

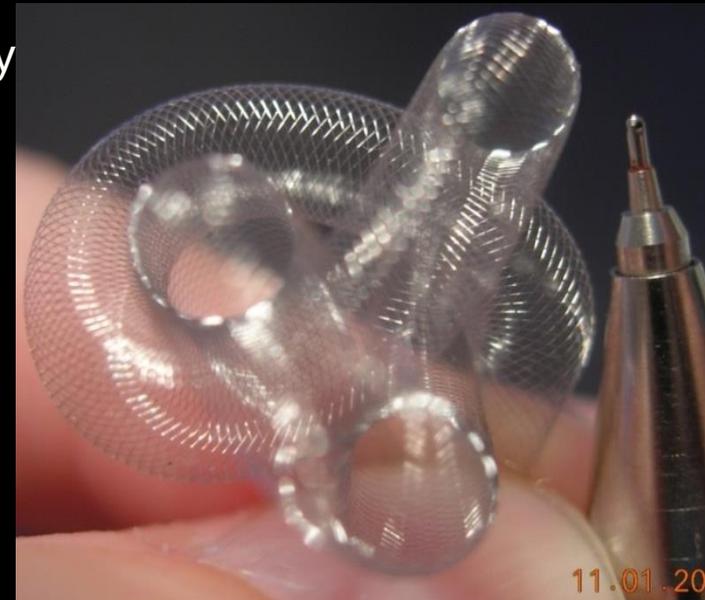
# FLOW DIVERSION FOR POSTERIOR CIRCULATION THE SURPASS EXPERIENCE

25<sup>th</sup> Annual Meeting  
SIMI

July 4-6, 2016

Buenos Aires, Argentina

Ajay K. Wakhloo, M.D., Ph.D., FAHA  
Department of Radiology, Neurology and Neurosurgery  
Division Neuroimaging and Intervention  
University of Massachusetts Medical School



# DISCLOSURES

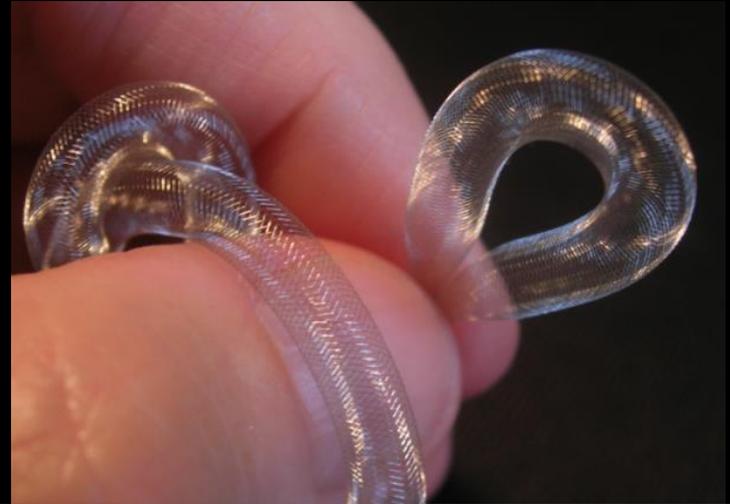
- Stryker Neurovascular (Consultant)
- Codman J&J (Consultant)
- InNeuroco (Stockholder, CMO)
- Pulsar (Bridge loan)
- EpiEp (Stockholder)
- Medtronic (Stockholder)
- Philips (MAB, Research Grant, Equipment support)
- Postgraduate Course Harvard Medical School (Speaker)
- Baptist Hospital, Miami, Florida (Speaker)
- Mayo Clinic, Jacksonville, Florida (Speaker)
- NIH (R01 NS45753-01A1; 1R21EB007767-02;  
5R01 NS045753-02; 1R21NS061132-01A1; 1R01NS091552-01A1)

# Posterior Circulation - Surpass Study Group

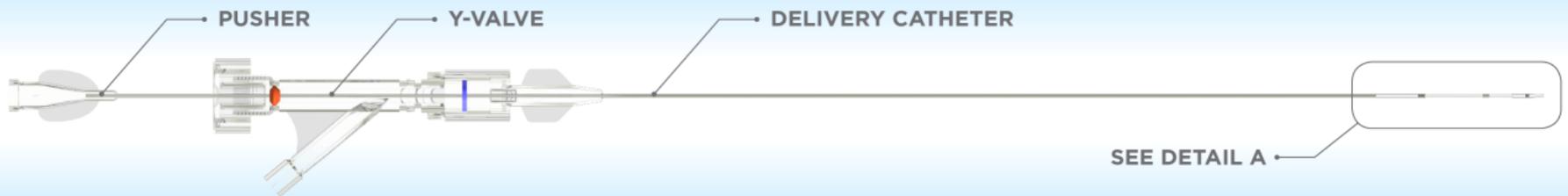
- Christian Taschner, Julia Bernardy; Freiburg, Germany
- Joost de Vries, Jeroen Boogaarts; Nijmegen, The Netherlands
- Nobuyuki Sakai, Kobe, Japan
- Pedro Lylyk, Buenos Aires, Argentina
- Alessandra Biondi, Besancon, France
- Istvan Szikora, Budapest, Hungary
- Bernd Eckert, Hamburg, Germany
- Bruening, Hamburg, Germany
- Ralph Siekmann, Kassel, Germany
- Peter Kan, Tampa, Florida, USA
- Patrick Brouwer, Rotterdam, The Netherlands
- Ajay K. Wakhloo, Ajit S. Puri, Matthew Gounis; Worcester, USA

# Surpass Flow Diverter

- Self-expandable braided device
- 48 - 96 Chrome-Cobalt wires
- FD preloaded in an over-the-wire microcatheter delivery system
- Navigated over 0.014" microwire



## DELIVERY SYSTEM

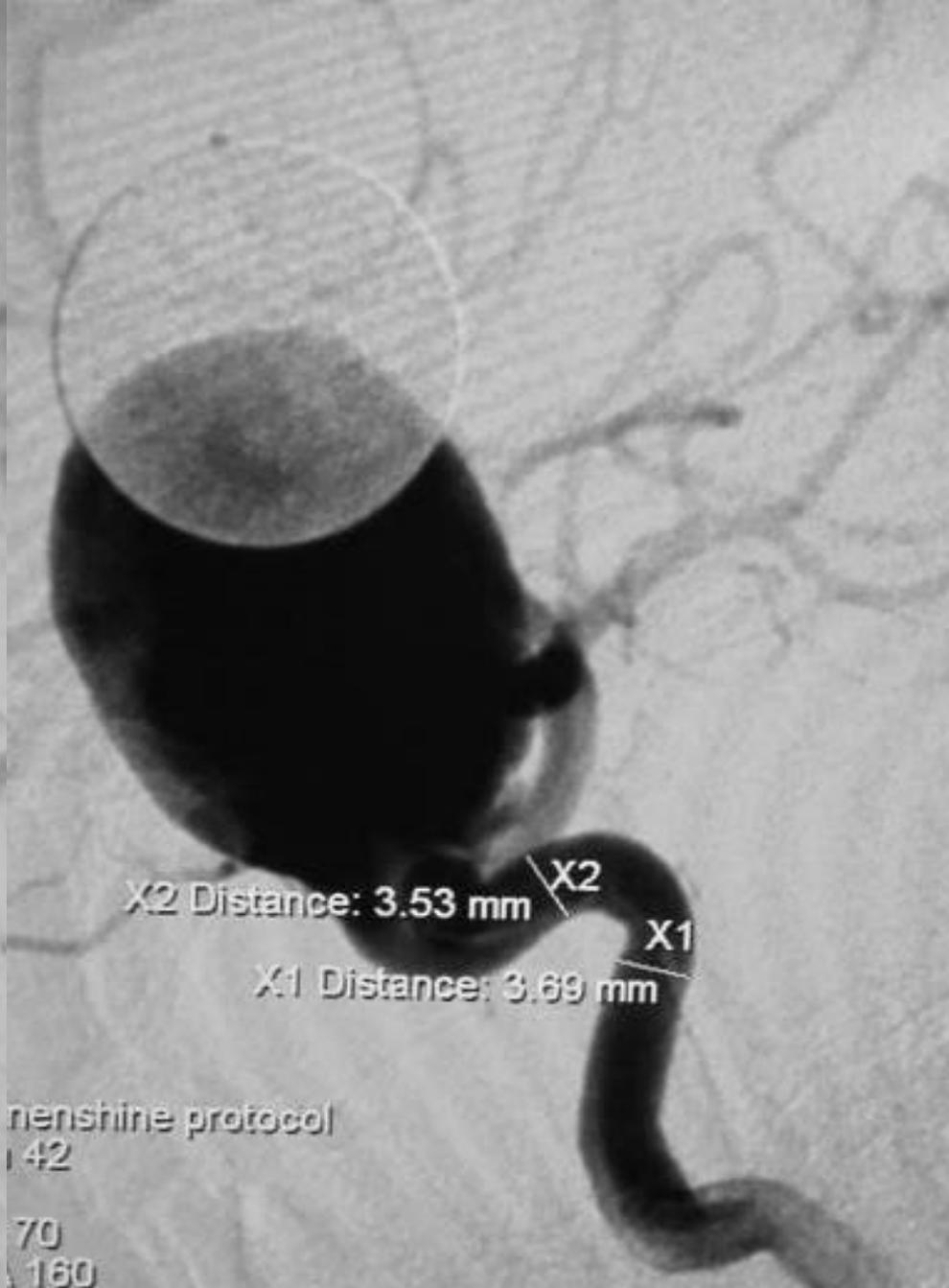
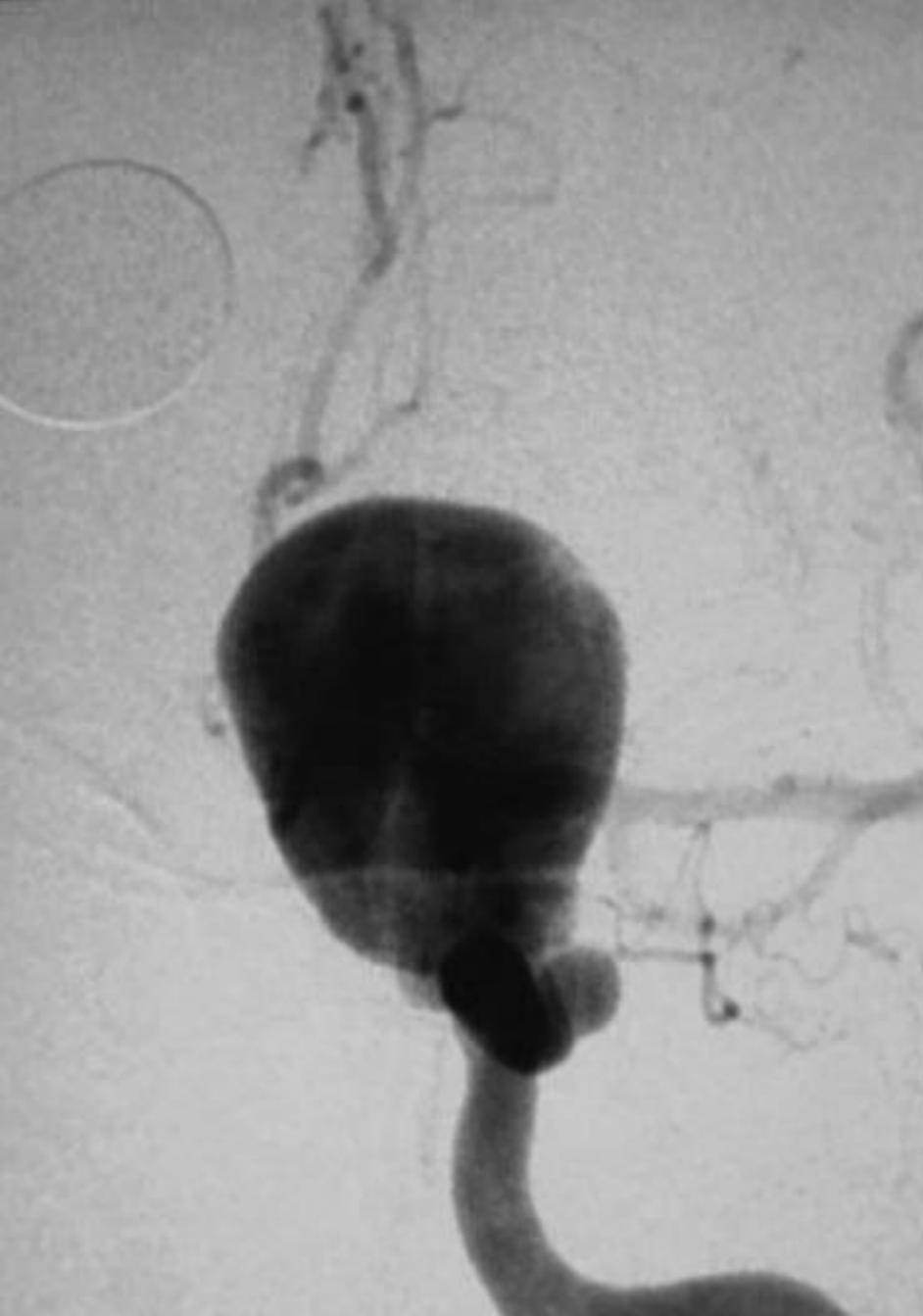


## DETAIL A



# Available Sizes

Length (mm)	Diameter: 2mm	Diameter: 3mm	Diameter: 4mm	Diameter: 5mm
12mm	✓			
15mm	✓	✓	✓	
20mm	✓	✓	✓	✓
25mm		✓	✓	✓
30mm			✓	✓
40mm			✓	✓
50mm			✓	✓



