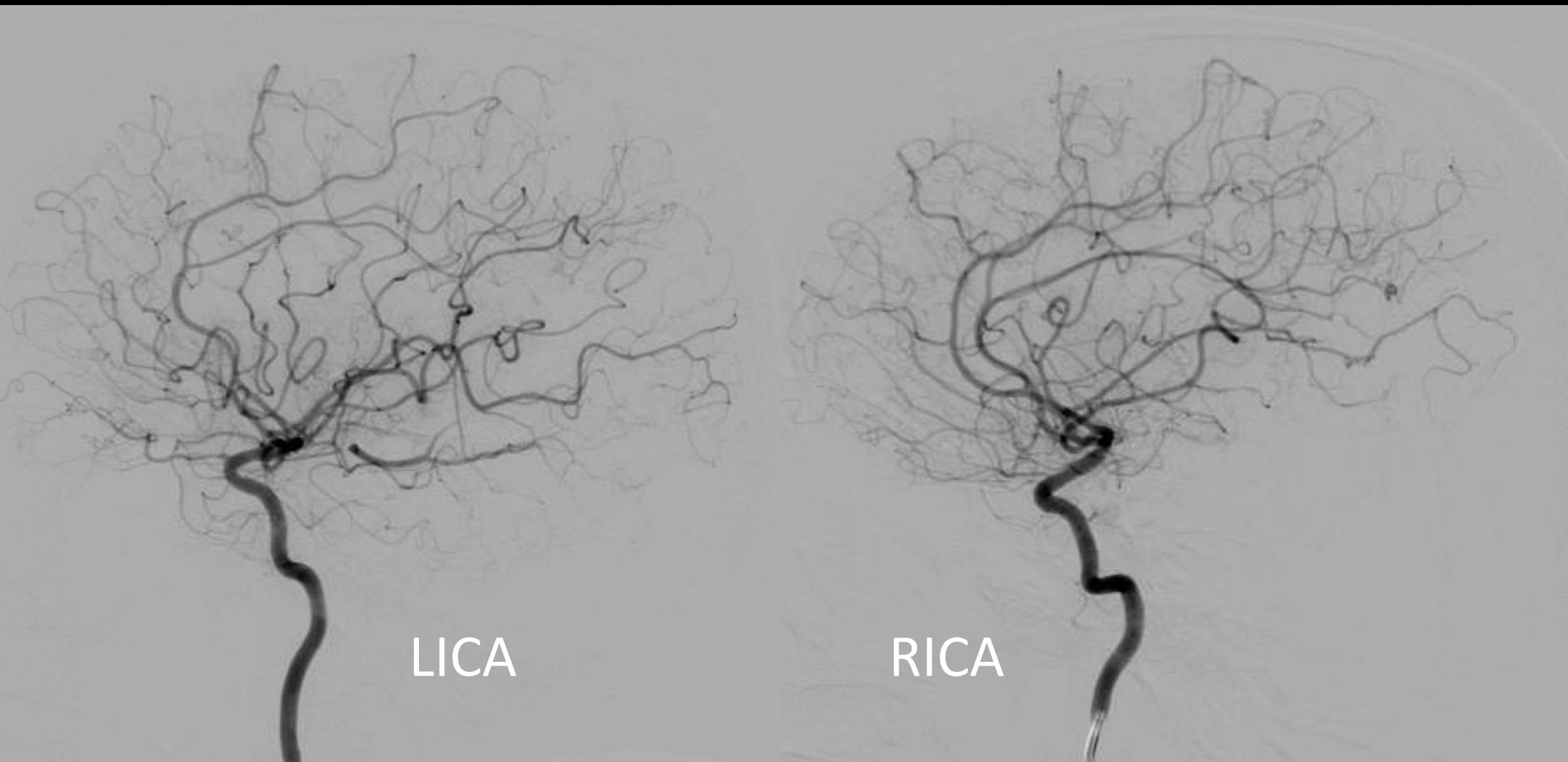
Post ECR



Post ECR – 15 and 30 min



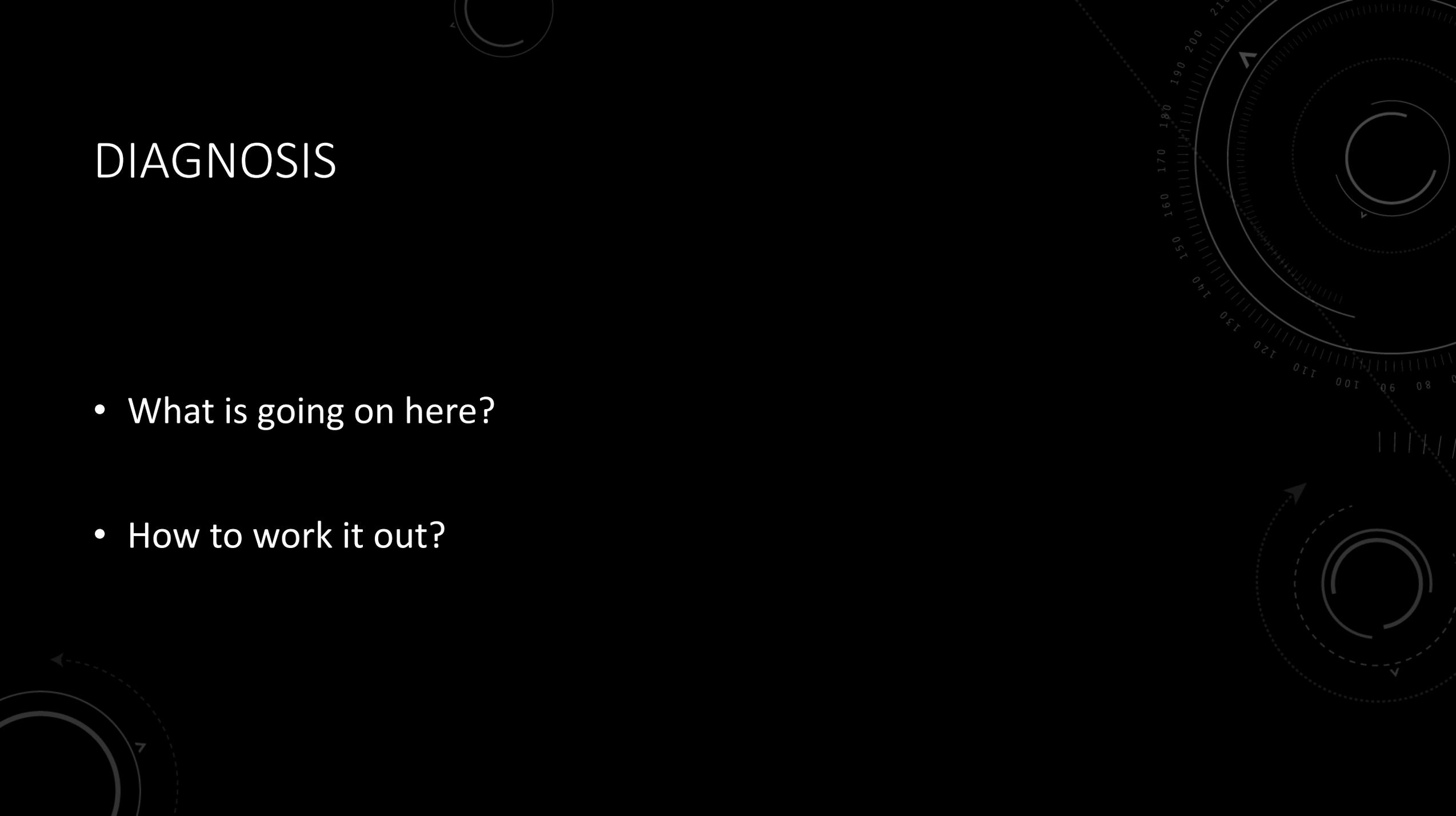
While waiting...



LICA

RICA

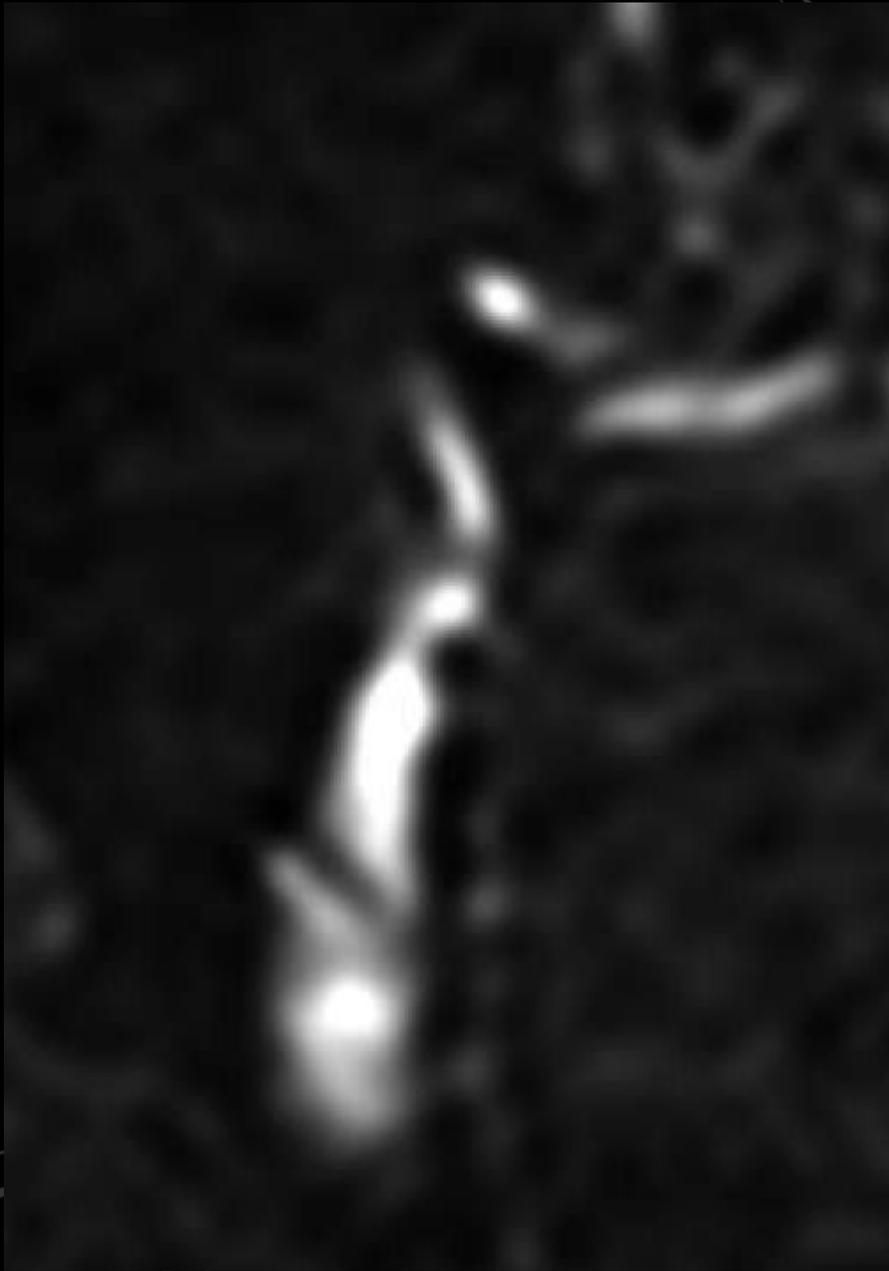
# DIAGNOSIS

The background features several faint, light-colored circular patterns. On the right side, there is a large circular scale with numerical markings from 80 to 210. The scale has concentric circles and tick marks. There are also some dashed lines and arrows scattered throughout the background, suggesting a technical or scientific theme.