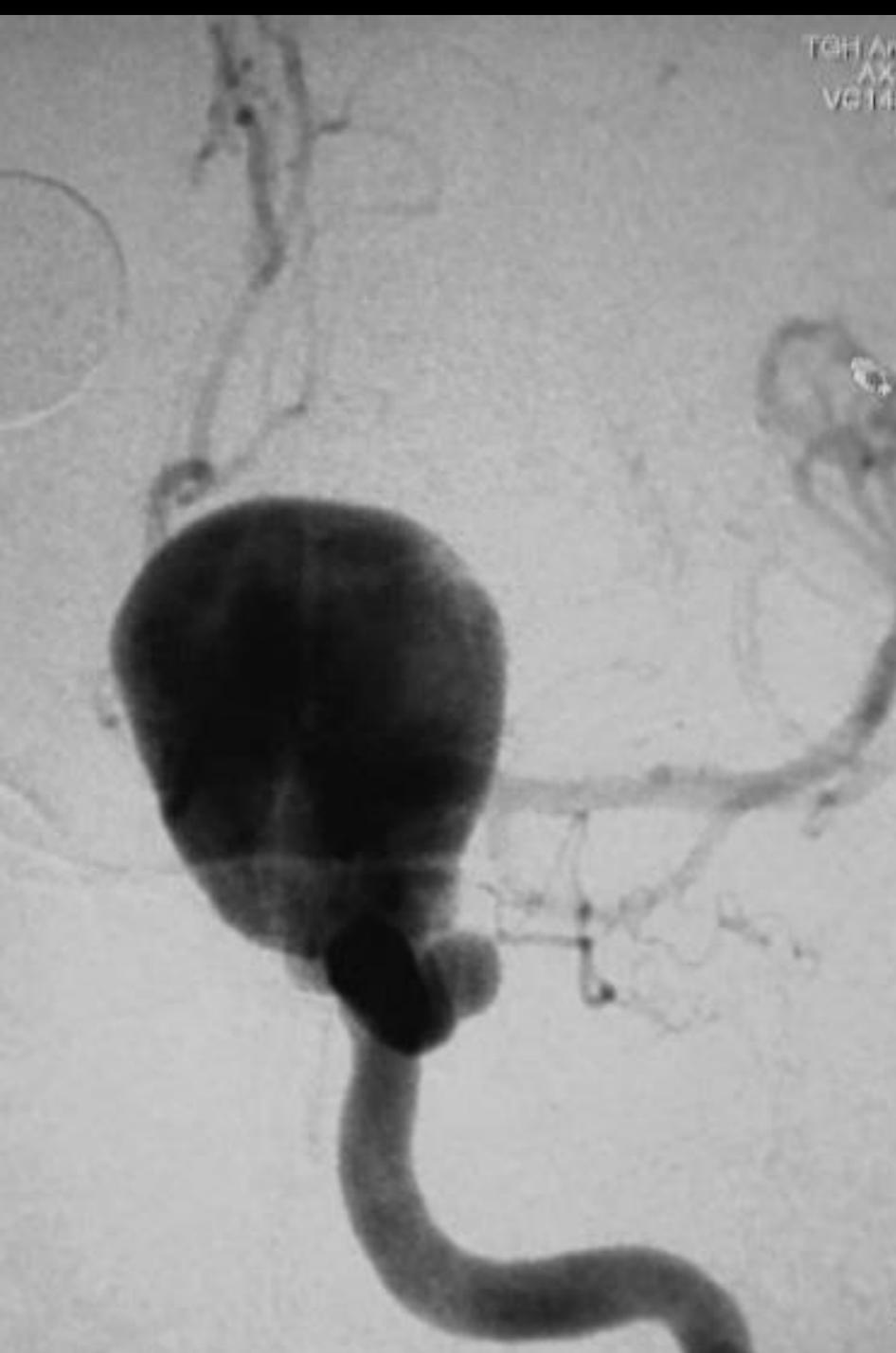
\* Surpass FD currently not FDA approved

# Surpass FD



*\* Surpass FD currently not FDA approved*

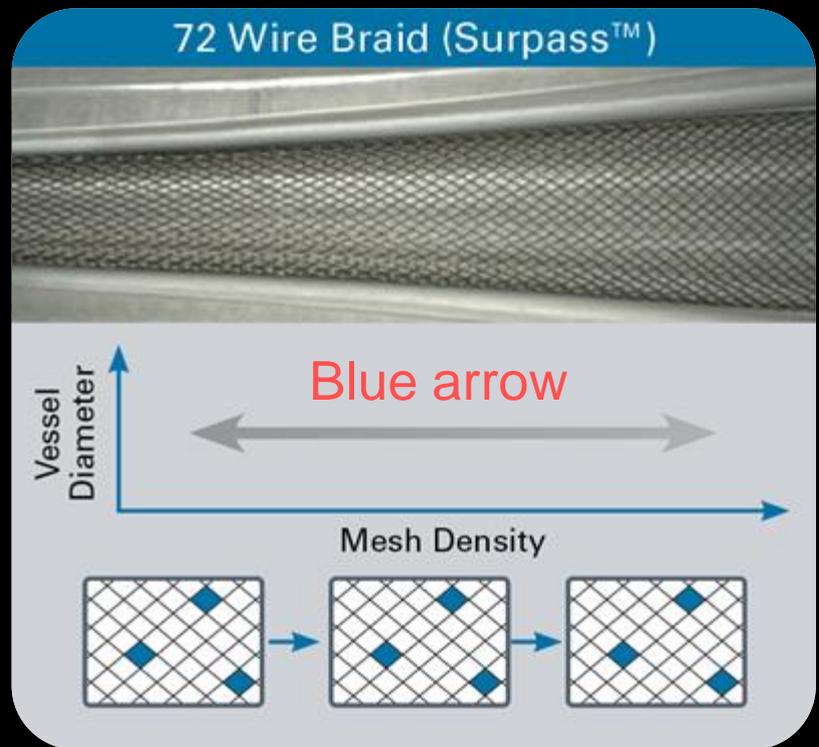
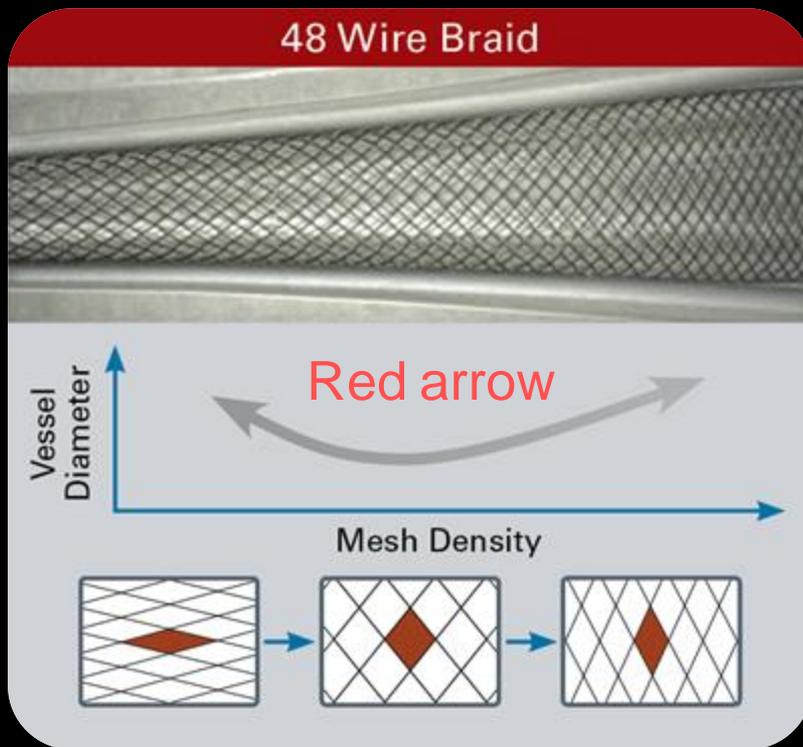
6 month fu



# Flow Diversion

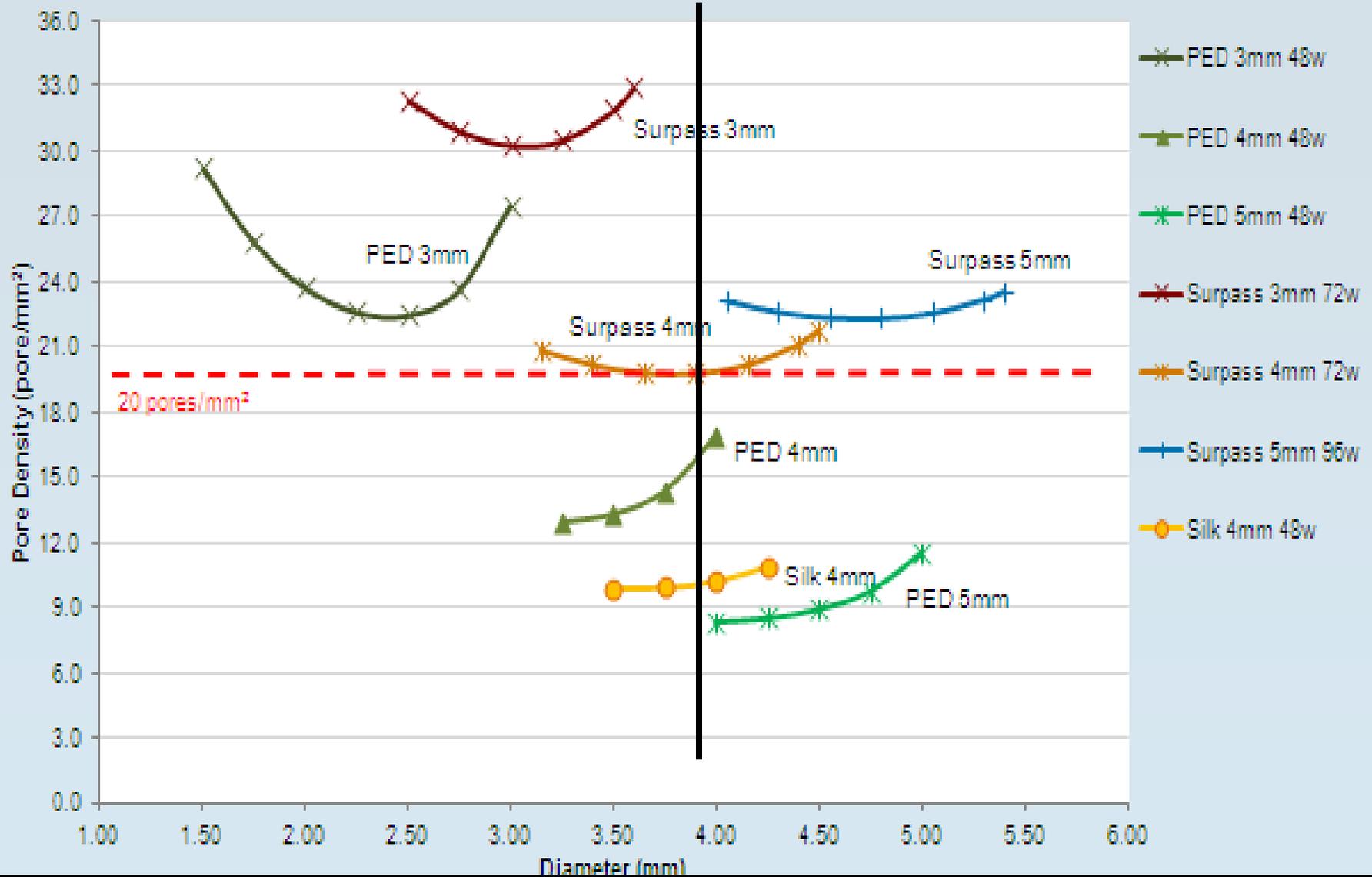
## Why is *Mesh Density* important?

- Consistent flow diversion across vessels that taper



# Currently available Flow Diverters

## Mesh Density

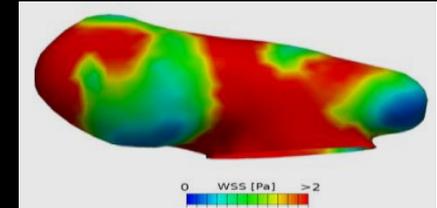
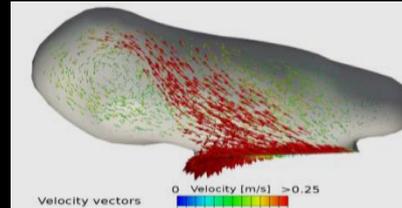


# Flow Diversion

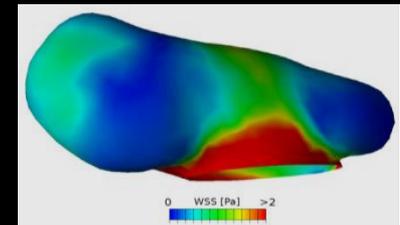
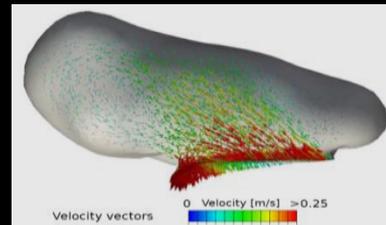
## Why is *Mesh Density* important?

- Mesh density and braid angle affect fluid velocity
- Increasing wire count from 48 to 72
  - Reduces aneurysm inflow rate by **24%**
  - Shrinks the impact zone by almost **90%**

**48 Wire Braid**



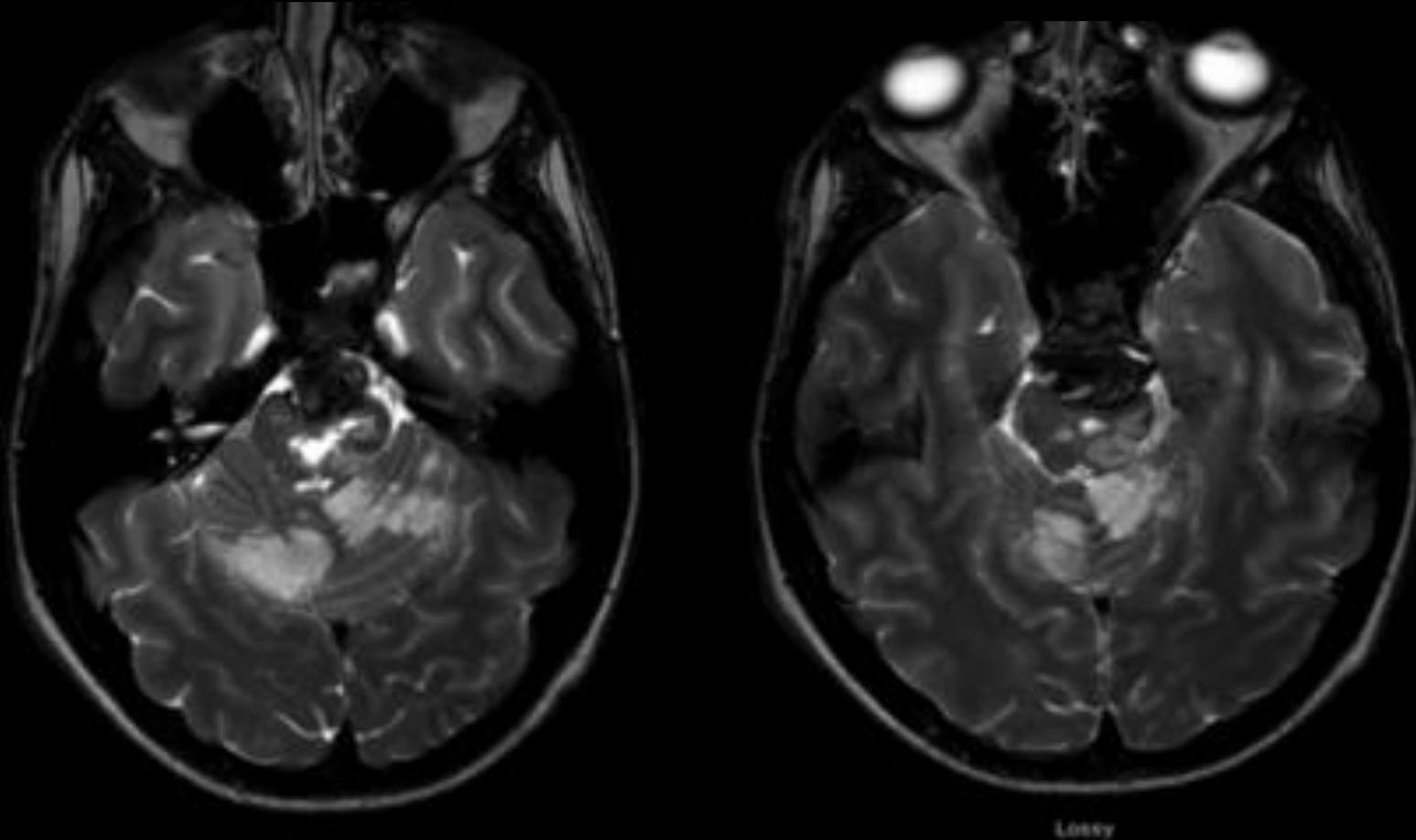
**72 Wire Braid (Surpass™)**



	Inflow Rate (mL/S)	Aneurysmal Inflow	Turnover Time	Impact Zone (mm <sup>2</sup> / %)
<b>Before Stenting</b>	2.241	42%	0.099s	137 / 74%
<b>48 wires 33 microns</b>	1.302	25%	0.171s	92 / 50%
<b>72 wires 32 microns</b>	0.991	19%	0.217s	10 / 6%
<b>96 wires 32 microns</b>	0.779	15%	0.277s	10 / 6%

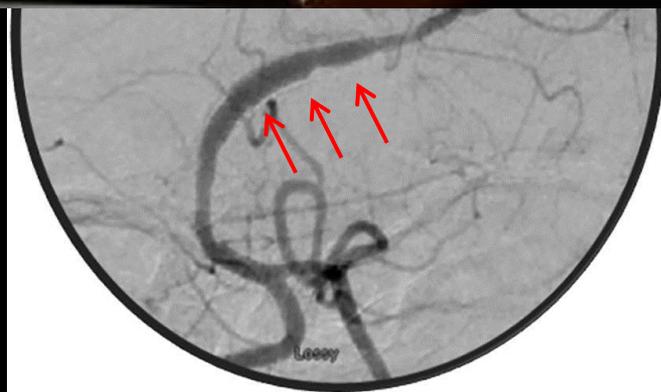
# Dissecting Basilar Trunk Aneurysm

16-year young boy with stroke, speech problems, hemiparesis and inability to walk  
Progressive deterioration on dual antiplatelet treatment and anticoagulation



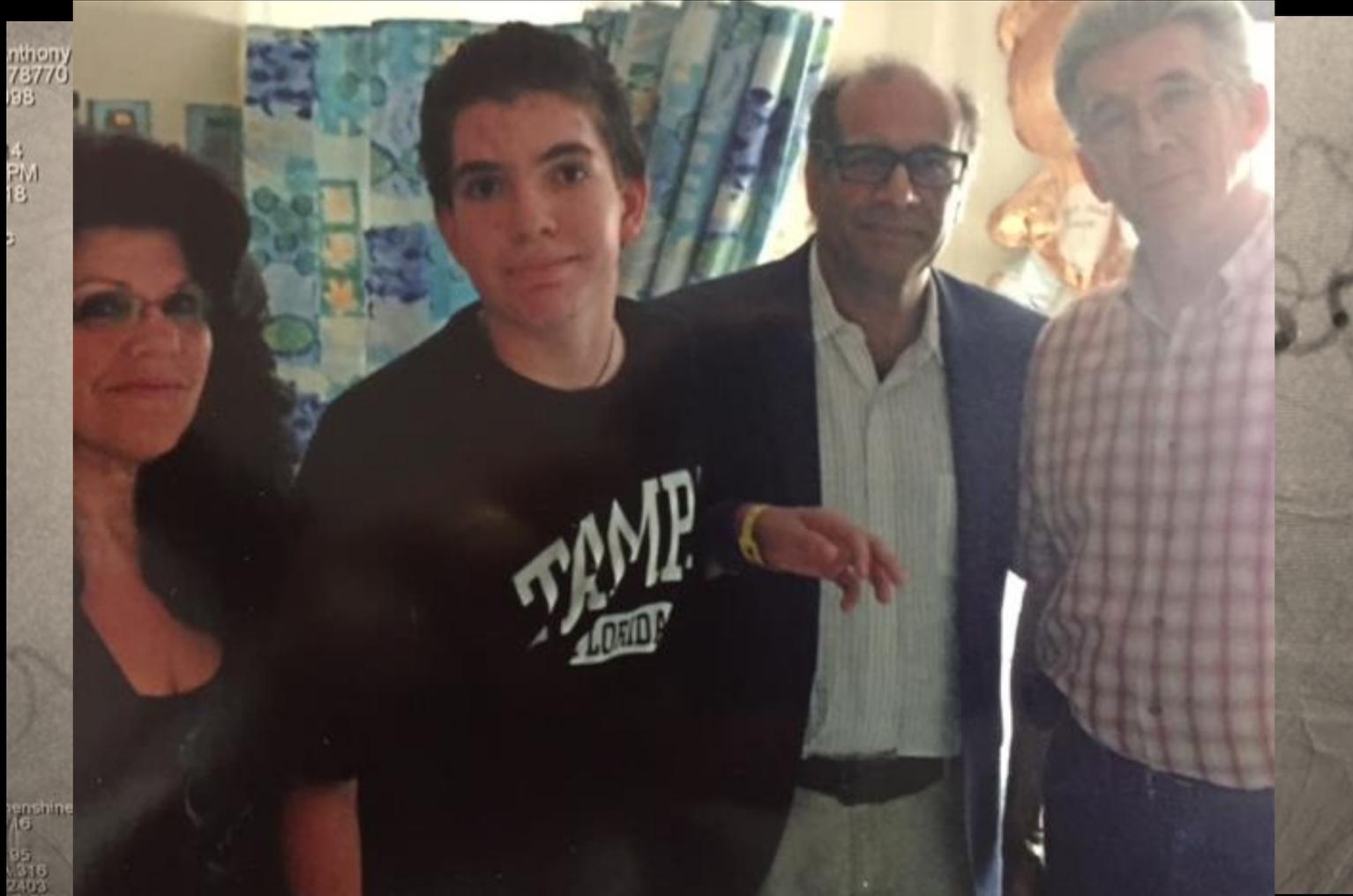
Postoperative Day 1

4 Months After

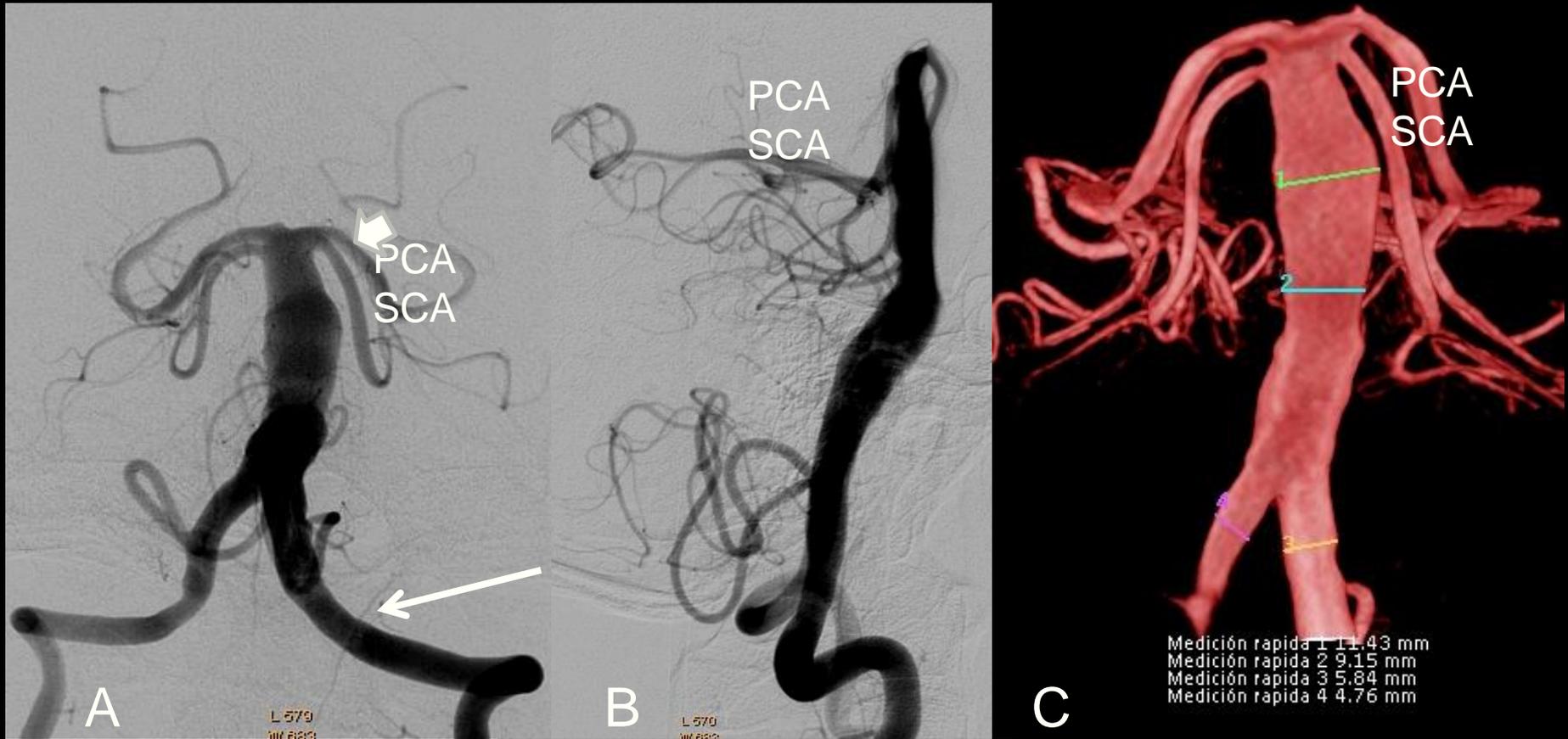


## Dissecting Basilar Trunk Aneurysm –

16-year young boy with stroke, speech problems, hemiparesis and inability to walk  
Progressive deterioration on dual antiplatelet treatment and anticoagulation



# Initial Observations - Role of Contralateral Vertebral Artery Occlusion to prevent Endoleak

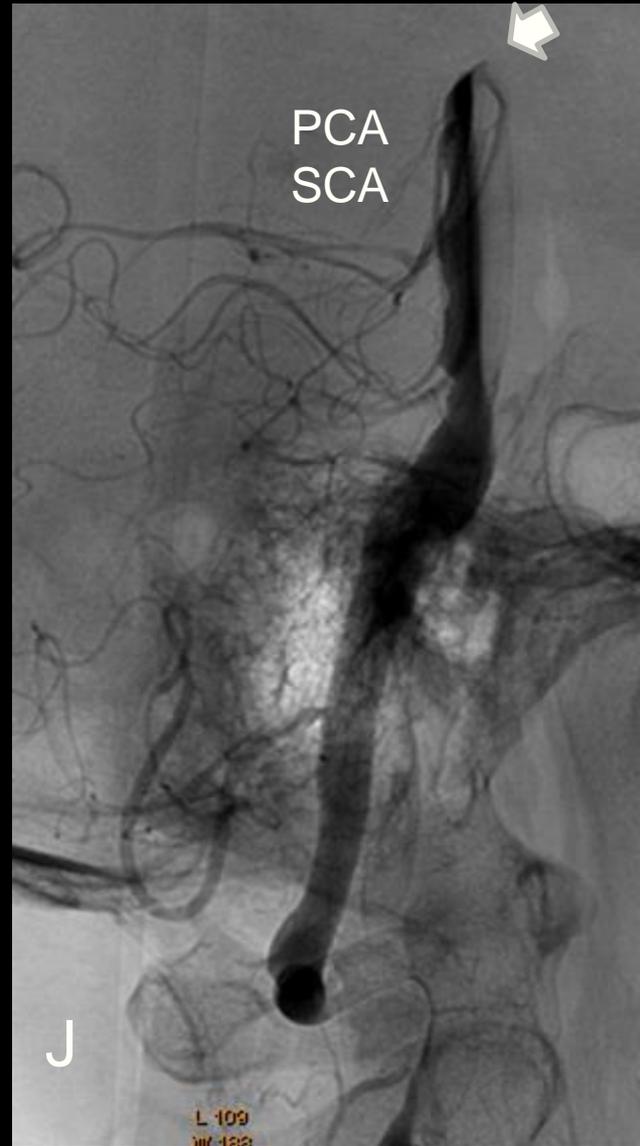
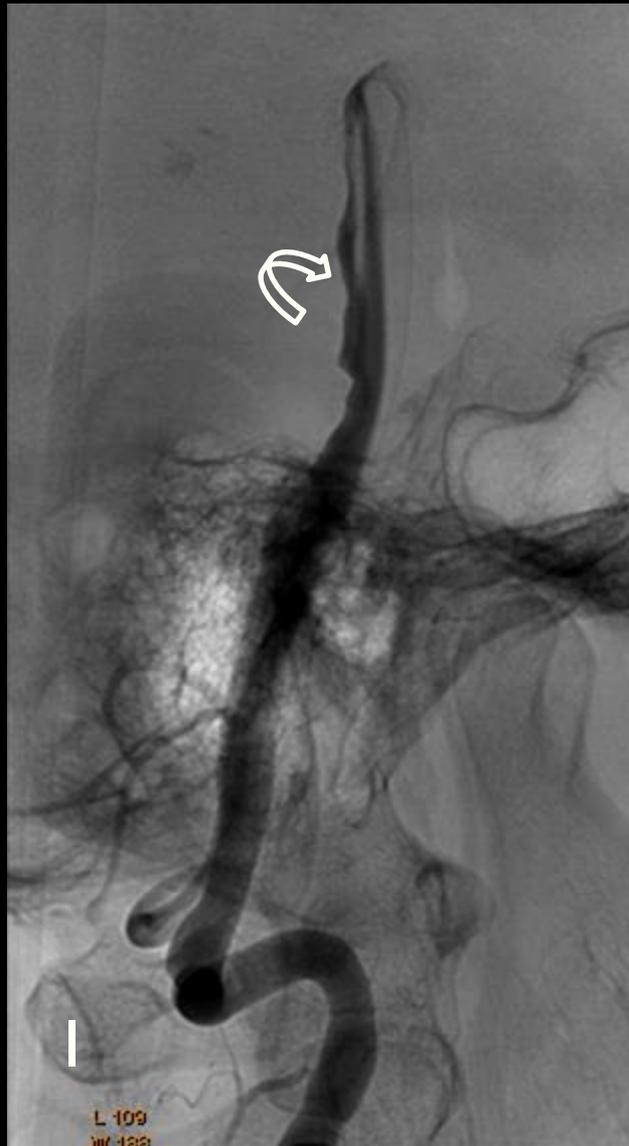
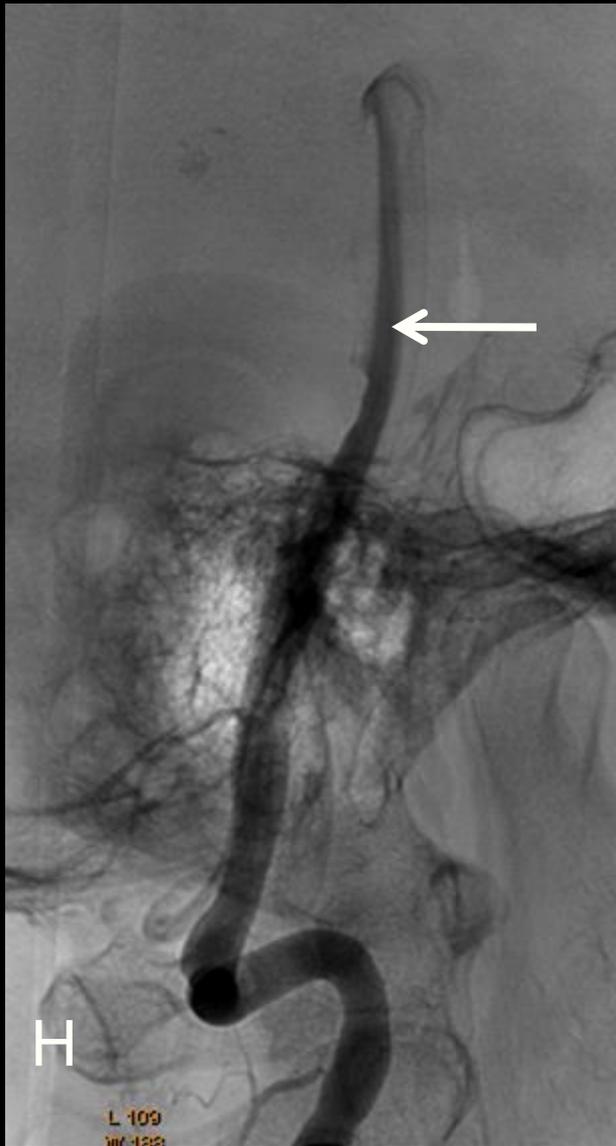


60-year-old male with a history of a right middle cerebral artery ischemic infarction and new lower cranial nerve deficit associated with a fusiform basilar artery aneurysm.