- What is going on here?
- How to work it out?

# DECISION TIME

- Stop?
  - No drugs
  - Heparin
  - SAP
  - DAP
  - Heparin + DAP
  - Other

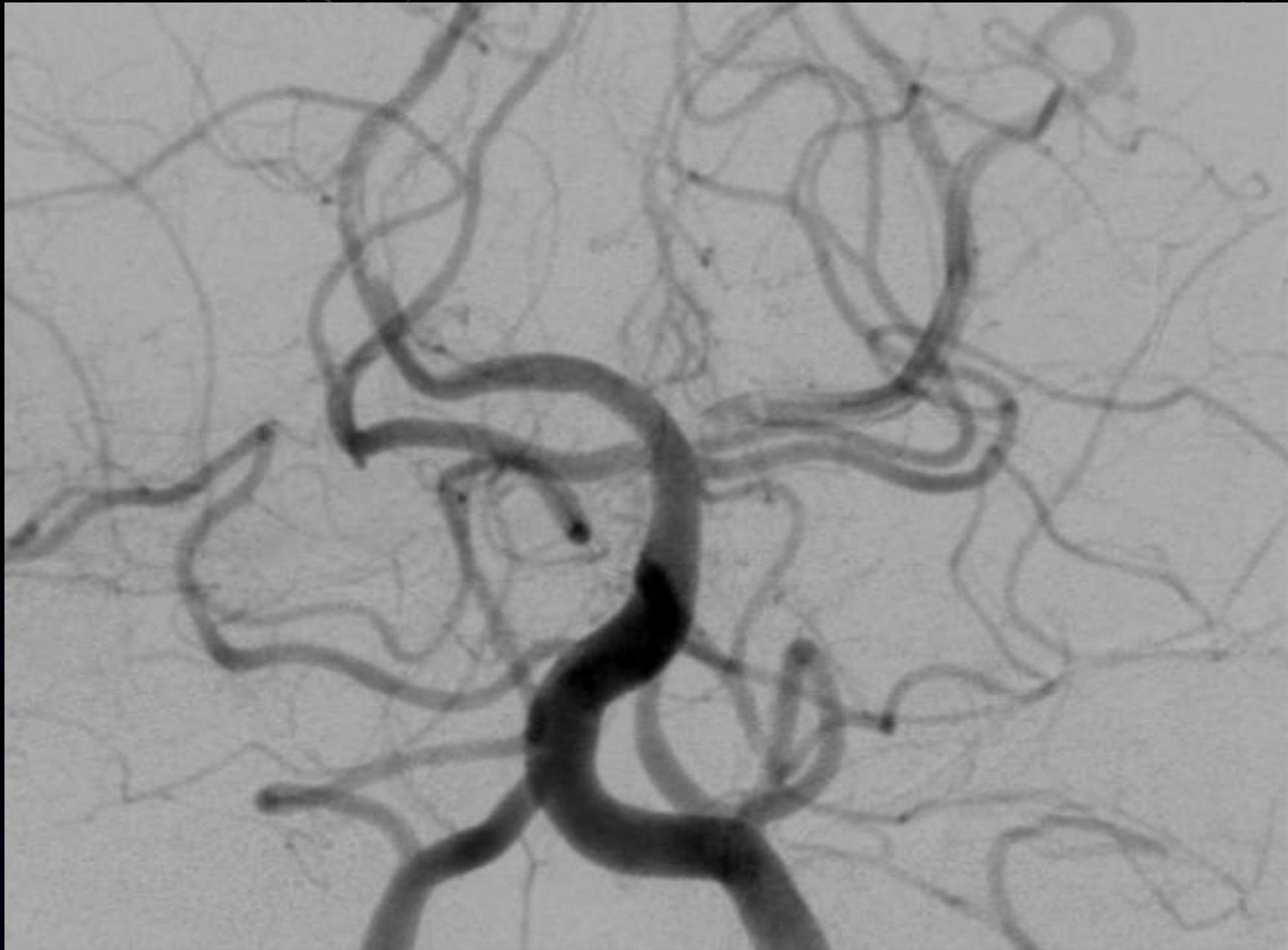


# DECISION TIME

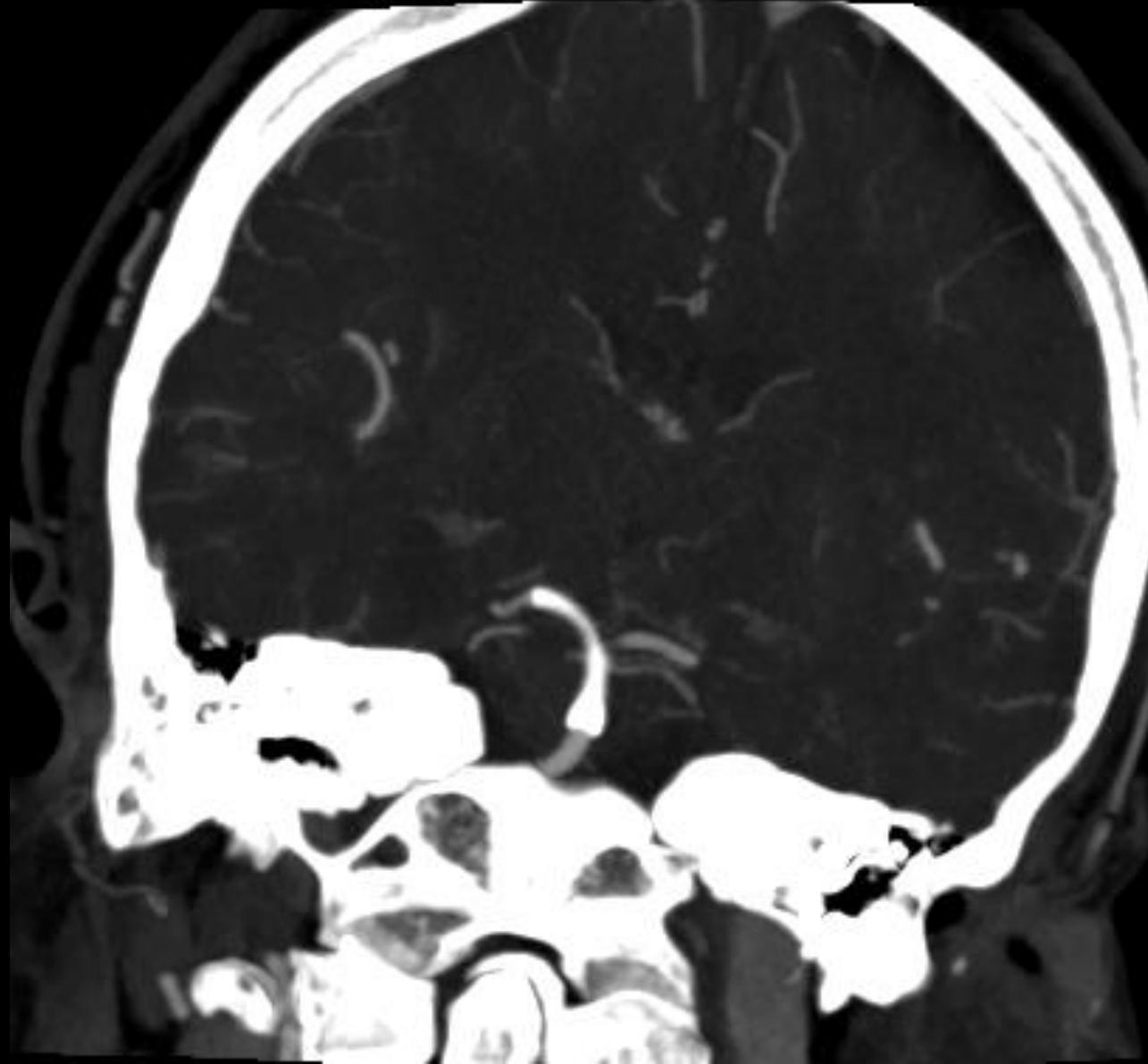
- Stent?
  - Which?
    - Laser cut – Enterprise, Atlas, other?
    - Woven – Leo Baby, LVIS Jr?
    - Balloon-mounted – Wingspan, coronary?
    - Flow diverter – PED Shield, Silk, FRED, other?
  - Antiplatelets?
    - Which and how?

# DECISION

- IV load 50% dose abciximab (0.125mg/kg)
- Pipeline Shield 3.5 x 16mm L P1/2 to BA
- Load aspirin/prasugrel 6 hours post op



CTA 24h



# CT D4



# PROGRESS

- 24h NIHSS 1 (from 2-4)
- Discharge NIHSS 1
- Phone follow up D21 – independent at home