# Single 4.4 mm x 80mm long 1<sup>st</sup> Gen SURPASS FD

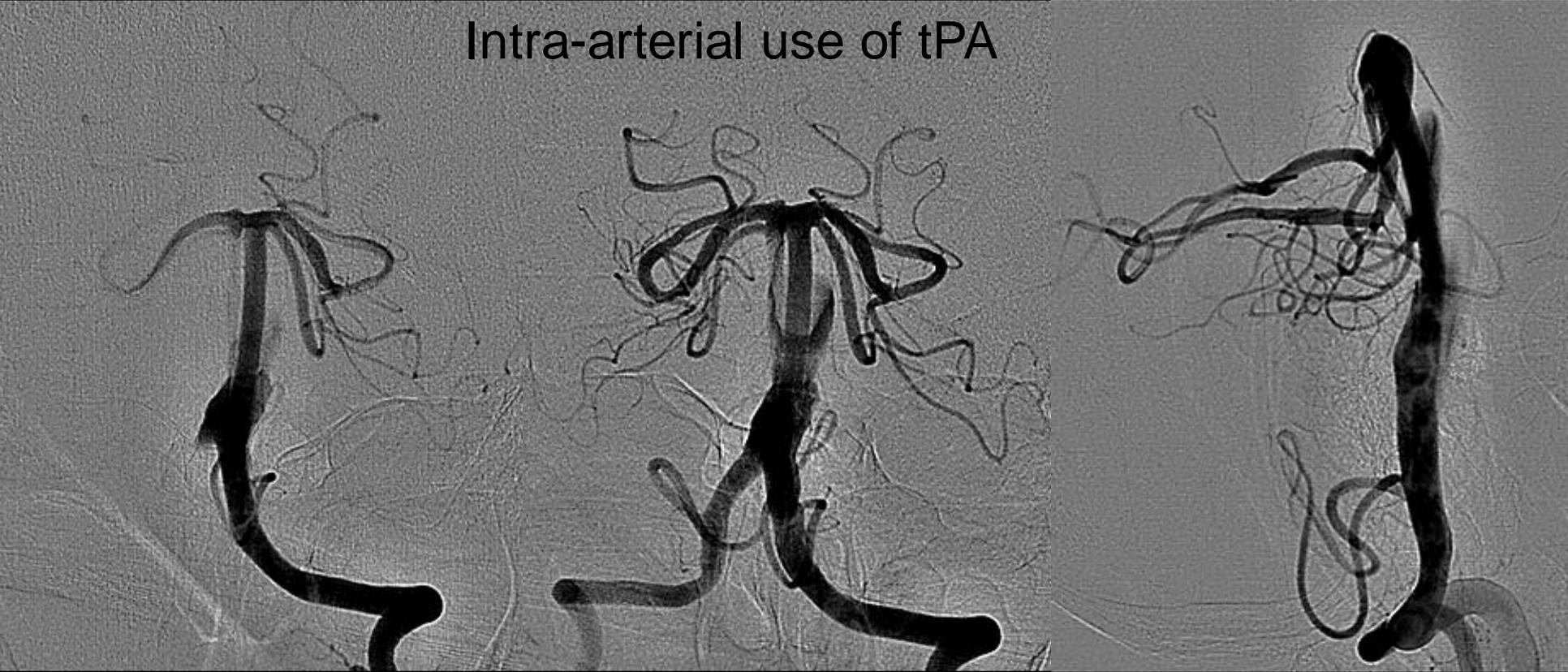


Surpass FD is currently not FDA approved

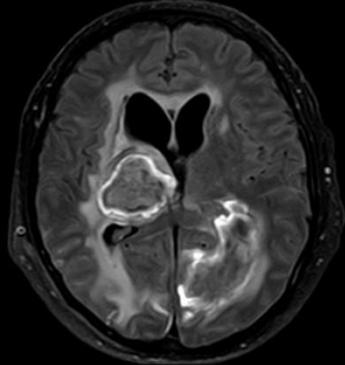


# 2-day FU

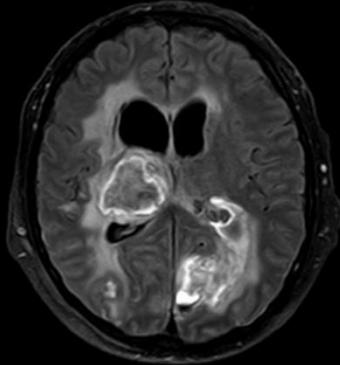
Intra-arterial use of tPA



Single 4.4 mm x 80mm long 1<sup>st</sup> Gen SURPASS FD



27-Jul-2010



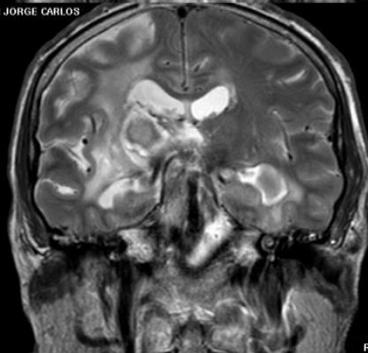
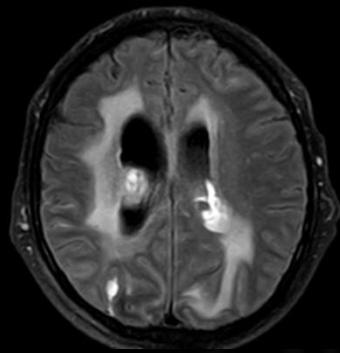
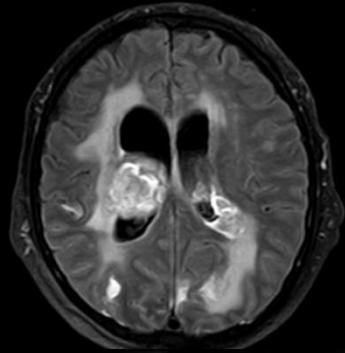
27-Jul-2010 RIMORINI JORGE CARLOS



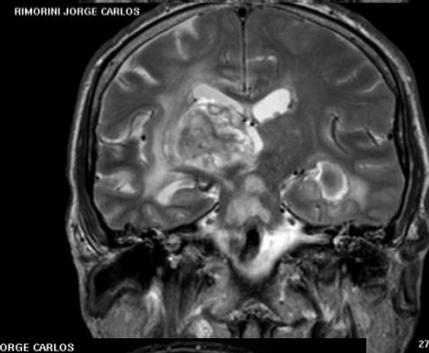
16:27:42  
27-Jul-2010



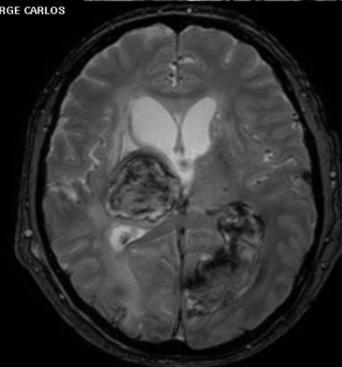
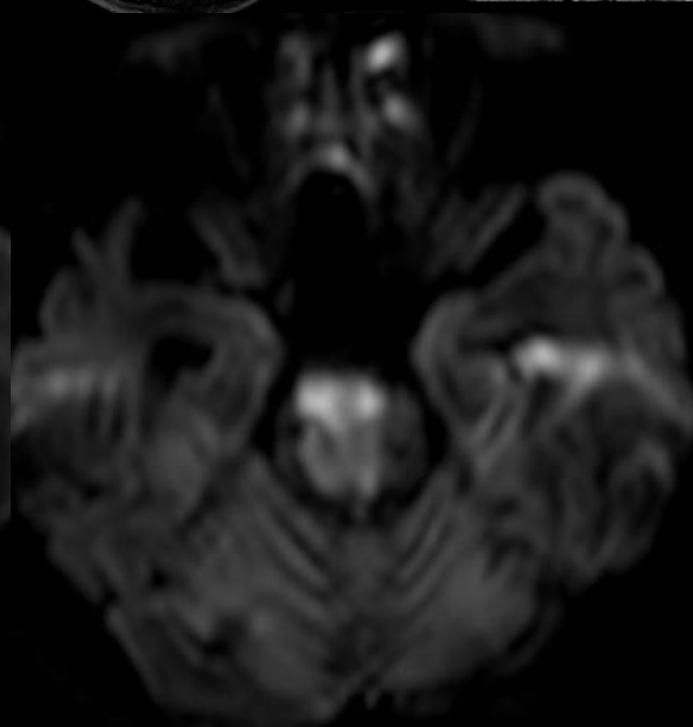
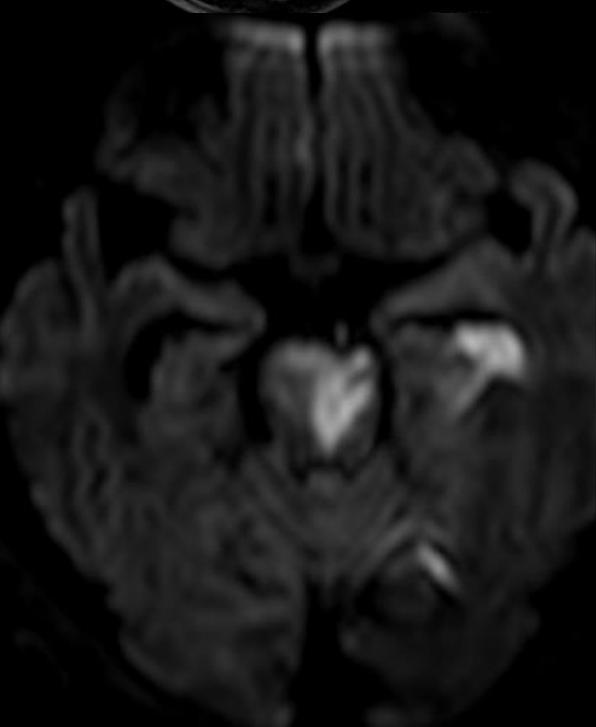
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27-Jul-2010



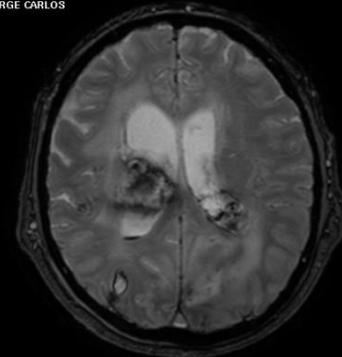
16:27:42  
RIMORINI JORGE CARLOS



16:27:42  
27-Jul-2010

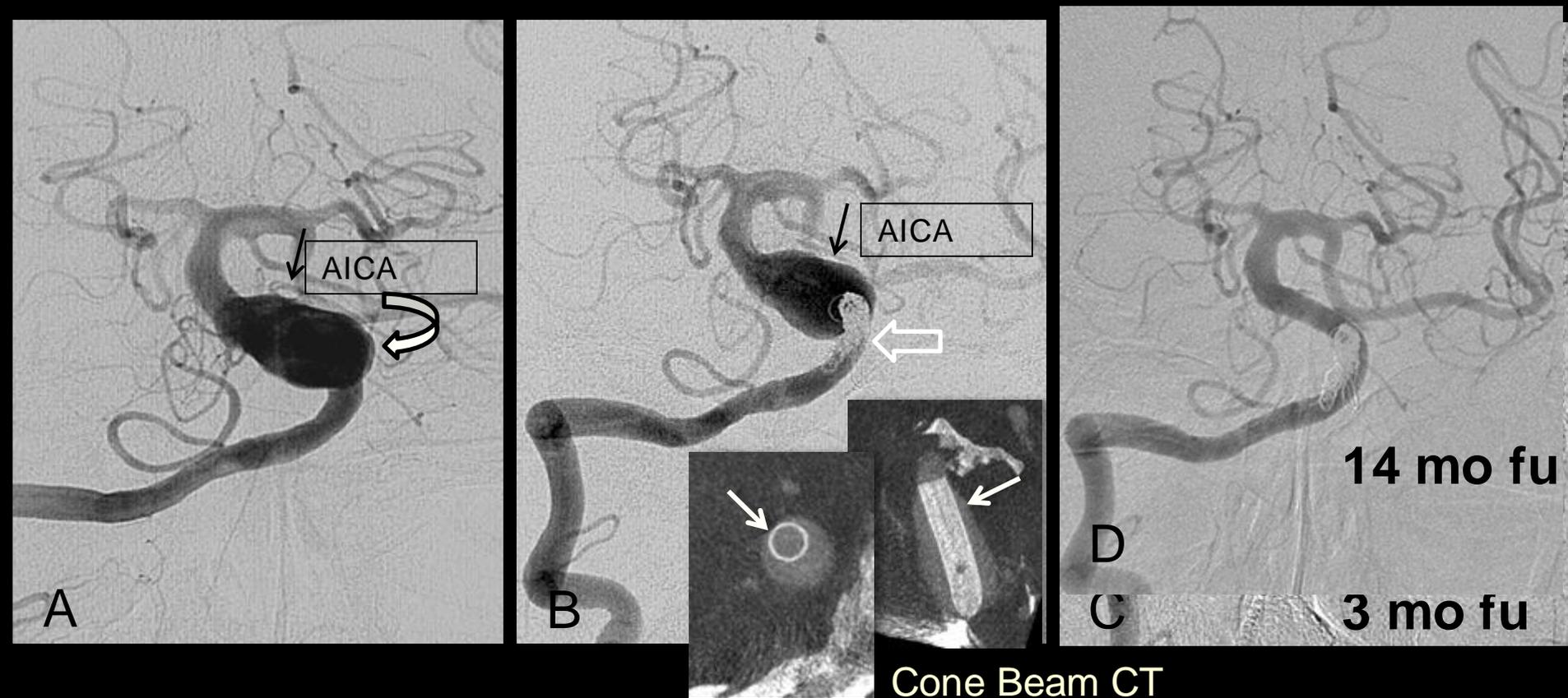


RIMORINI JORGE CARLOS



# Role of contralateral VA occlusion

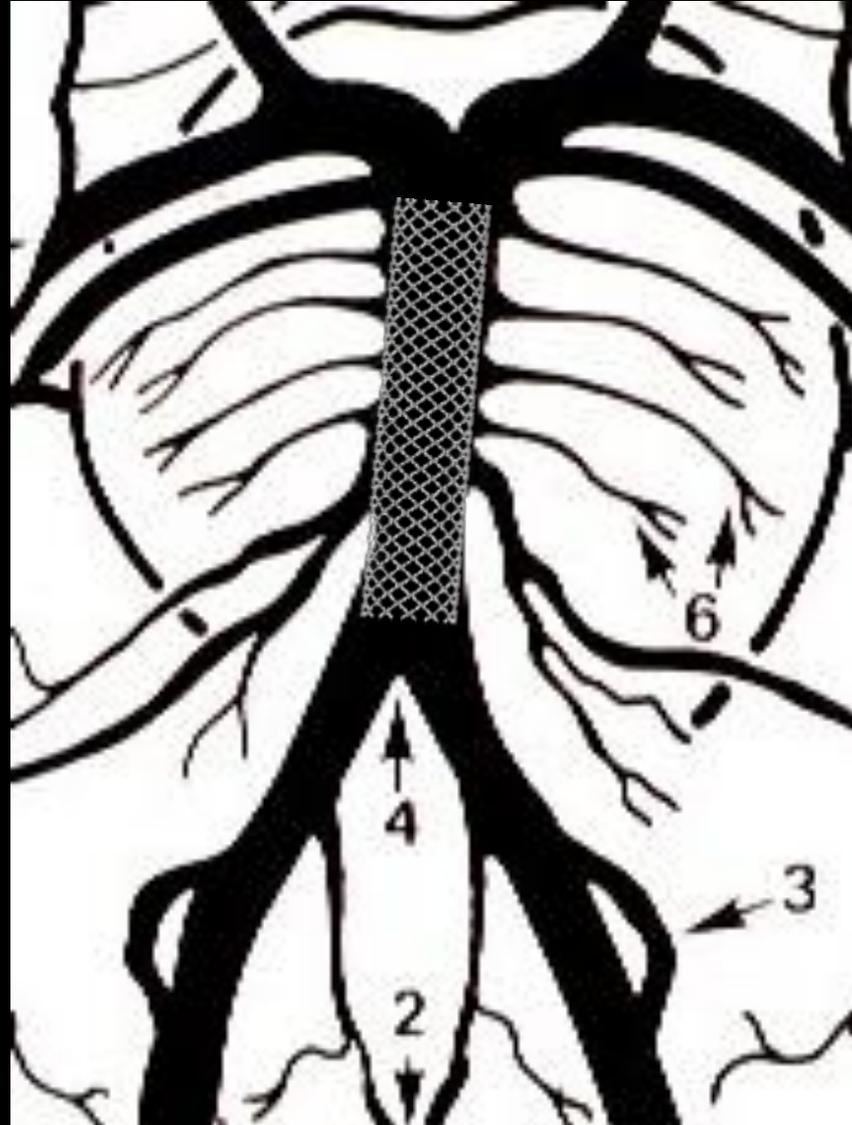
- Symptomatic Vertebro-basilar fusiform aneurysm
- Coil occlusion of left Vertebral artery to avoid “endoleak”



Surpass FD 5.3mm x 50mm

# Study Objective

Presence of  
dense  
perforators



# SURPASS FD multicenter registry

## Patient Data

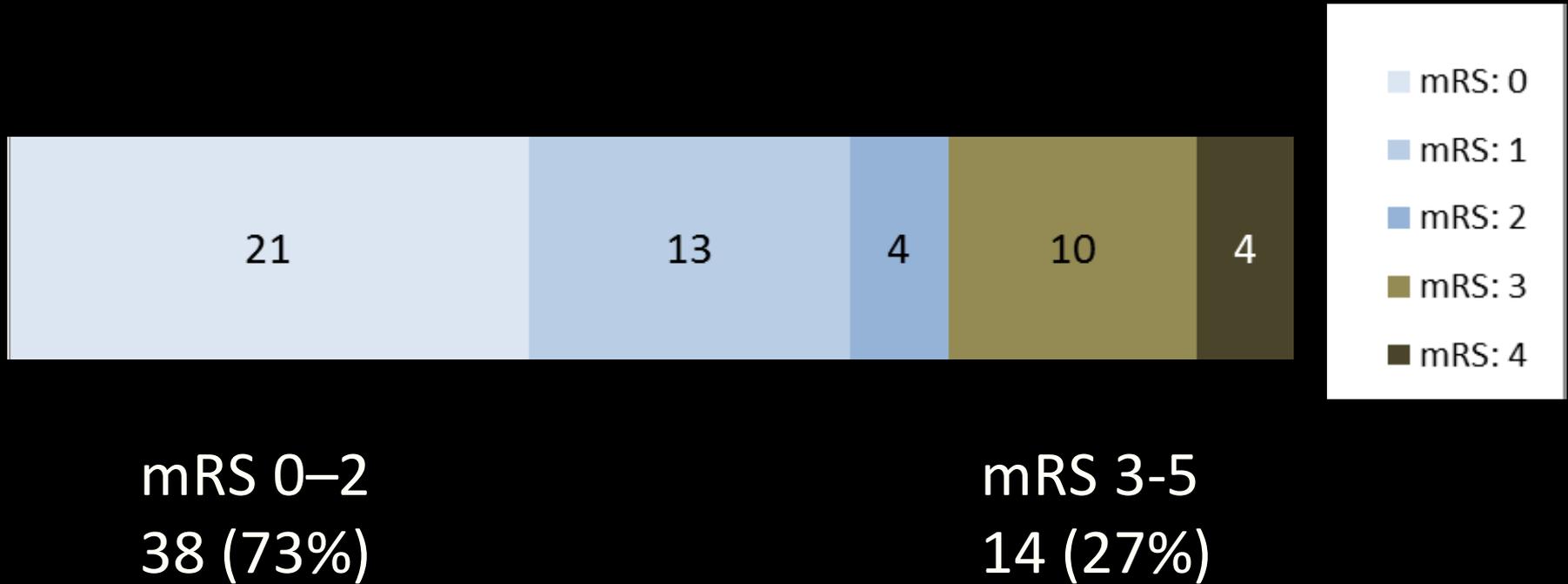
General information	
Patients	52
Aneurysms	52
Women (%)	21 (41%)
Mean age (yr) [range]	54 [16-79]

# SURPASS FD multicenter registry

## Presentation/Indication for Treatment

General information	
Acute SAH	7/52 (13%)
Stroke/TIA	7/52 (13%)
Cranial nerve deficit/mass effect	14/52 (27%)
Incidental findings/headaches	20 (38%)
Recurrent after coiling/stenting/failed clipping	16 (31%)

# Baseline mRS (n=52)



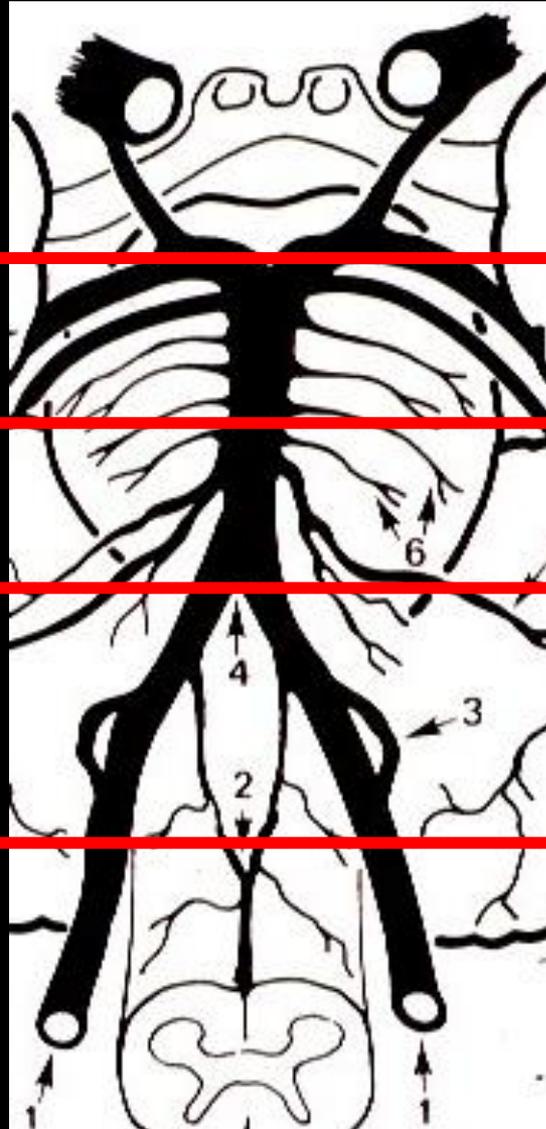
# Aneurysm location (n=52)

PCA

Basilar trunk

VB Junction

Vertebral artery



6 (12%)

15 (29%)

11 (21%)

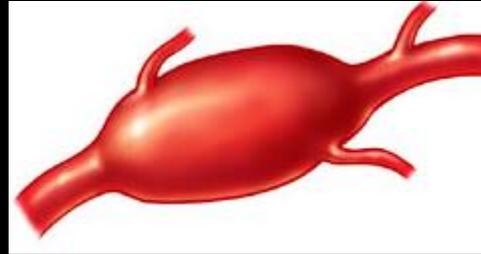
20 (38%)

# Aneurysm sizes (n=52)

< 5 mm	4 (8%)
5 – 9.9 mm	13 (25%)
10 – 20 mm	17 (33%)
> 20 mm	17 (33%)

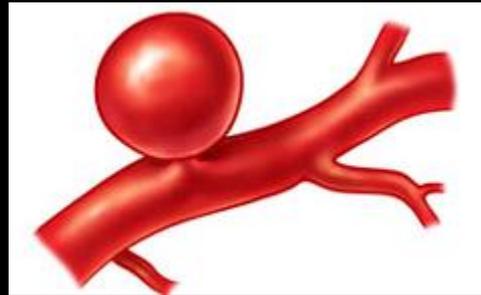
# Aneurysm type (n=52)

Fusiforme



39 (75%)

Wide-neck Saccular



12 (23%)

Blood-blister type



1 (2%)

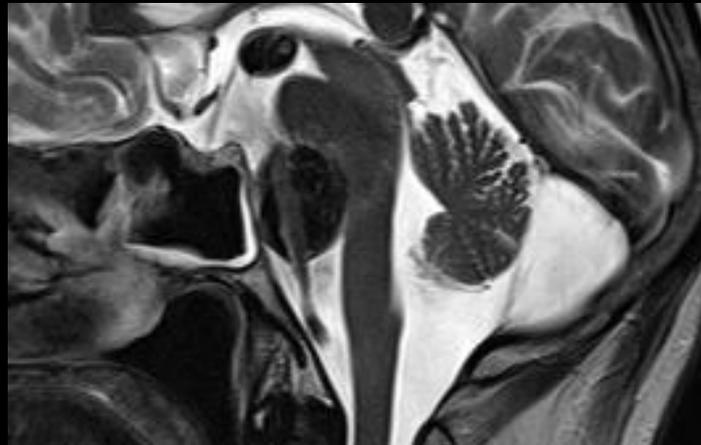
# Aneurysm characteristics

Pretreated  
(Coil, Stent, Clip,  
failed surgery)



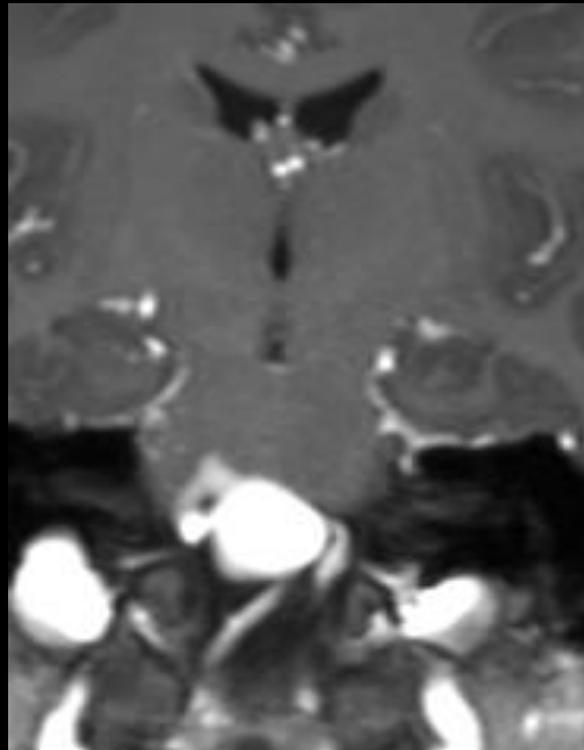
16 (31%)

Partially  
thrombosed



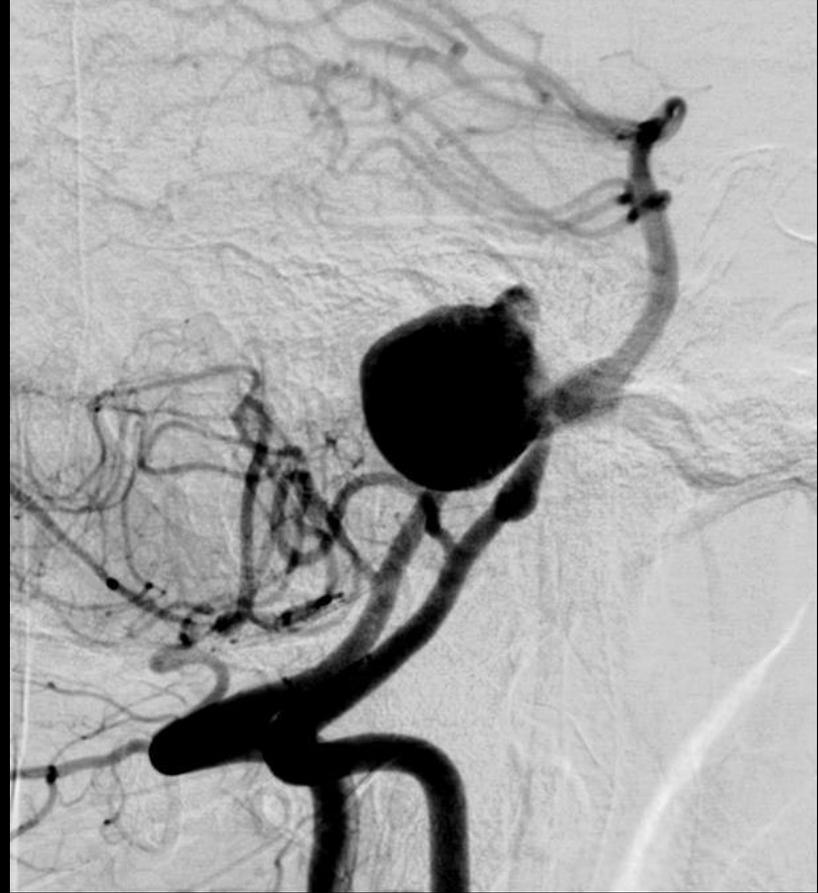
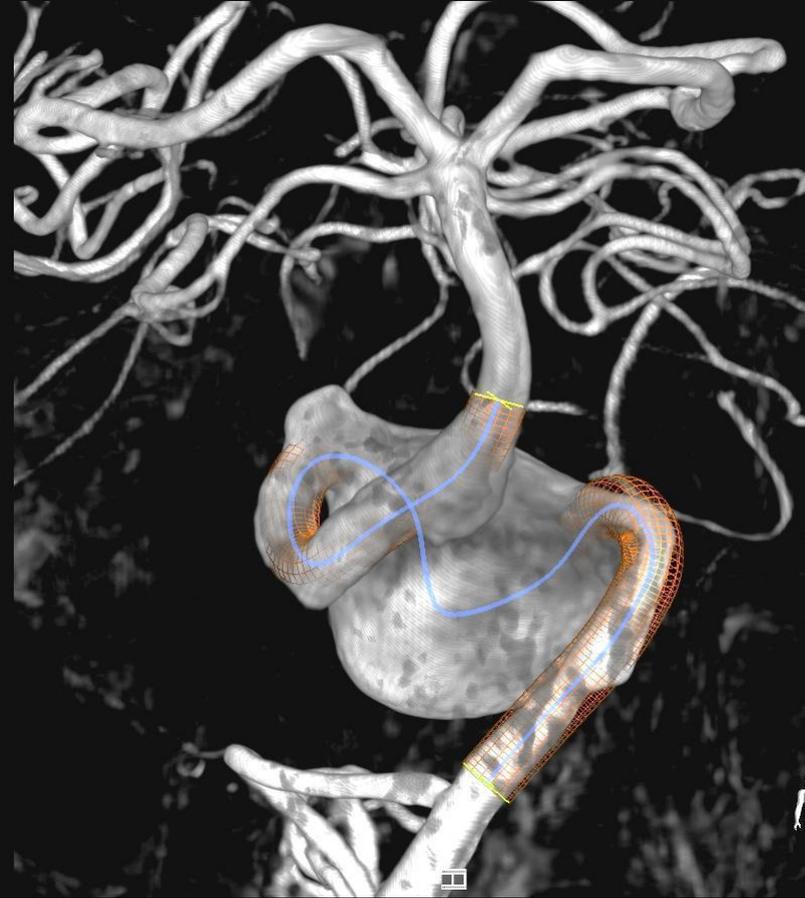
14 (27%)