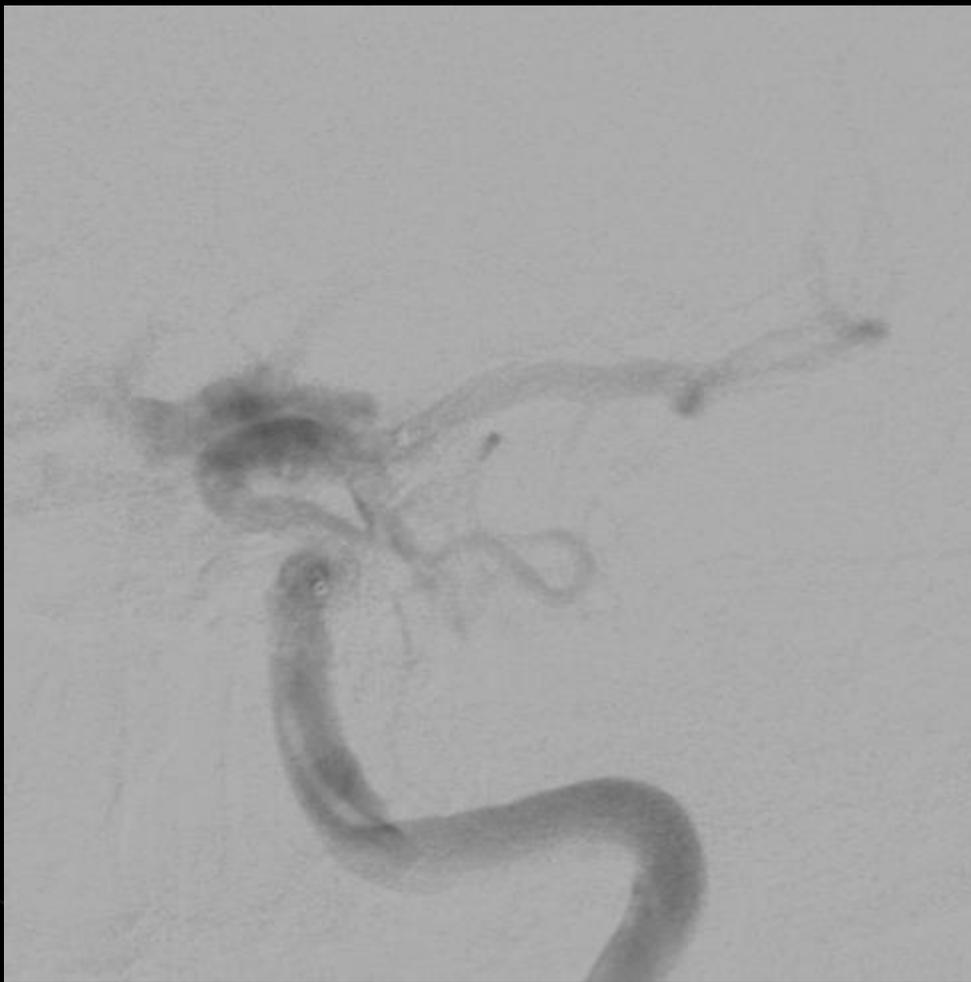
# ANTIPLATELETS IN ACUTE STENT CASES

- Prior to March 2016:
  - 36 acute stent cases (34 for tandem occlusion, 2 for stent/coil)
  - Periprocedural/intraprocedural loading with DAP via NGT/orally
  - 7 cervical ICA stent occlusions in this cohort
- Post March 2016:
  - 27 acute stent cases (22 for tandem occlusions, 5 for I/C dissection, acute stent/coil)
  - 50% IV load abciximab, oral/NG prasugrel 15mg/aspirin 300mg load @ 6h.
  - No stent occlusions in this cohort

# LOW-THROMBOGENICITY STENTS

- Pipeline Shield – interesting new development
  - Phosphatidylcholine layer covalently bonded to stent
  - Hypothesised “in situ mimic” of cell membrane
- Our experience
  - Definite improvement in deliverability (friction, opening)
  - Early promise in acute cases
    - 6 cases of SAH with blister/dissecting aneurysms with ASA +/- heparin only
    - 1 case of iatrogenic ICA rupture with ASA postop only, 4 overlapped devices
    - No cases of stent thrombosis to date

# LOW-THROMBOGENICITY STENTS



# LOW-THROMBOGENICITY STENTS



# LOW-THROMBOGENICITY STENTS



6H POST OP



36H POST OP

# CONCLUSIONS

- Beware intracranial dissection presenting as AIS
  - symptom complex
  - CTA/DSA appearance
  - “look and feel” during instrumentation
- New stent developments + tailored APT offer new treatment options

TECHNICAL ARTICLE

## Onyx embolisation of cavernous sinus dural arteriovenous fistula via direct percutaneous transorbital puncture

CK Ong, LL Wang, RJ Parkinson and JD Wenderoth

Division of Interventional Neuroradiology, Department of Medical Imaging, Prince of Wales Hospital, Randwick, New South Wales, Australia

CASE SERIES

## Novel approaches to access and treatment of cavernous sinus dural arteriovenous fistula (CS-DAVF): case series and review of the literature

Jason Wenderoth

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**ABSTRACT**

Carotidocavernous fistula or cavernous sinus dural arteriovenous fistula (CS-DAVF) has presented various treatment challenges over many years. This paper outlines these challenges in a review of the literature, and attempts to address them by analyzing the anatomical and hemodynamic characteristics of 32 consecutive patients with CS-DAVF treated between 2007 and 2016, in doing so proposing novel strategies for safe access and treatment of CS-DAVF.

**METHODS**

Between 2007 and 2016, 32 consecutive patients with CS-DAVF of mean age 62 years (median age 63 years) were evaluated and treated. The patient cohort characteristics are summarized in [table 1](#). There were 17 women and 15 men. All patients had six-vessel diagnostic cerebral angiography on admission, followed by elective treatment between 3 hours and 14 days later.

Of the 32 patients with CS-DAVF, 29 had arteriovenous shunts confined exclusively to the dura of the CS. In 29 cases, access to and closure of the affected CS was performed with either

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Conflicts of interest: None.

Submitted 31 March 2009; accepted 2 April 2009.

**Summary**

The cavernous sinus dural arteriovenous fistulas of three patients were successfully embolised by using Onyx (Onyx Liquid Embolic System, MTI, Irvine, CA, USA) as the sole embolic agent, through direct percutaneous transorbital punctures of the cavernous sinuses. Our early experience suggests that this direct approach, coupled with the unique physical properties of Onyx, is a safe and effective alternative to treat cavernous sinus dural arteriovenous fistulas when the conventional transvenous routes are inaccessible.

**Key words:** cavernous sinus; dural arteriovenous fistula; embolisation; onyx; transorbital puncture.

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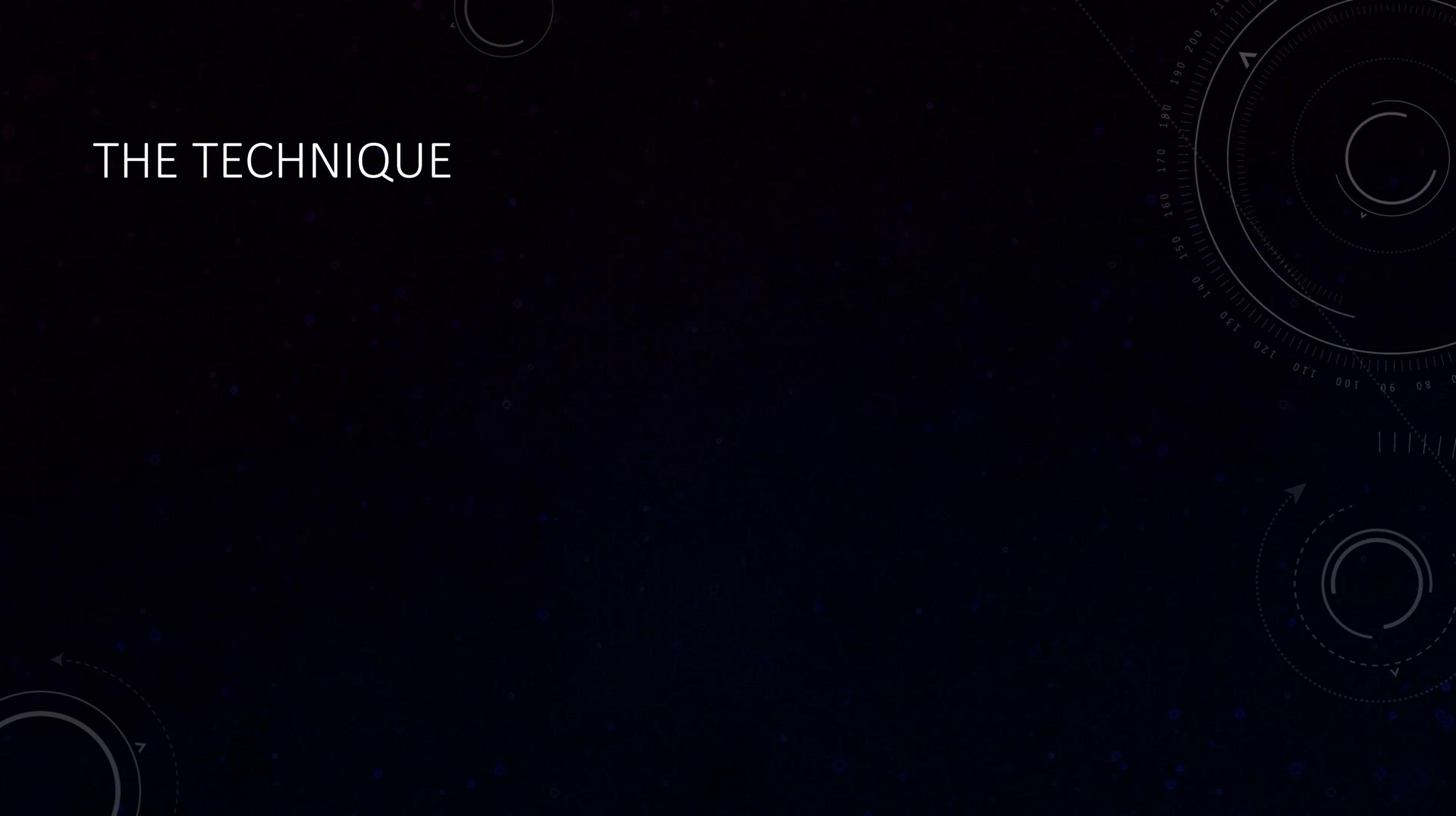
Commentary

## Proposal for an improved classification system for cavernous sinus dural arteriovenous fistula (CS-DAVF)

Jason Wenderoth

significant drainage to the orbit may be classified under the Cognard system as either a type I or a type IIa lesion (depending on whether one considers anterior drainage through the superior orbital vein as antegrade or retrograde). Elsewhere, type I and IIa lesions carry a negligible risk of hemorrhage and no substantial threat of neurological impairment. However, in the CS, these lesions carry a