# Symptomatic basilar tip aneurysm



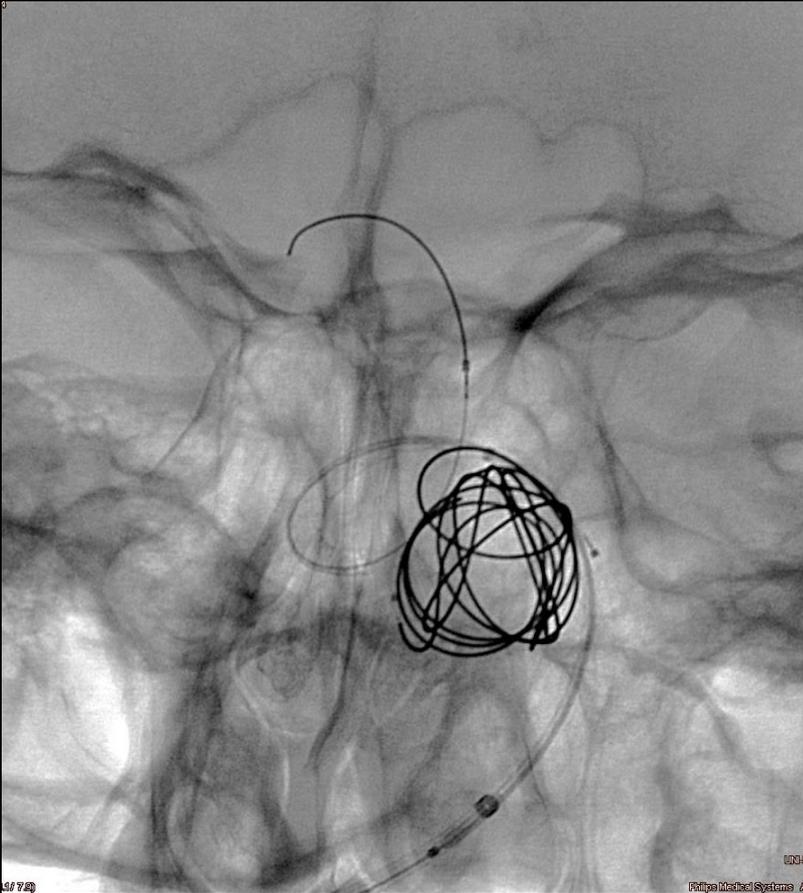
29-y-o-m w progressive incapacitating headaches and gait disturbance

# Symptomatic basilar tip aneurysm

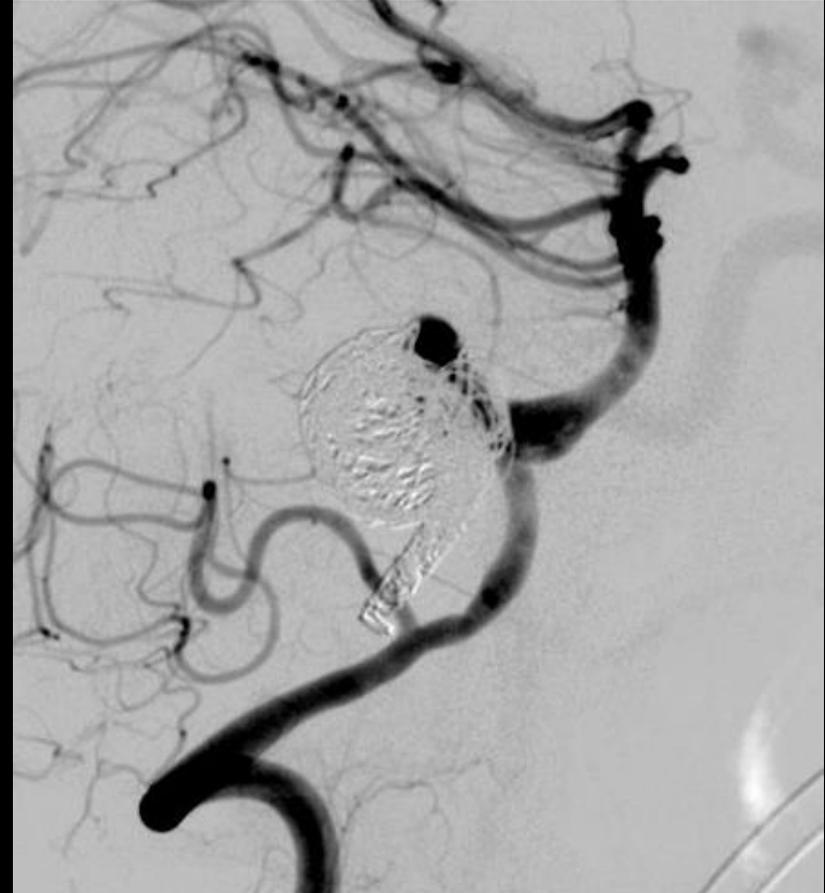


# Symptomatic basilar tip aneurysm

## Combined use of coils



# Symptomatic basilar tip aneurysm



24 hour follow-up

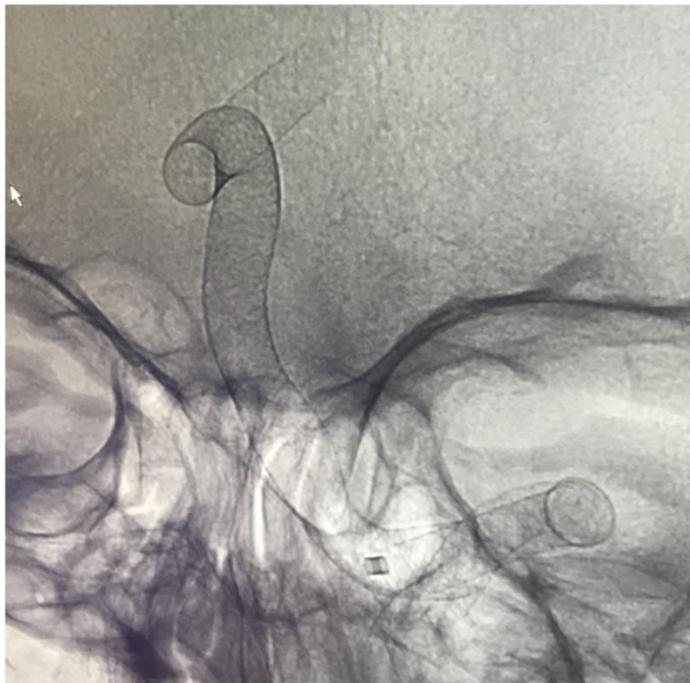
# Aneurysm treatment

Technical success rate

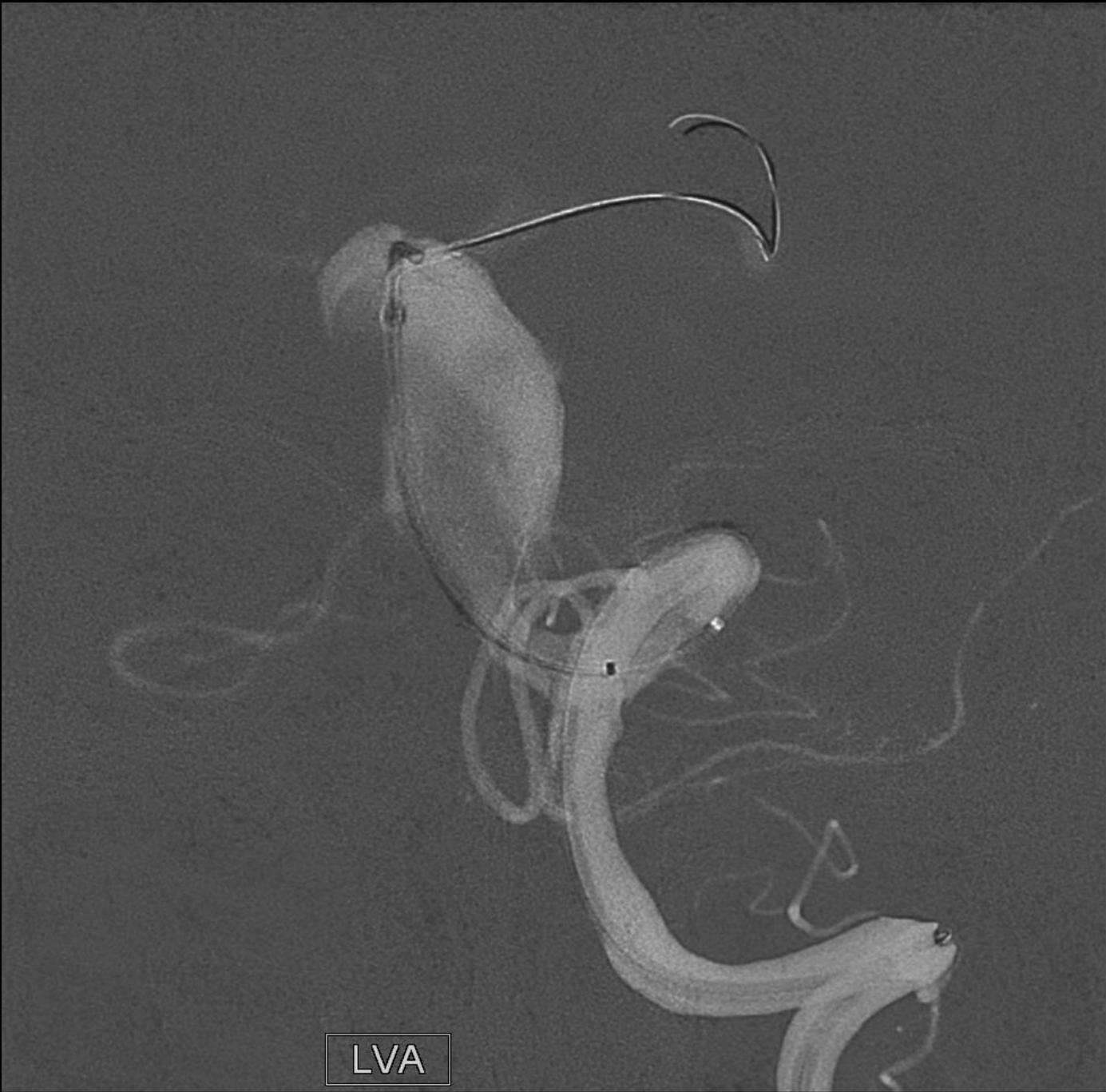
51/52 (98%)

Average # of FD / case

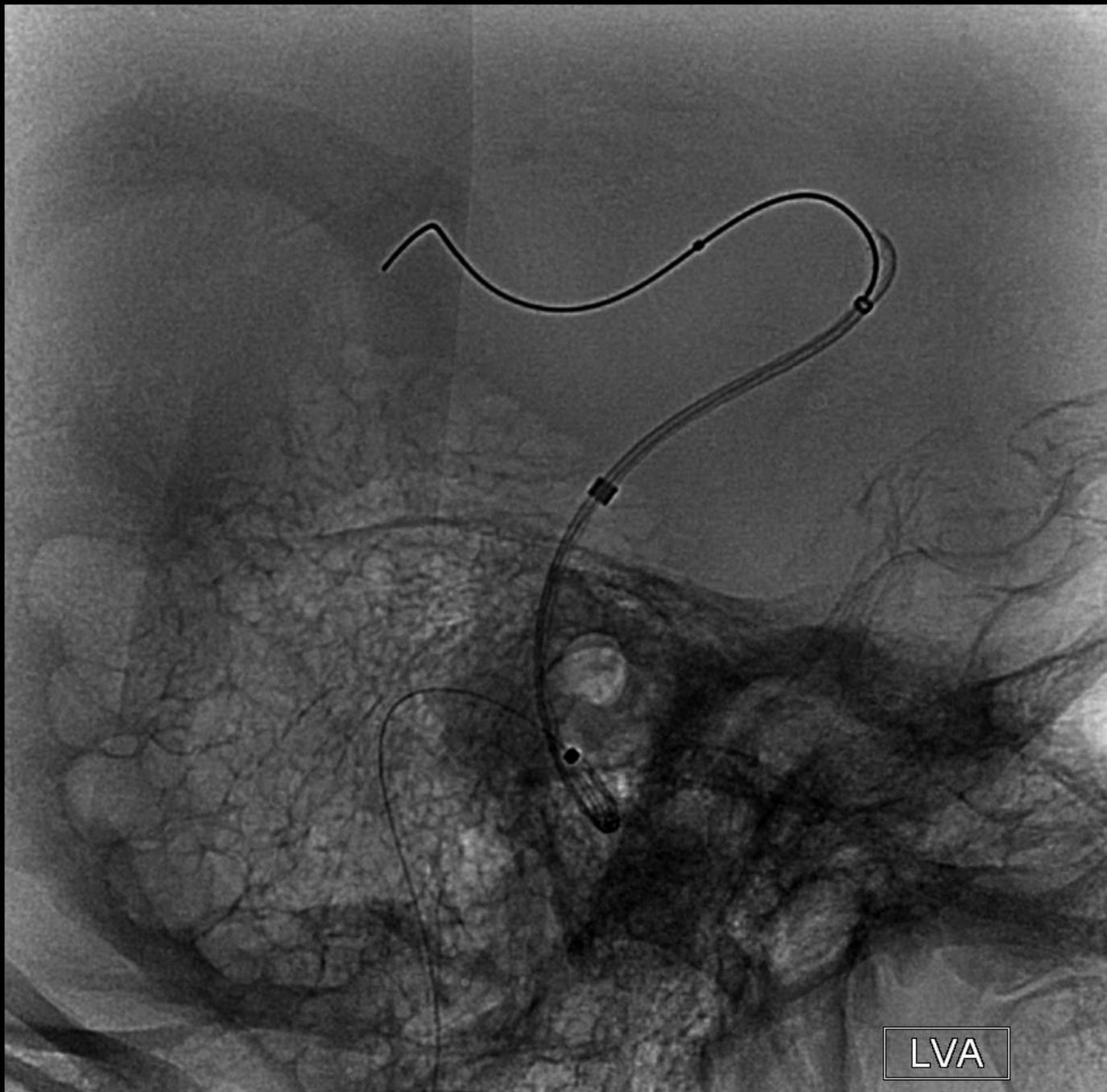
1.4 (range 1 – 3)



24  
14-12



LVA

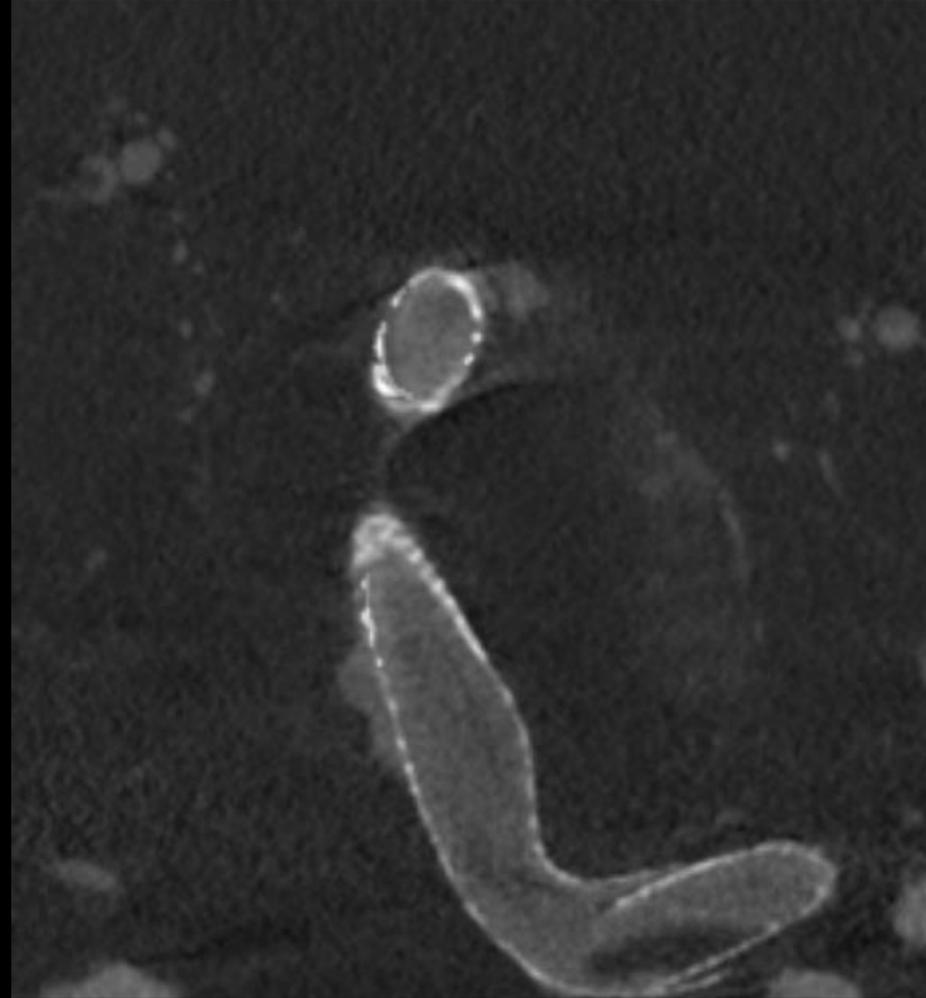


LVA

LVA



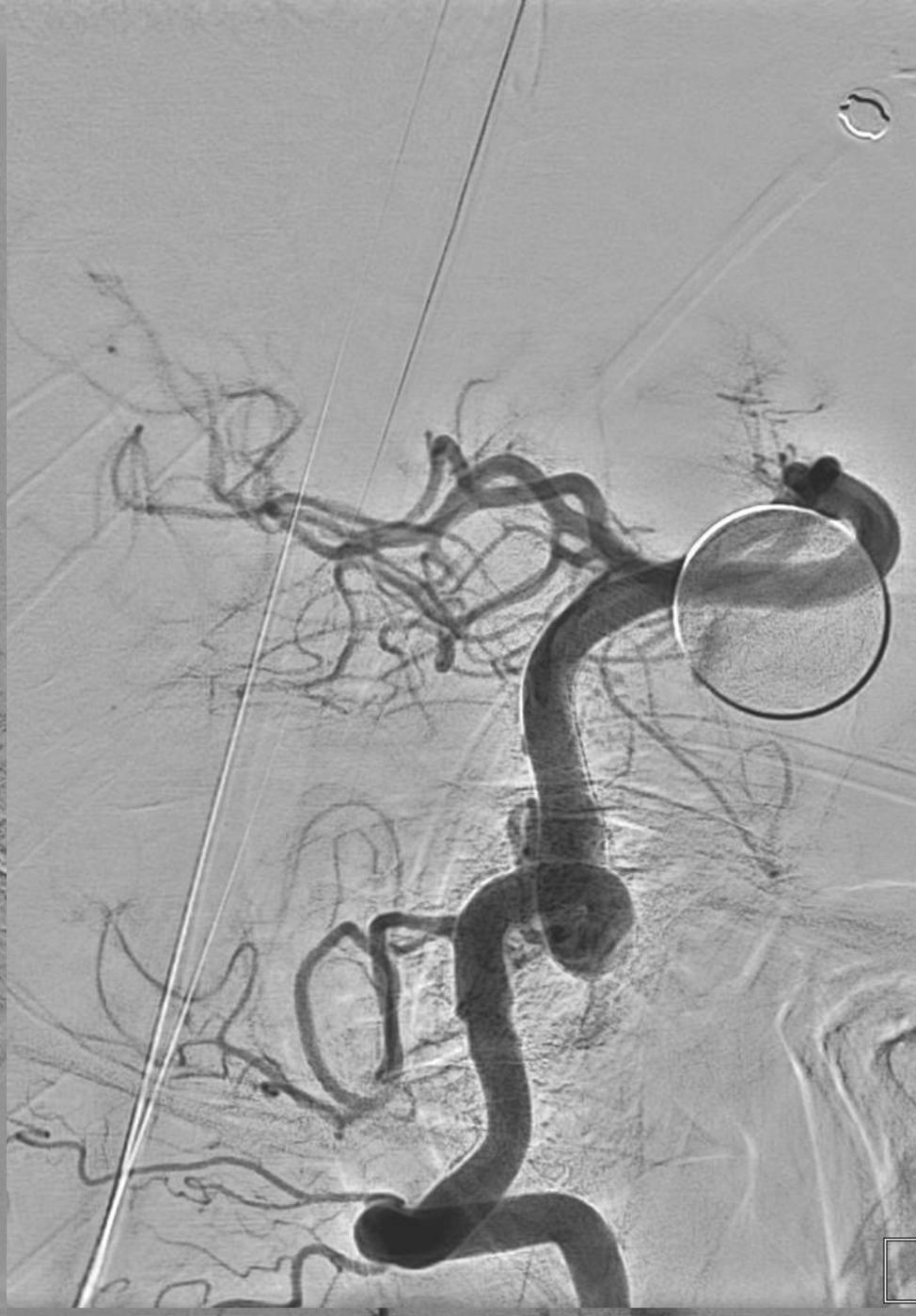
# Malapposition of telescoping FDs



...requiring post dilation LVA

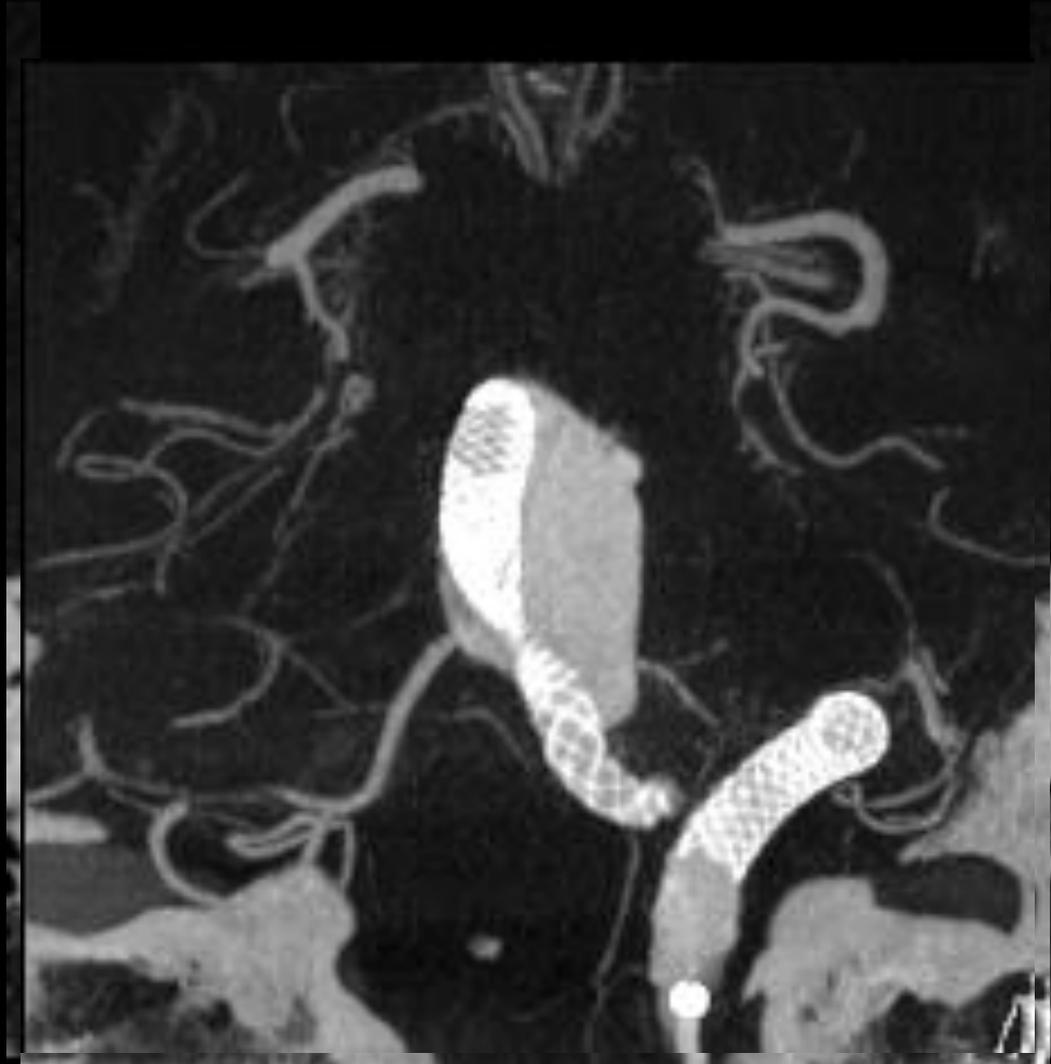


6 months follow-up

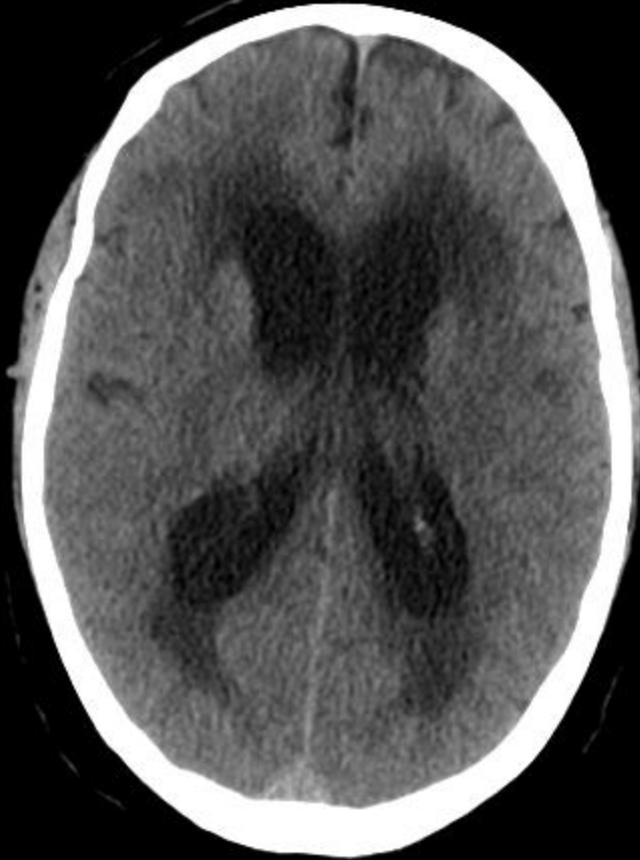




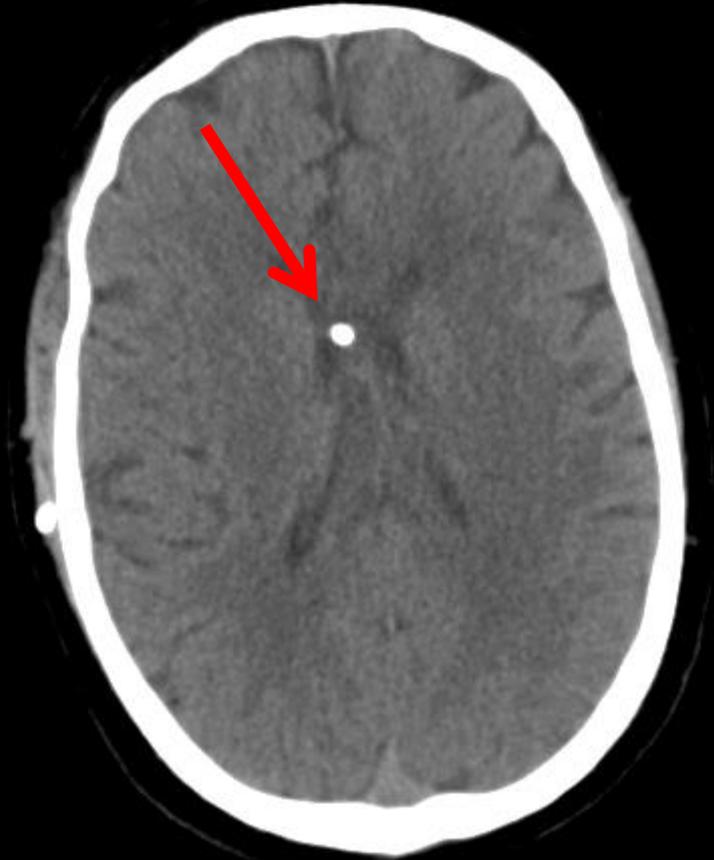
# 6-month follow-up



Requirement: Intraoperative placement of a shunt due to hydrocephalus via burr hole