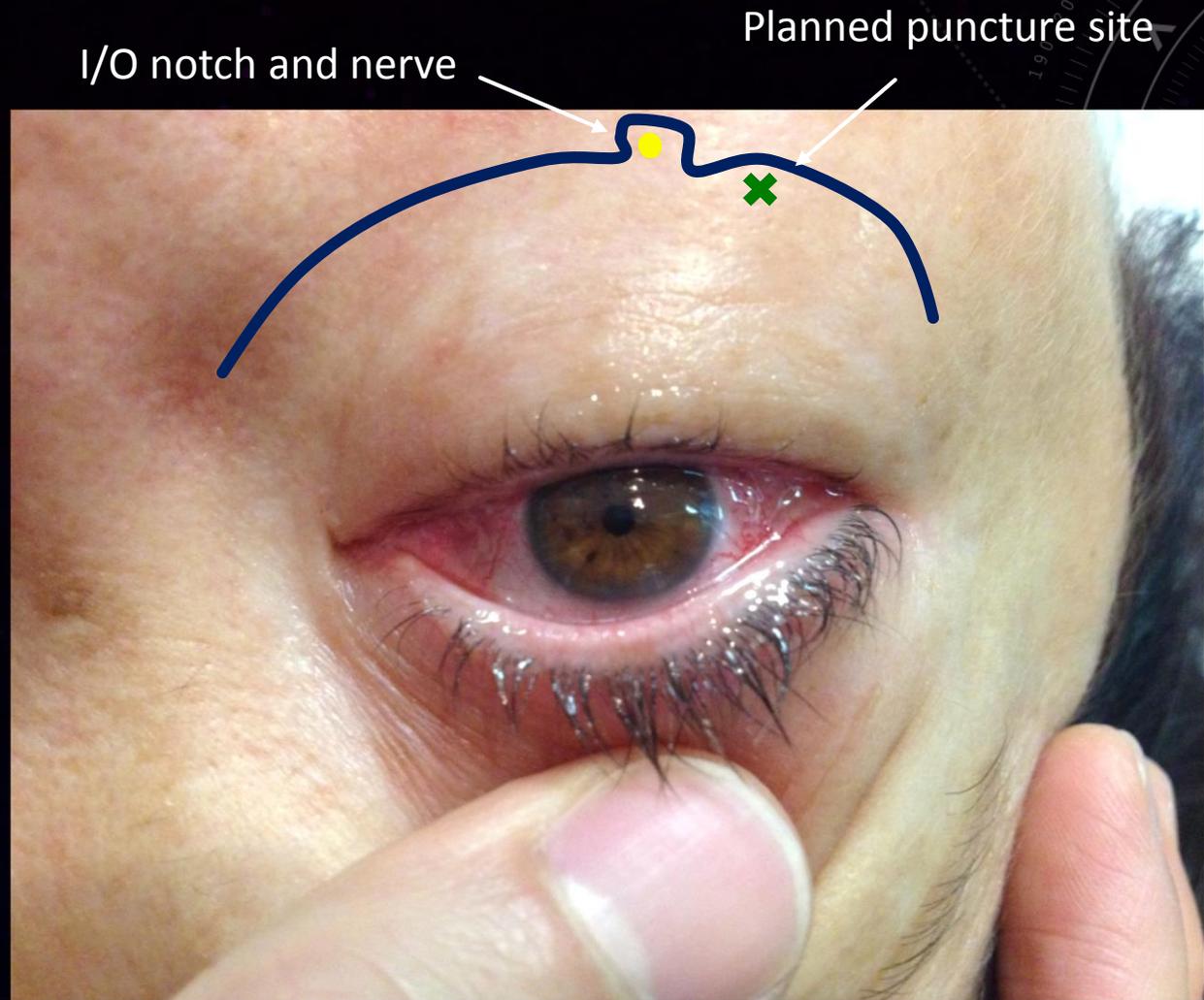
# THE TECHNIQUE



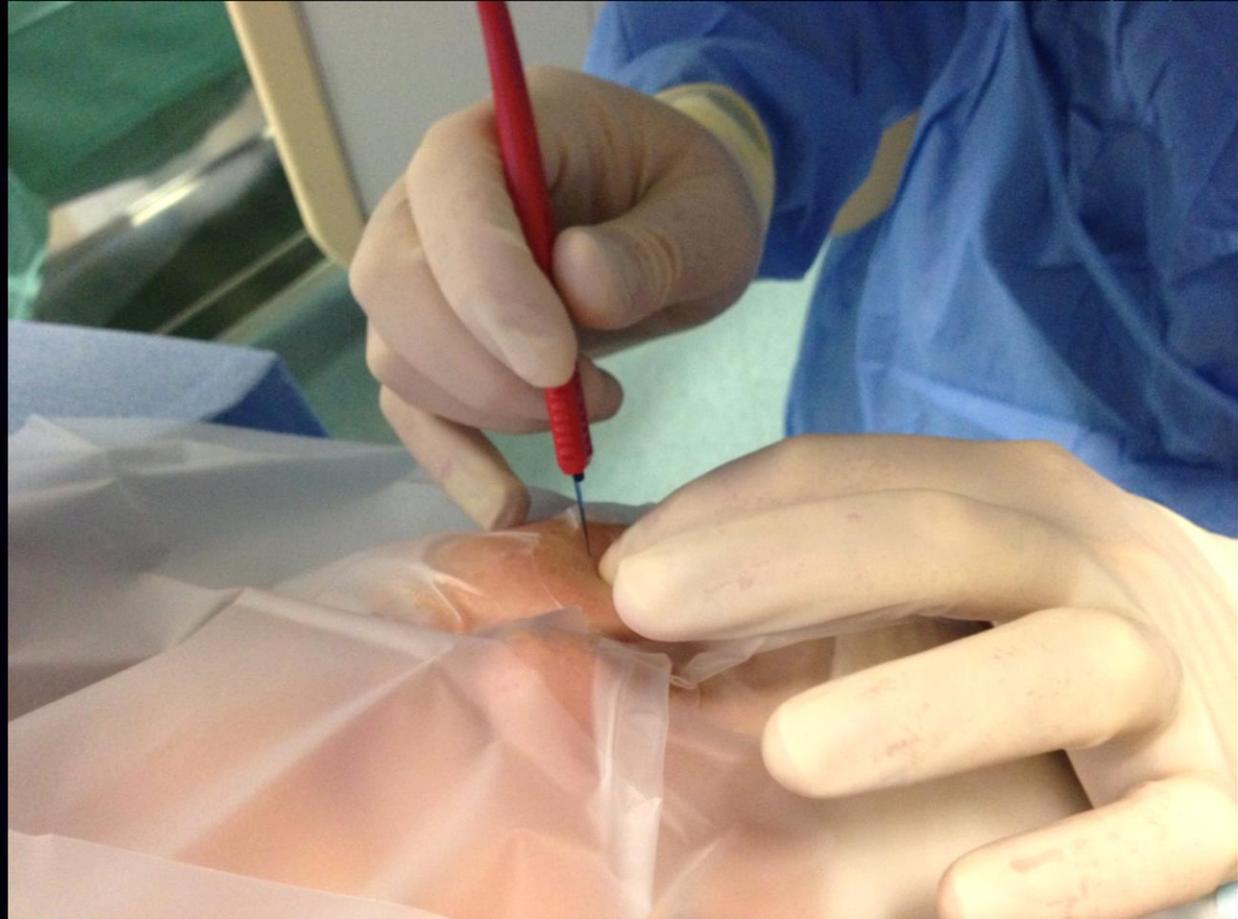
- Sterile orbit prep
- 50% betadine



- Pre op orbit check
- Locate infraorbital notch and mark

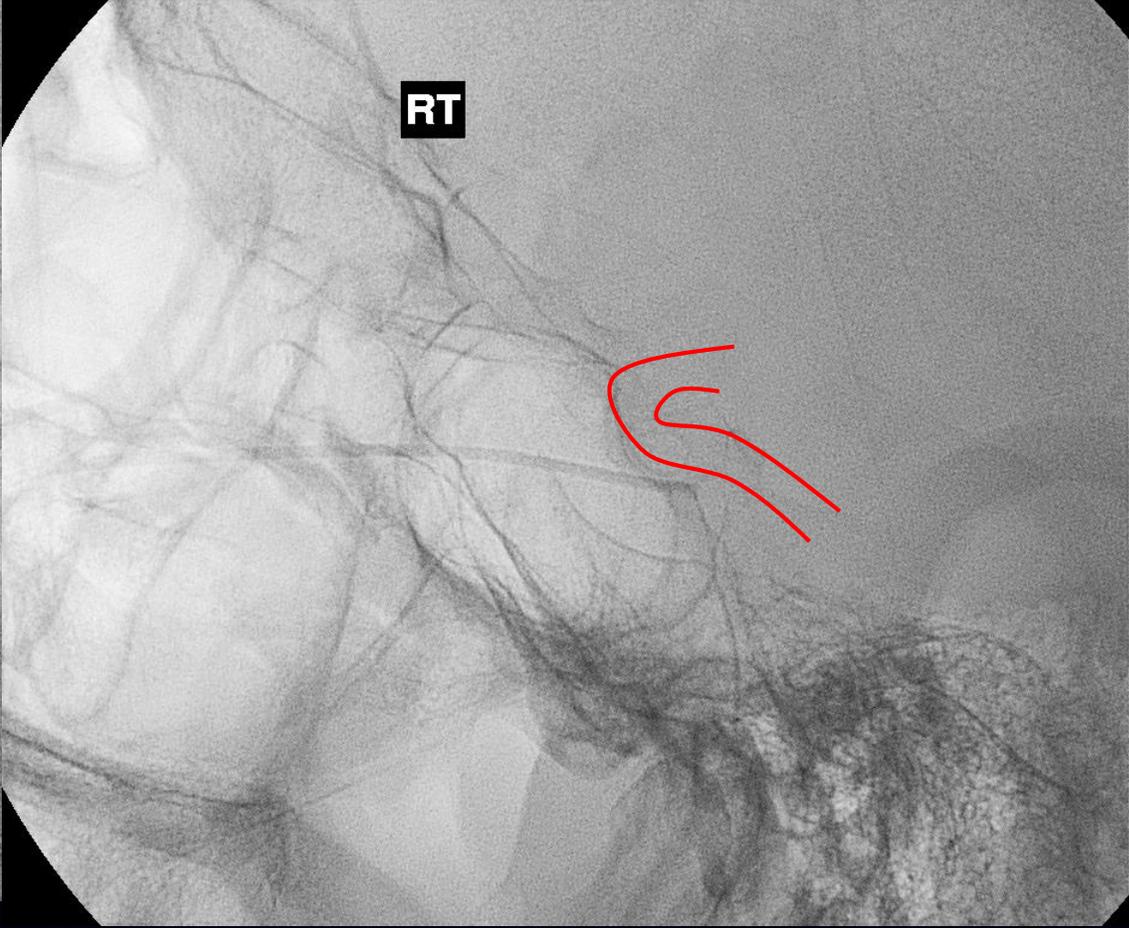
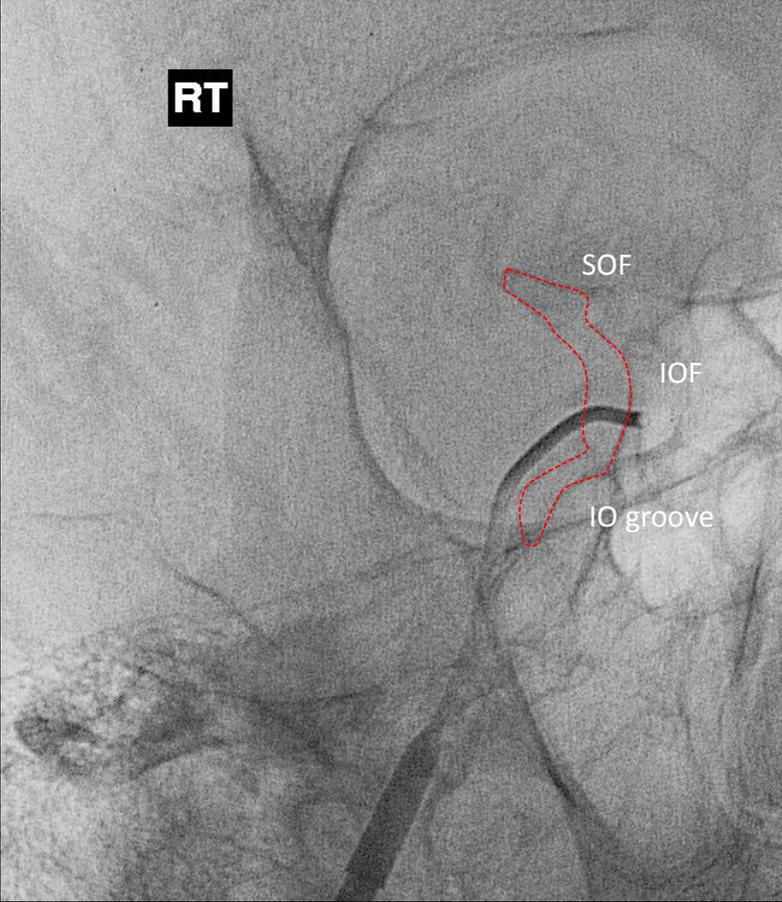