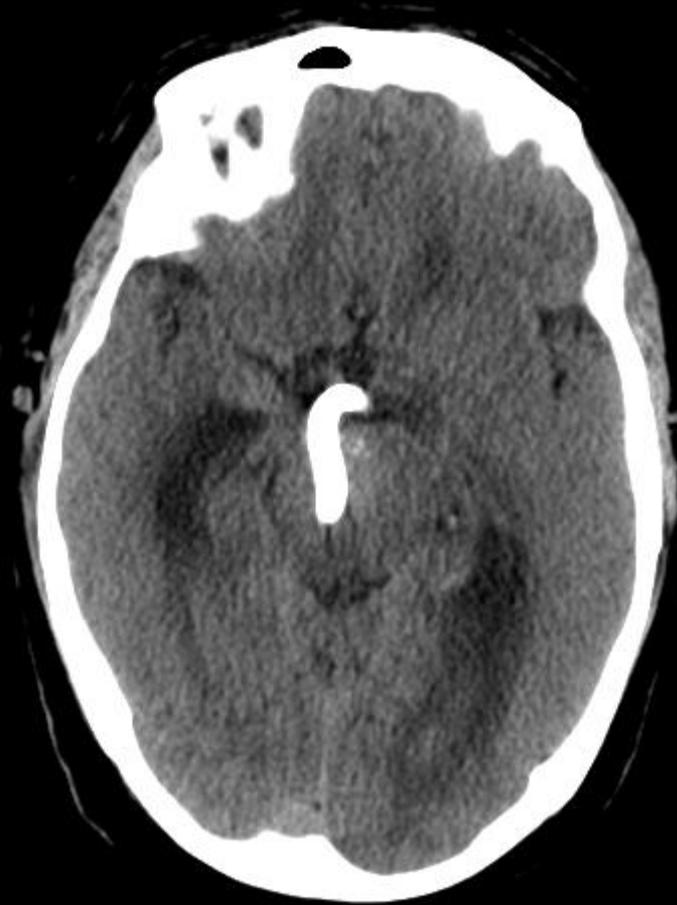


Before shunt



After shunt

# Requirement: Placement of a shunt due to hydrocephalus



Before shunt



After shunt

# Requirement: Placement of a shunt due to hydrocephalus



Before shunt



After shunt

# Aneurysm treatment

**Procedural complications 9 (17.3%)**

(binary; 95% CI:8.2%-30.3%)

Aneurysmal rupture	1/52
Dissection target vessel	2/52
Thrombus formation	6/52

**Procedure complications correlated with patient age ( $p < 0.05$ )**

Procedure complications did not correlate with location ( $p = 0.304$ )

Procedure complications did not correlate with # of FDs ( $p < 0.2$ )

# Aneurysm treatment

## New neurological deficit @ 24h follow up

(binary; 95% CI: 15.6%-41%)

Death	1/52
Tetraparesis	1/52
Hemiparesis	2/52
Cranial nerve deficits	6/52

New neurological deficit correlated with **baseline mRS** ( $p=0.0018$ )  
**location** ( $p=0.028$ )  
**# of FDs** ( $p=0.0266$ )  
**aneurysm size** ( $p=0.0071$ )  
**Neck size** ( $p=0.0359$ )

# Complications during hospital stay

Neuro	
Ischemia	4
Asymptomatic ICH	3
SAH	1

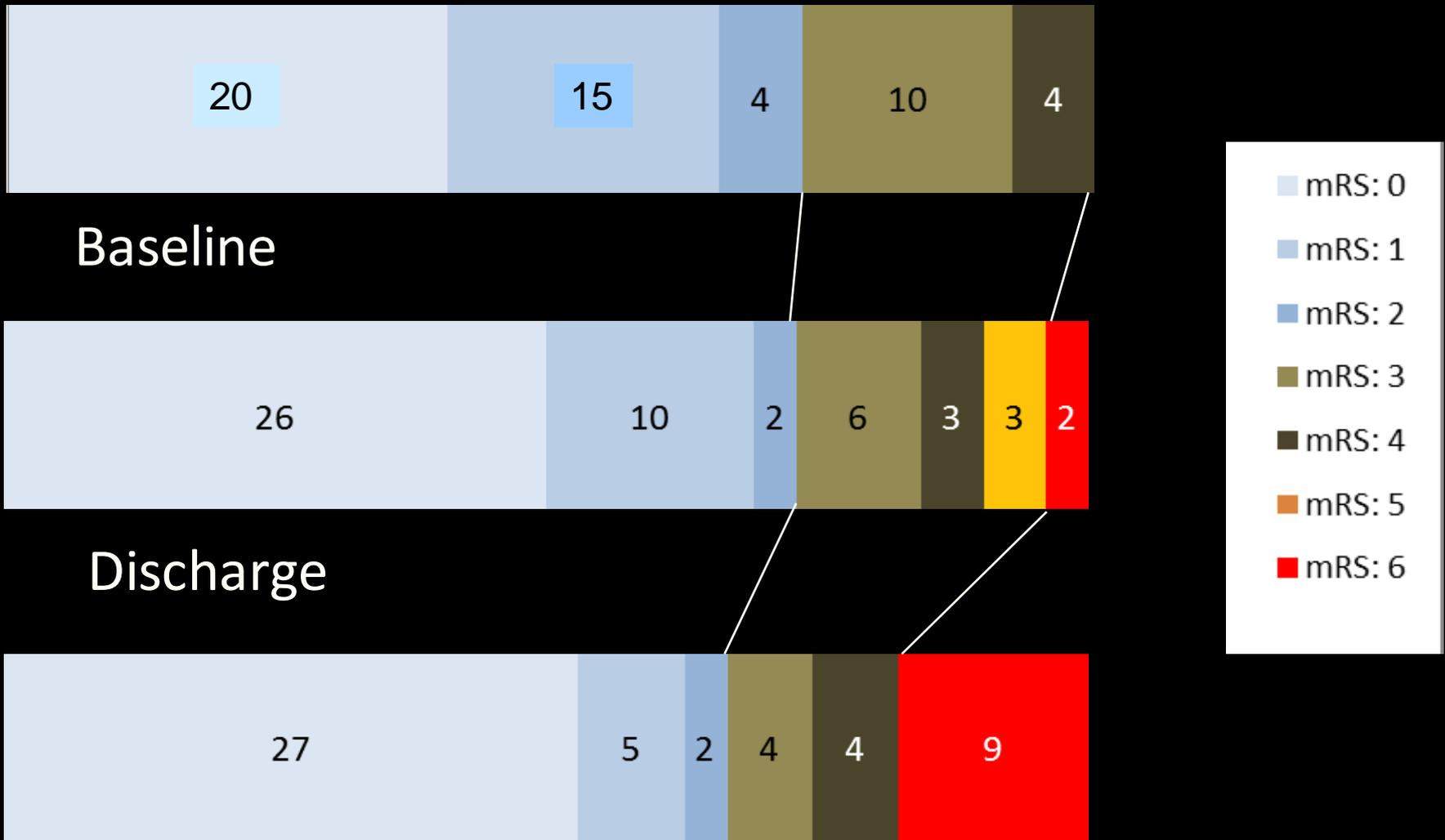
Clinically stable                      39/52 pts                      (75%)

Clinically improved                      7/52 pts                      (13%)

Clinically deteriorated                      4/52 pts                      (8%)

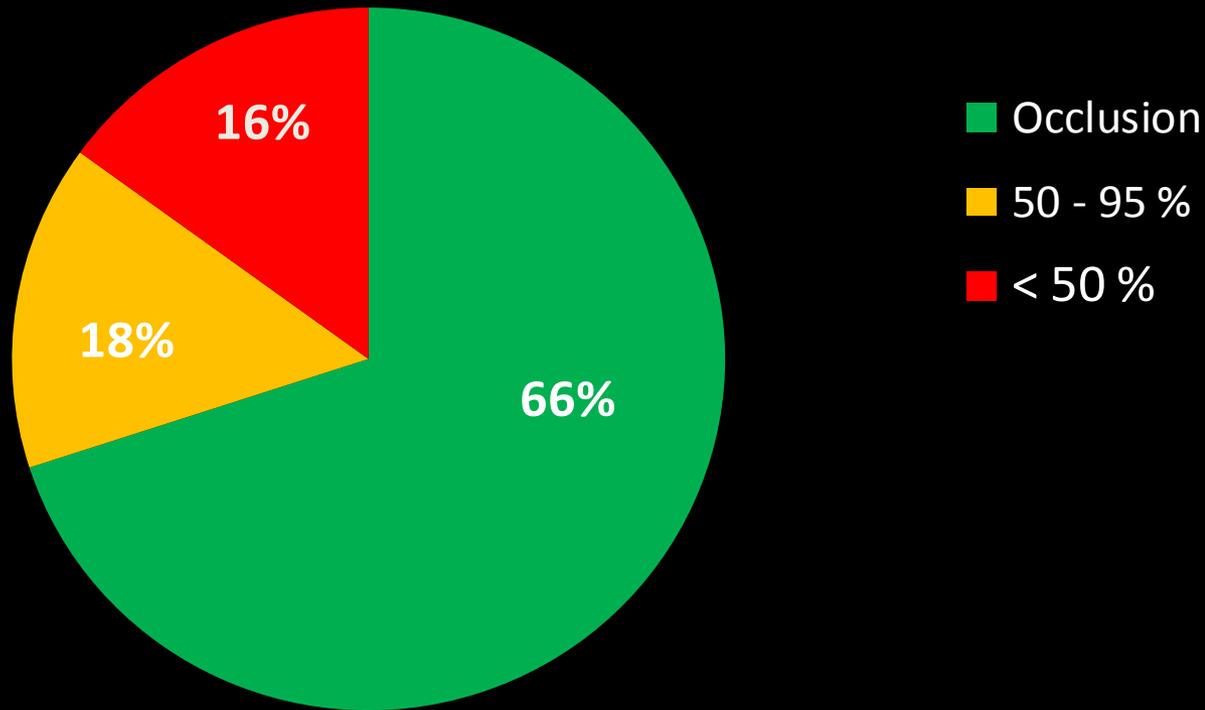
Death                      2/52 pts                      (4%)

# Clinical Outcome



Follow-up: mean 11.3 months (range 6 – 12.7)

# Angiographic outcome (n=44; 85%)



Follow-up: mean 11.3 months (range 1 – 23)

## mRS shift: All patients (n=51)

Baseline mRS	mRS at follow-up						
	mRS 0	mRS 1	mRS 2	mRS 3	mRS 4	mRS 5	mRS 6
mRS 0 (n=21)	20	1					
mRS 1 (n=12)	4	4	1	1	1		1
mRS 2 (n=4)	1		1		1		1
mRS 3 (n=10)	2			3			5
mRS 4 (n=4)					2		2

Improvement mRS 2/3	Improvement mRS 1	Stable mRS	Deterioration mRS 1	Deterioration mRS 2/3
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All cause mortality rate of 17.3% (95% CI: 7%-27.6%);  
 13.5% directly related to procedure  
 Morbidity 13.9% (95% CI: 3.6%-24.3%);

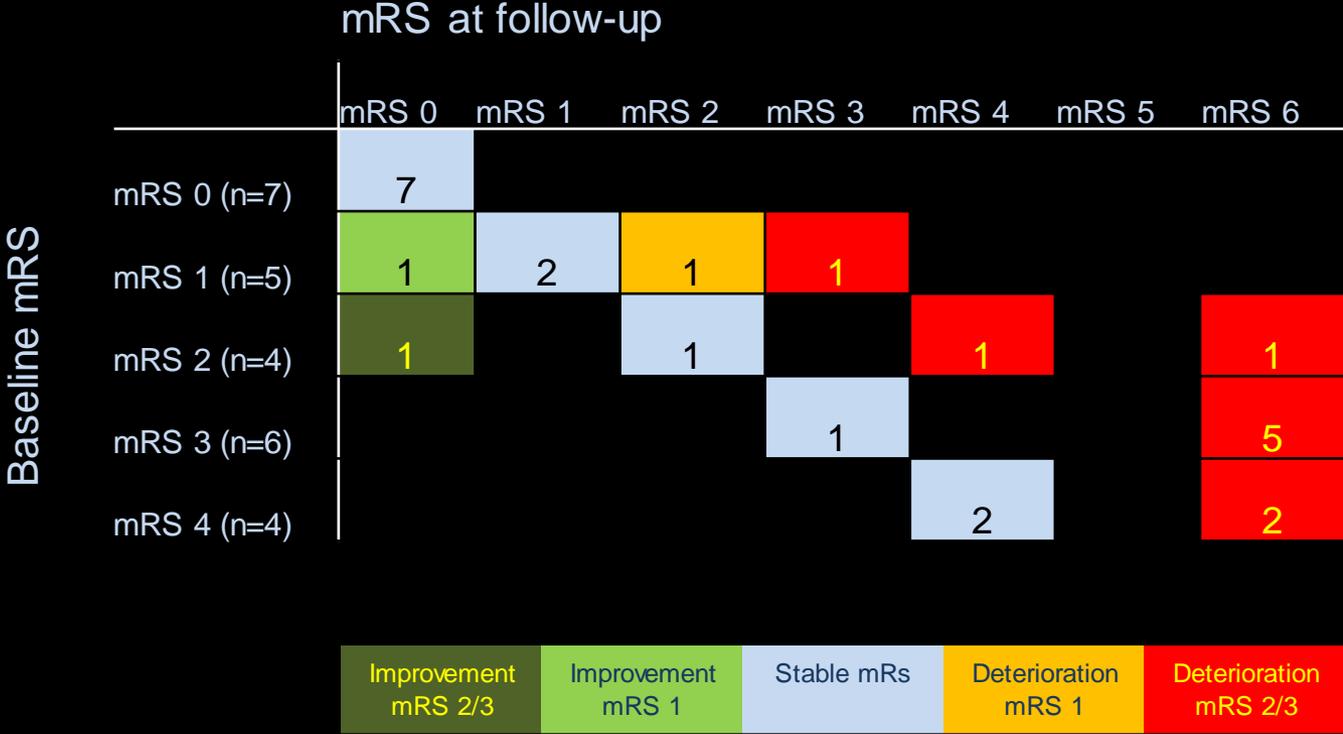
# mRS shift: Vertebral artery aneurysm (n=19)

		mRS at follow-up						
		mRS 0	mRS 1	mRS 2	mRS 3	mRS 4	mRS 5	mRS 6
Baseline mRS	mRS 0 (n=13)	12	1					
	mRS 1 (n=5)	3	1					1
	mRS 2 (n=0)							
	mRS 3 (n=1)				1			
	mRS 4 (n=0)							

Improvement mRS 2/3	Improvement mRS 1	Stable mRS	Deterioration mRS 1	Deterioration mRS 2/3
------------------------	----------------------	------------	------------------------	--------------------------

# mRS shift: Basilar artery/VB junction aneurysm (n=26)



# Summary

Treatment of aneurysms located in the posterior circulation with the Surpass FD is feasible

It shows a variable safety profile

Good clinical outcomes were observed in patients bearing aneurysms of the vertebral artery

Worst outcome was observed in symptomatic patients with fusiform aneurysms of the basilar artery and the VB junction

# Conclusion

In patients with fusiform basilar and VB junction aneurysms the clinical outcome seemed better in asymptomatic patients when compared to symptomatic patients

Overall morbidity and mortality 27%

Asymptomatic patient: morbidity 5% mortality 0%

Symptomatic patient: morbidity 44% mortality 28%

# Conclusion

Mortality was positively correlated with

- Baseline mRS (p=0.0001)
- Age (p=0.018)
- Aneurysm location (p=0.02)
- Aneurysm size (p=0.0098)
- Neck diameter (p=0.06)
- Number of FDs (p=0.0002)

# Discussion Points

1. Classification of basilar trunk aneurysms?
2. Time for a multicenter study for large/giant basilar trunk/VB junction aneurysm?