- Sterile drape
- Nick skin immediately lateral to IO notch



- Align AP plate along orbital axis and floor of orbit
- Roadmap in CCA AP/lat
- Insert 20G 9cm needle under globe along floor of orbit, bevel down





- When needle tip near apex, turn bevel up
- Place needle tip under ICA siphon on lateral view
- Withdraw stylette – await arterialised blood
- Insert wire from micropuncture set



- Insert 4/5F micropuncture sheath over wire
- Remove obturator



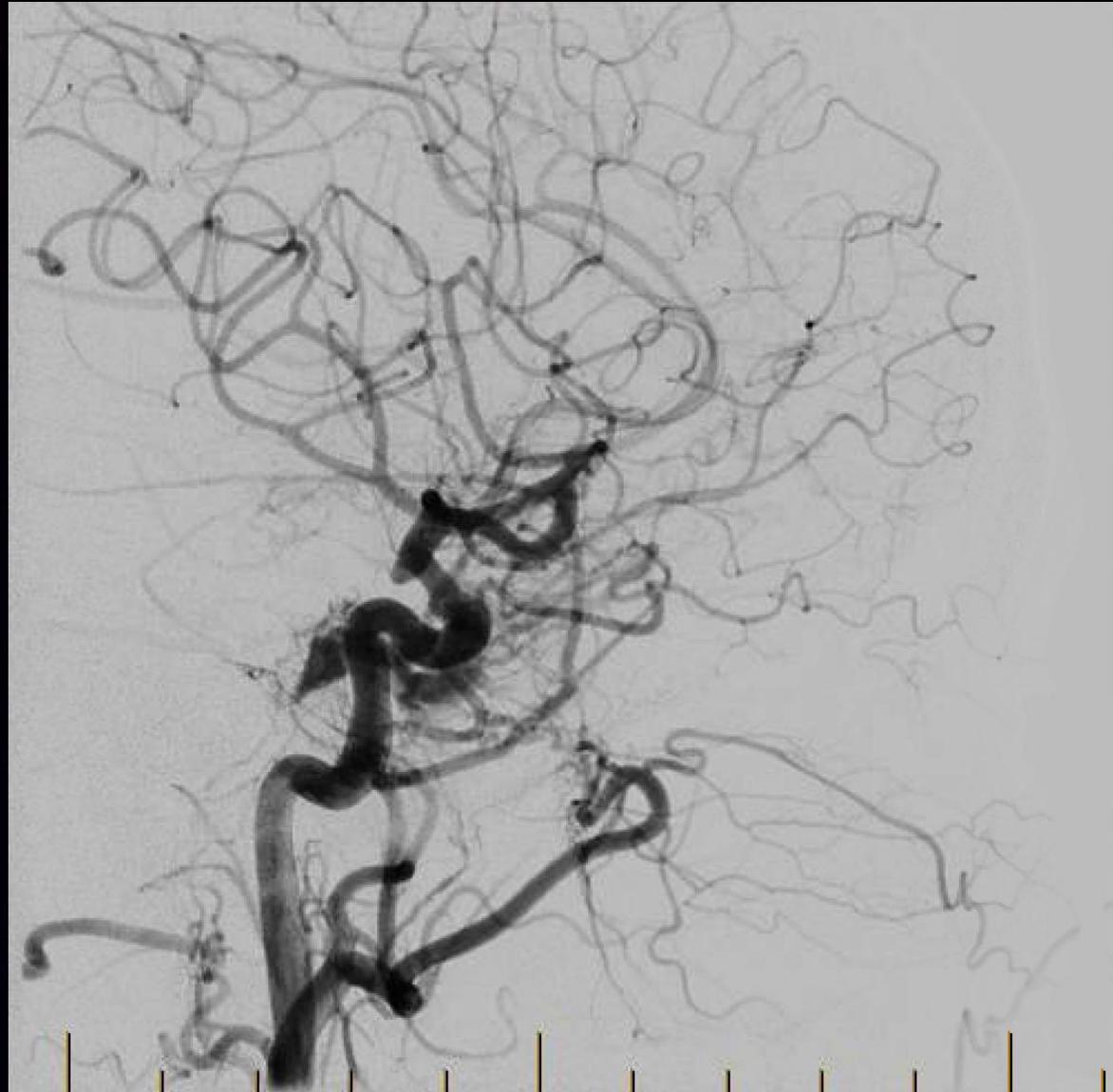
- Connect RHV
- Gentle flush on sidearm
- Secure to skin



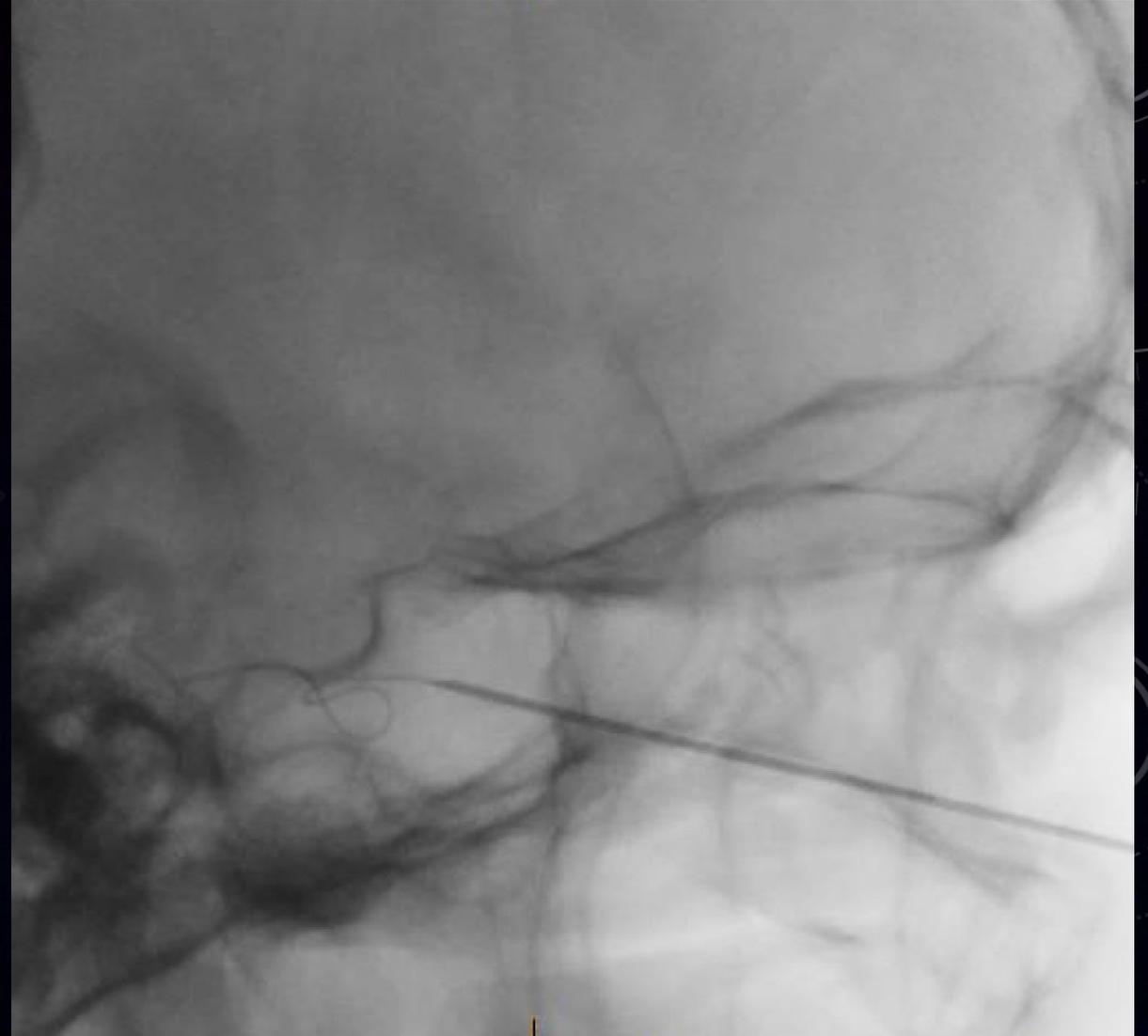
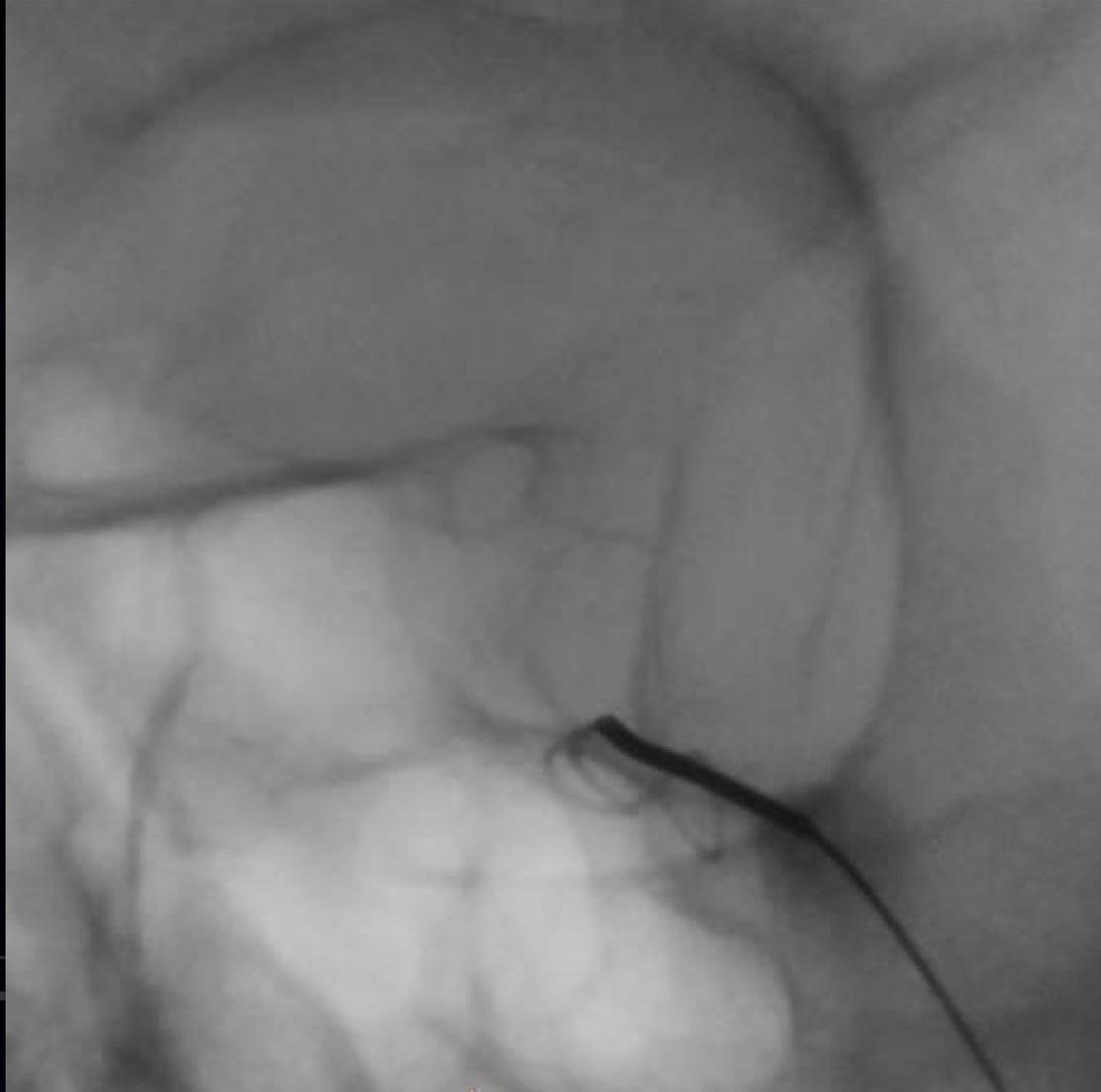
- Insert DMSO compatible microcatheter
- DSA to check position
- Secure to patient/drape
- DMSO prep as usual
- Onyx-34/PHIL-35 injection to sinus closure



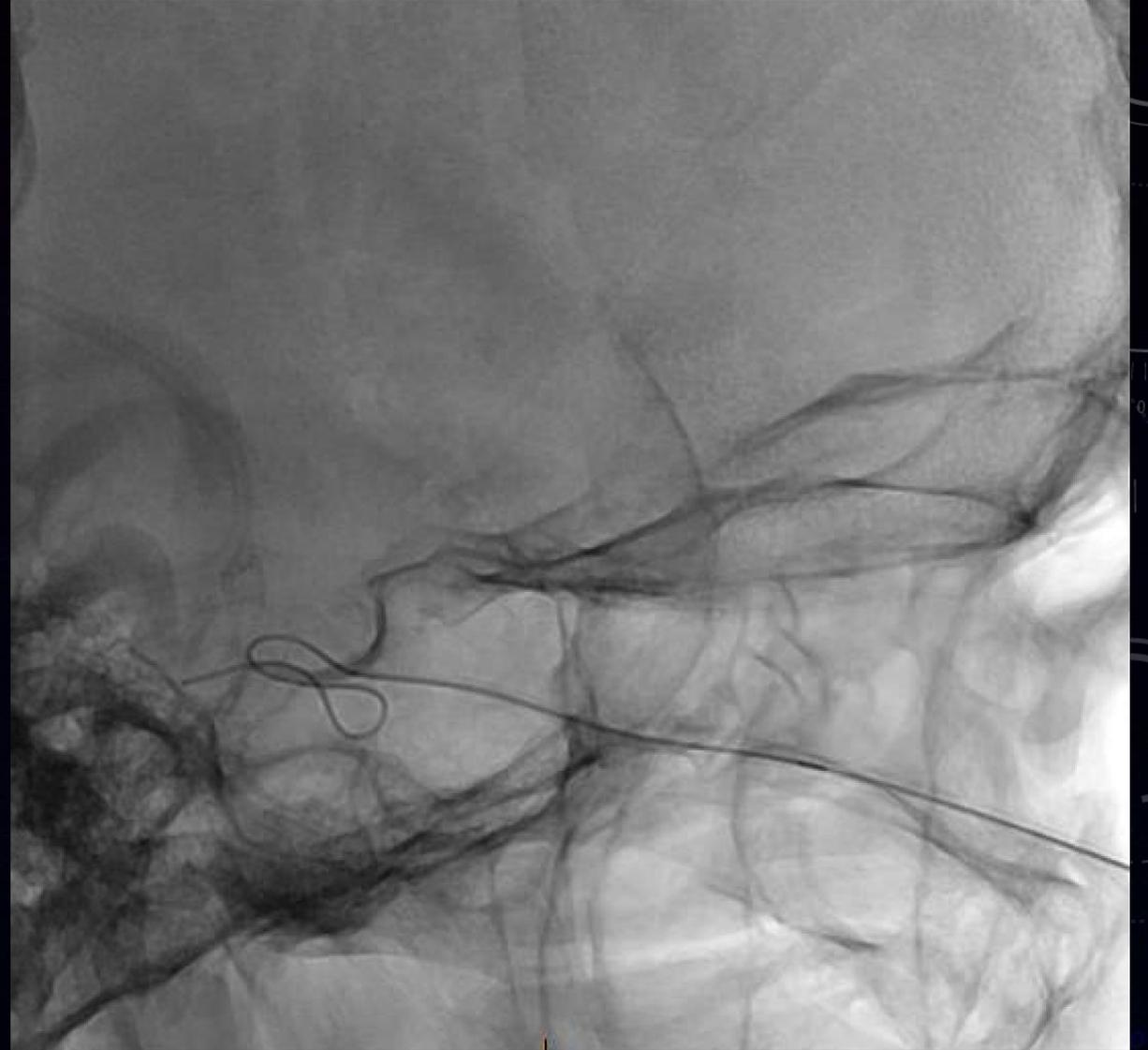
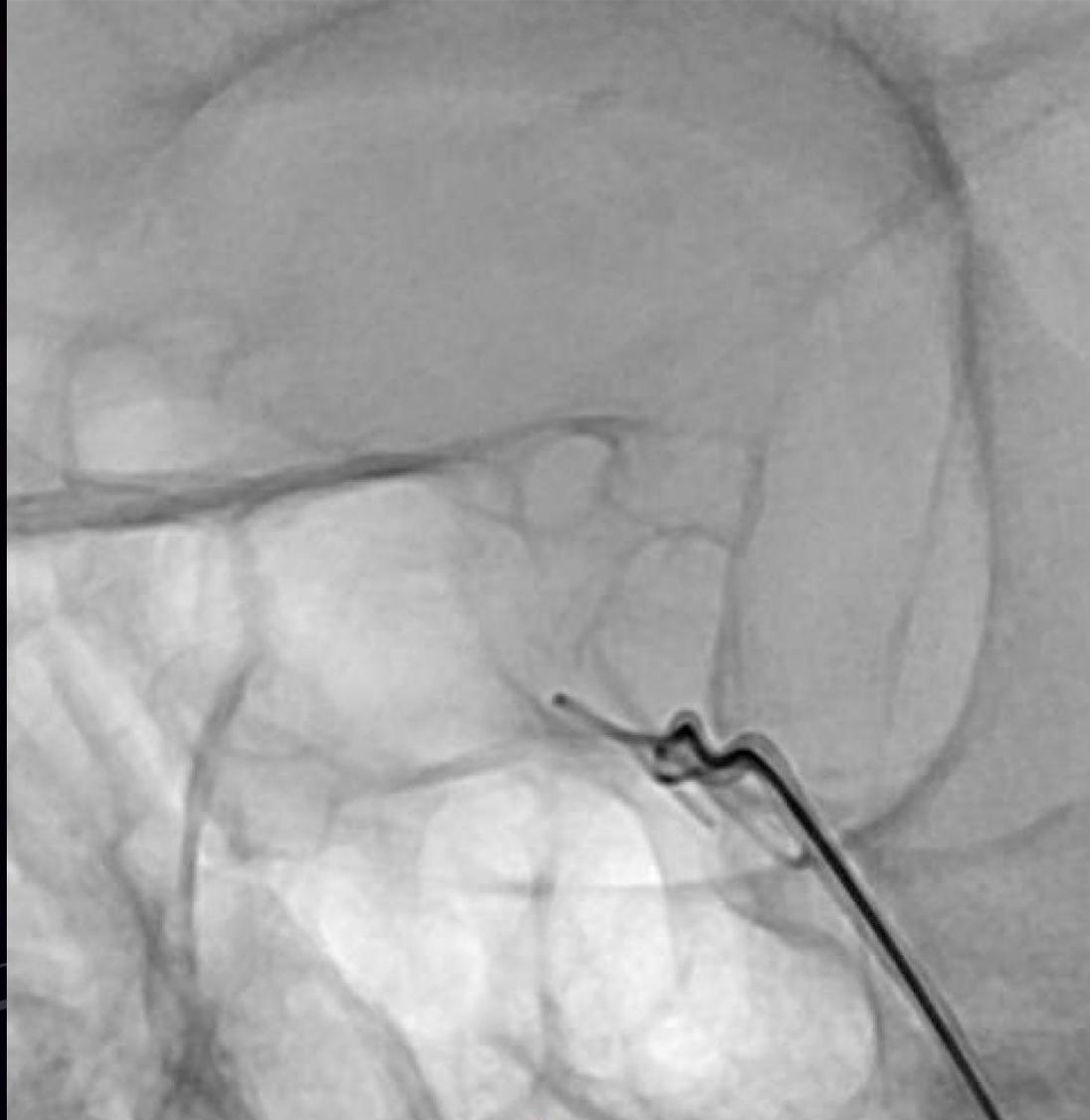
# Initial DSA 17:45



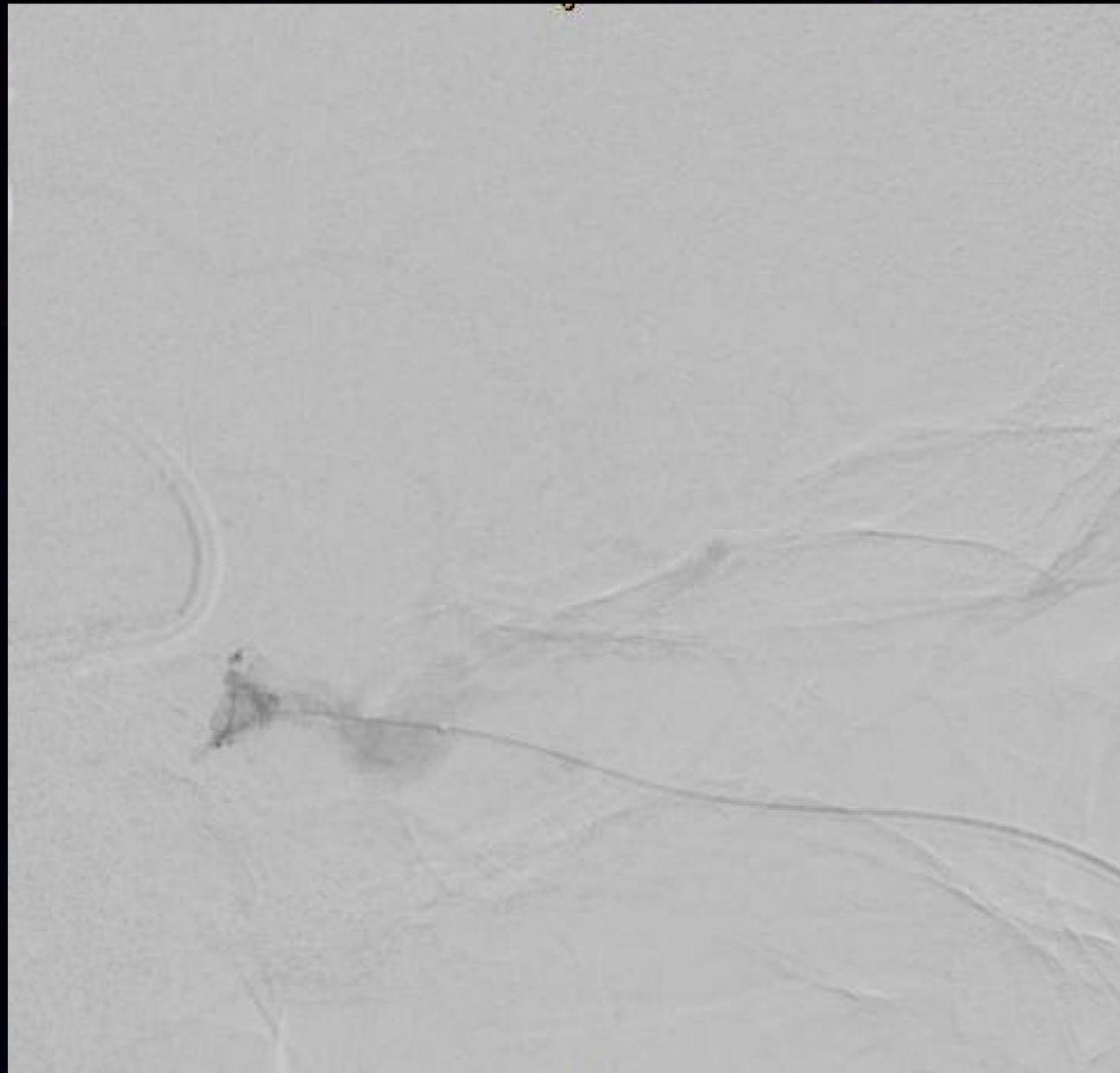
Puncture 17:50



Sheath inserted 17:52



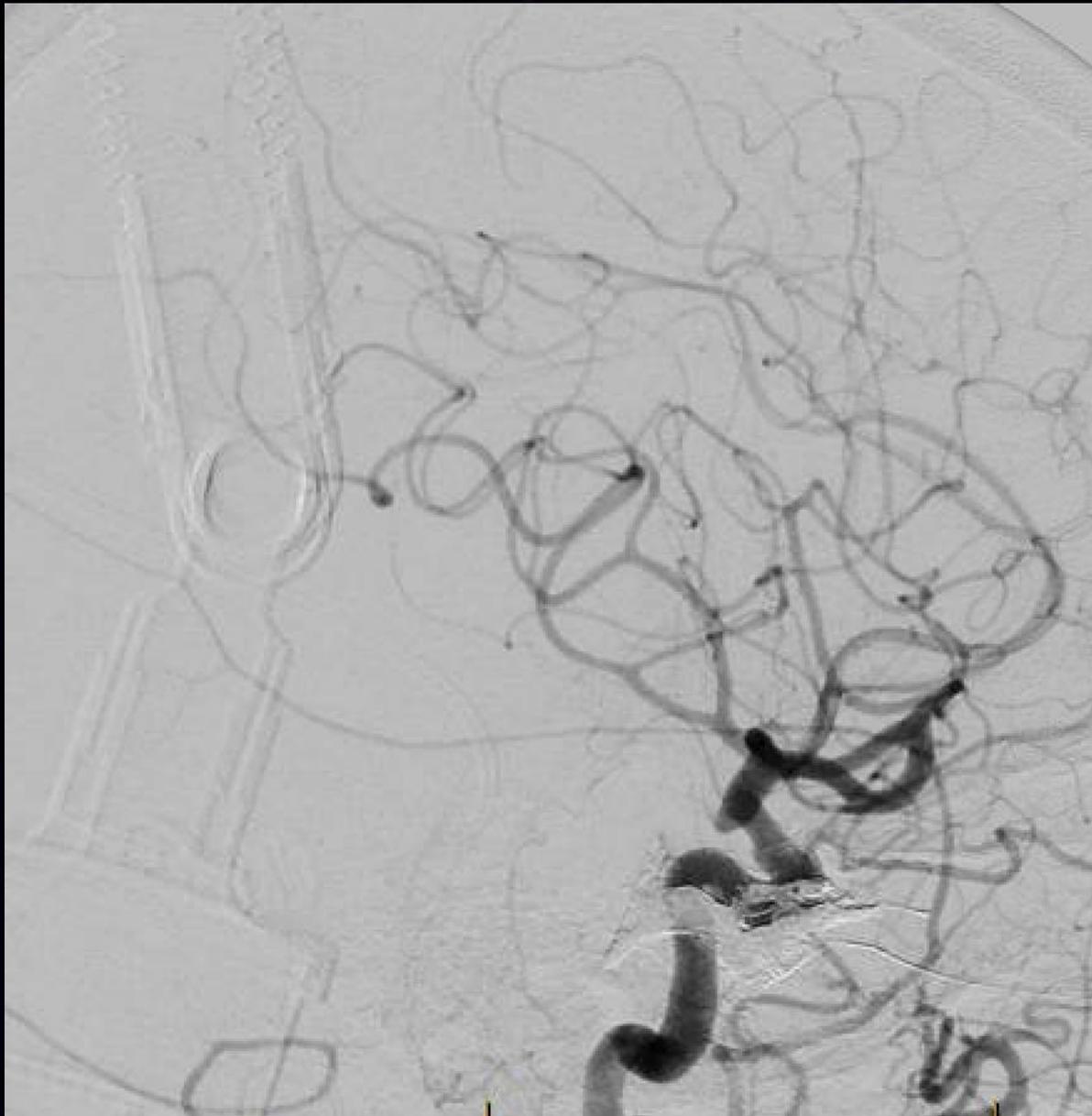
# Cavernous sinogram: 17:58



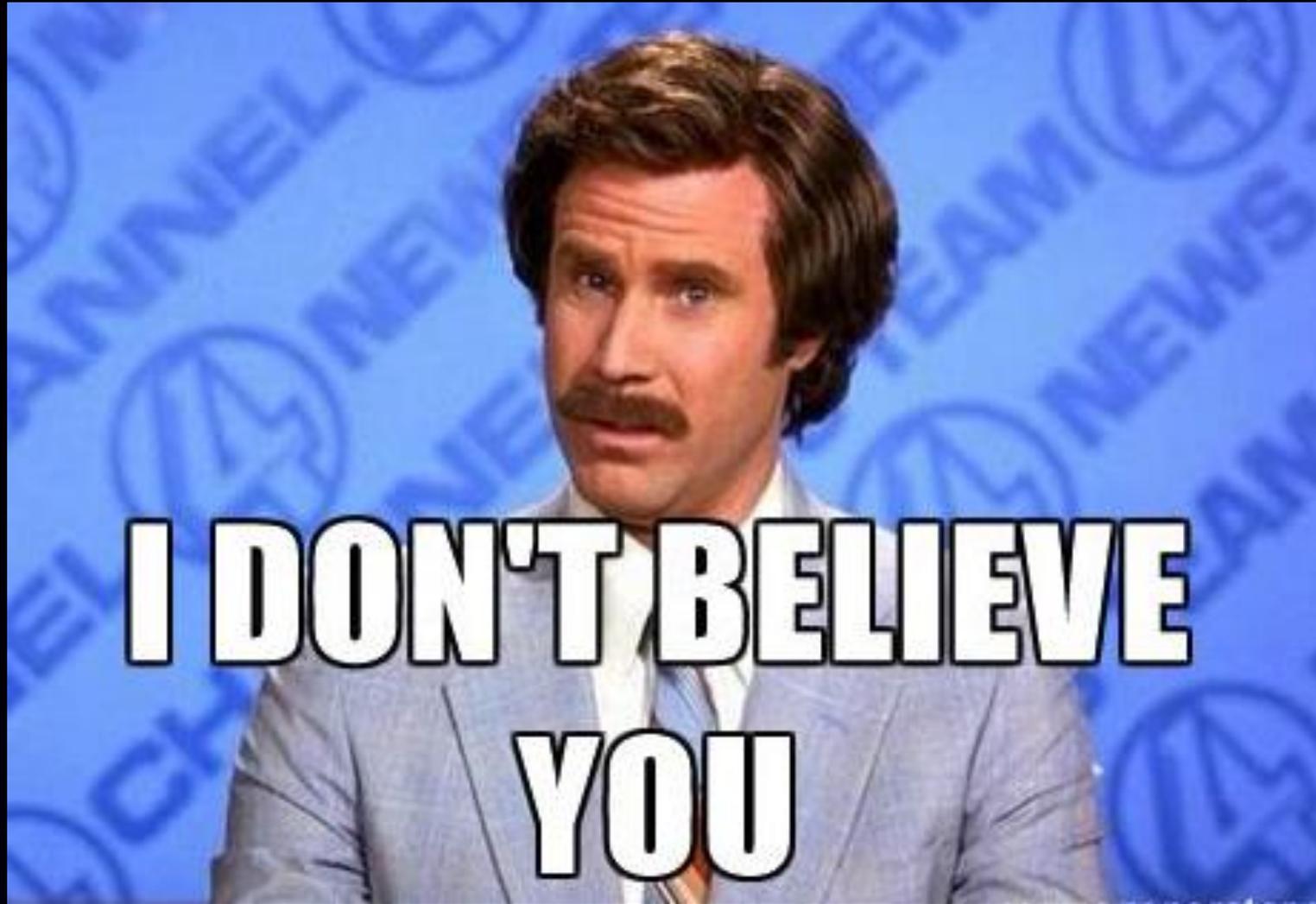
# Mid-Onyx injection: 18:11



Final DSA: 18:22



Total procedure time:  
43 minutes



**IT'S GREAT**



**BELIEVE ME**

# LINNC Paris 2016



Image Date: 24/05/2016  
Image Time: 5:59:19 PM  
MRN: 3560093

Patient recovery, room cleaning, CCF patient anaesthetised

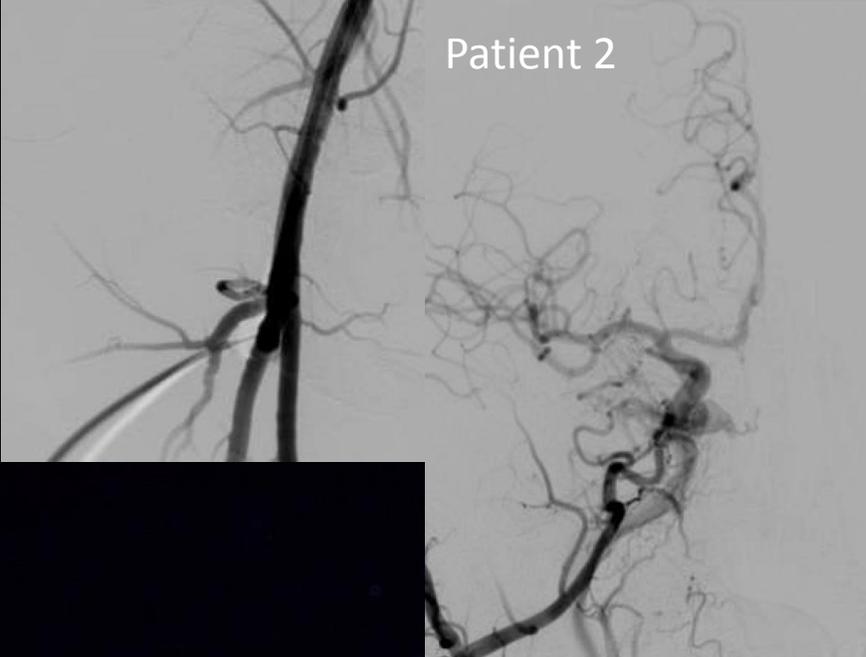


Image Date: 24/05/2016  
Image Time: 6:50:59 PM  
MRN: 10108116

Waiting for satellite link at 7pm!

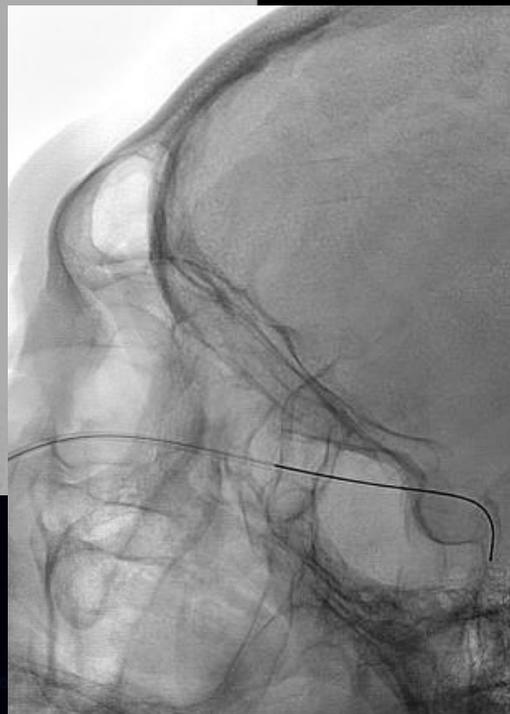


Image Date: 24/05/2016  
Image Time: 7:05:19 PM  
MRN: 10108116

Embo

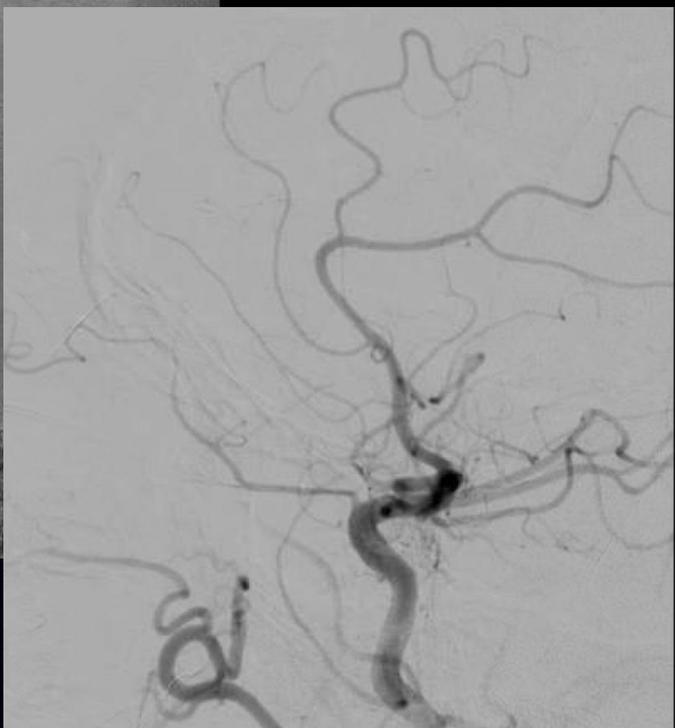


Image Date: 24/05/2016  
Image Time: 7:30:40 PM  
MRN: 10108116

Beers

# COMMENTS

- We classify CS-DAVF according to patency or otherwise of IPS +/- presence/absence of cortical venous drainage
  - Type 1 – ipsilateral IPS patent
    - Treat via IPS
  - Type 2 – bilateral CS involvement, one IPS occluded
    - Via IPS if ipsilateral IPS patent
    - Transorbital if ipsilateral IPS occluded
  - Type 3 – no patent IPS
    - Transorbital
- Determines our treatment urgency and strategy
  - If IPS open, transjugular/IPS
  - If IPS closed, transorbital

# OUR SERIES

- 42 transorbital cases as at April 2017
  - 0 coils used; all Onyx-34 or PHIL-35 only
  - 100% cure, 41/42 at first procedure
    - Repeat procedure in patient with failed coiling at other centre; difficult visibility/access
  - 0 recurrence
  - 0 retrobulbar haematoma
  - 1 lateral cantholysis for persistent raised IOP
  - 0 new cranial neuropathy attributable to DMSO
    - One mild worsening of IVn palsy at 48h, fully recovered - ?venous thrombosis

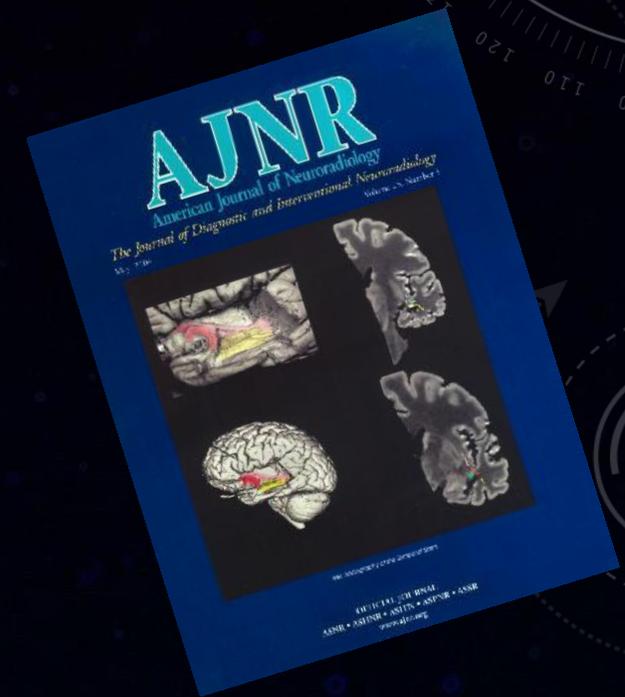
# RADIATION

Treatment Route	Total	Ave. procedure time (min)	Ave. Screening time (min)
IPS/SOV	11	35	39
Transorbital	42	46	23
Transarterial	3	46	97
TA + TO	3	138	38

- Kirsch et al, 2006
  - 141 patients, 159 transvenous procedures; 157 via IPS, 2 via SOV cut-down.
  - 82 patients with closed IPSs
  - Procedure times 30-610 minutes; average 245 minutes

# ARE “CONVENTIONAL” TECHNIQUES THAT GOOD?

- Isn't it dangerous to insert wires up blind-ended intracranial vessels? Against resistance?
- Quite often, you just can't get in
- Oh, and if you do get there:
  - Coils don't work very well
  - The procedures take hours
  - There are a lot of mechanical CN palsies
  - Long procedures with arterial catheters = stroke



# LITERATURE: INTRACAVERNOUS COILS

- Aihara N et al, 1999 – 9 patients
  - 2/9 new cranial nerve palsy 22%
- Kirsch M et al, 2006 – 141 patients - 20-33% unsatisfactory results
  - Incomplete occlusion in 27/141 19.1%
  - Complications in 21/141 14.6%
    - CN palsy 5.5%
    - Other complications in 9.2%
      - Venous perforation 3.5%
      - Arterial emboli 2.8%
      - Other 2.8%

# LITERATURE: INTRACAVERNOUS COILS

- Nishino K et al, 2008 – 33 lesions
  - 13/33 new CN palsy 39.4%
- Ducruet et al, 2013 – 58 lesions – 20-40% unsatisfactory results
  - Failed access 10 17.2%
  - Incomplete occlusion 10 17.2%
  - CN palsy 4 8.3%
- Macdonald, Millar, 2010 – 4 lesions
  - 3 failed occlusion 75%

# LITERATURE: INTRACAVERNOUS ONYX/PHIL

- Short case series only
  - Bhatia et al, 2009
  - Ong CK et al, 2009
- No reports of major complications from DMSO-based embolics as sole transvenous agents

- Our published series:

• Patients	32 (now 42)
• Failed access	1 (successful on second attempt)
• Failed closure	0
• New or worse CN palsy	2 (7.7%)
• Other complications	0

One patient – malpositioned IPS catheter: Onyx into Dorello’s canal  
One patient – delayed venous thrombosis @48h; full recovery

- **Unsatisfactory outcomes (total)**                      **2 (7.7%)**

# SUMMARY

- Percutaneous access to cavernous sinus for treatment of CS-DAVF is
  - Simple
  - Fast
  - Effective
  - Reduces radiation dose
- In cases of CS-DAVF with closed IPS, transorbital approach is our standard of care