

"Focus! . . . Focus!"

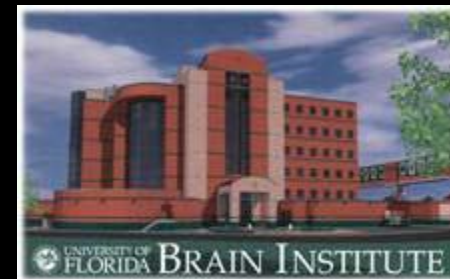
# Vascular malformations: The Neurosurgical approach



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# ***Vascular malformations***

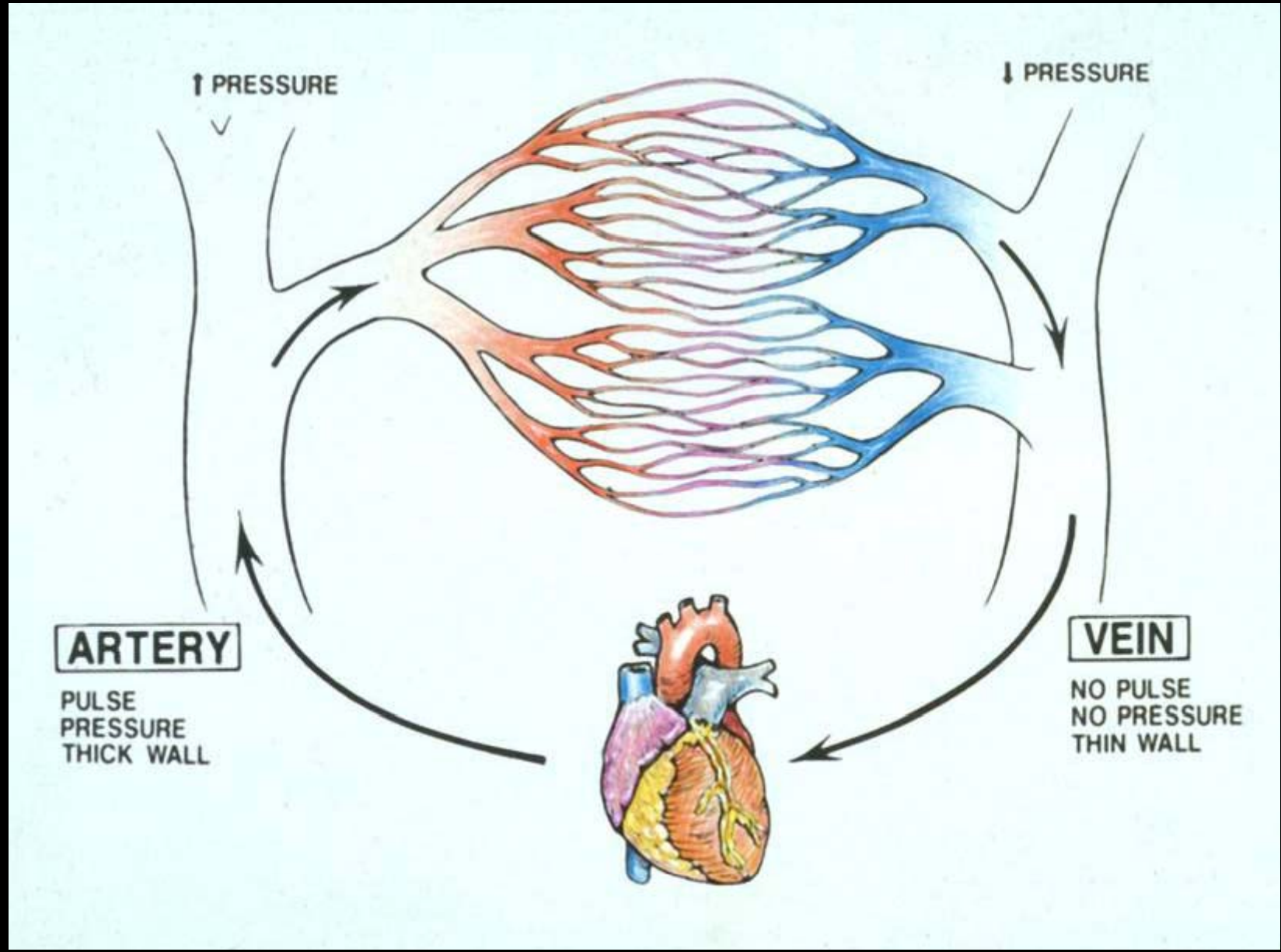


**Arteriovenous malformation**

**Capillary telangiectasia**

**Cavernous malformations**

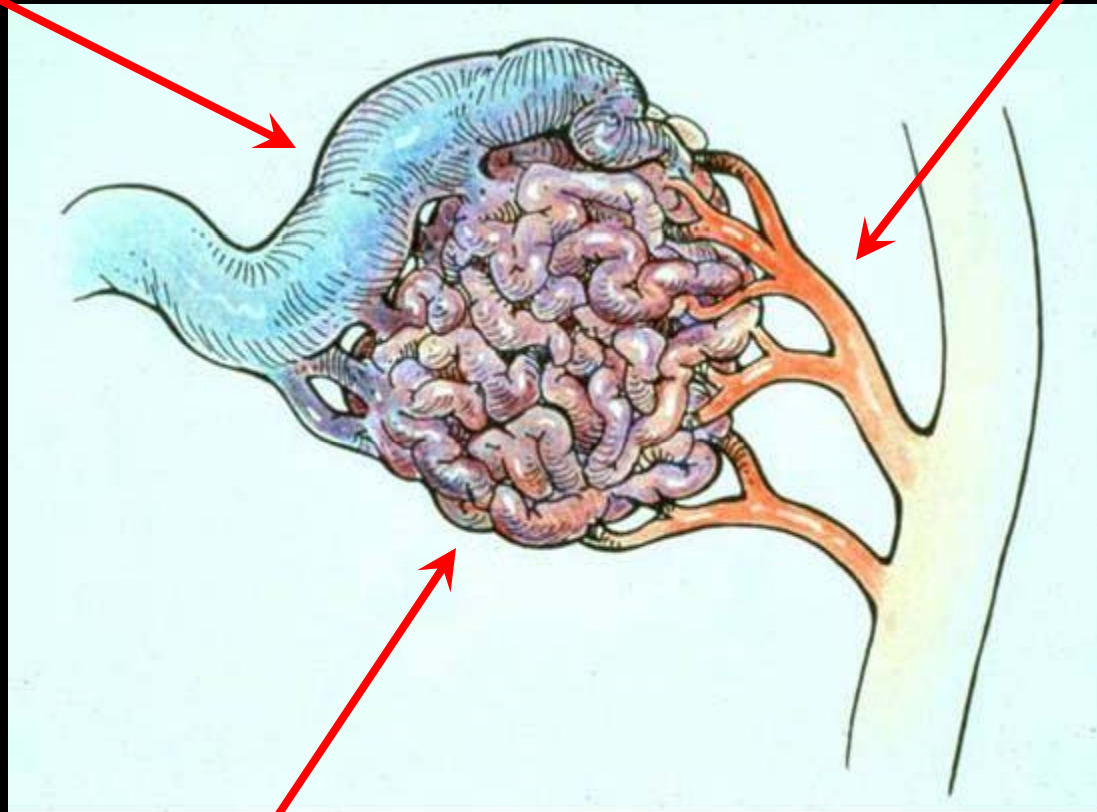
**Venous angiomas**



# ***AVM: morphologic components***

**Draining veins**

**Feeding arteries**



**Dysplastic vascular core (nidus)**

# ***AVM: types***

## **1. Parenchymal**

- a. pial**
- b. subcortical**
- c. paraventricular**
- (d) combinations**

## **2. Dural**

## **(3) Combinations**



# ***AVM: natural history***

**Frequency:** 1.4 to 4.3% of the population

**Age:** Before 40 years of age

**Presentation:**

1. Hemorrhage (> 50%)
  - ICH, IVH, SAH
2. Seizures (20 to 25%)
3. Headache (15%)
4. Focal neuro deficit (5%)
5. Other – tinnitus, steal, CHF

# **AVM: natural history**

**Hemorrhage:** long term risk and outcome controversial

<b>Author</b>	<b>Study type</b>	<b>Cases</b>	<b>Follow-up (y)</b>	<b>Hemorrhage rate (%/y)</b>
Brown (1988)	Retrospective	168	8.2	2.3
Graf (1983)	Retrospective	71	4.8	4.1
Crawford (1986)	Retrospective	217	10.4	3.4
Ondra (1990)	Retrospective	160	23.7	1.7
Mast (1997)	Prospective	139	1.0	2.2

**Lifetime risk of hemorrhage (%):**  $105 - \text{age (years)}$

(Kondziolka et al. Neurosurgery 1995; 37:851-855)

# ***AVM: natural history***

## **Unruptured AVM risks:**

**Risk of death:** 1% per year

**Risk of disability:** 1% per year

## **Effect of hemorrhage:**

**Mortality:** 10 to 30%

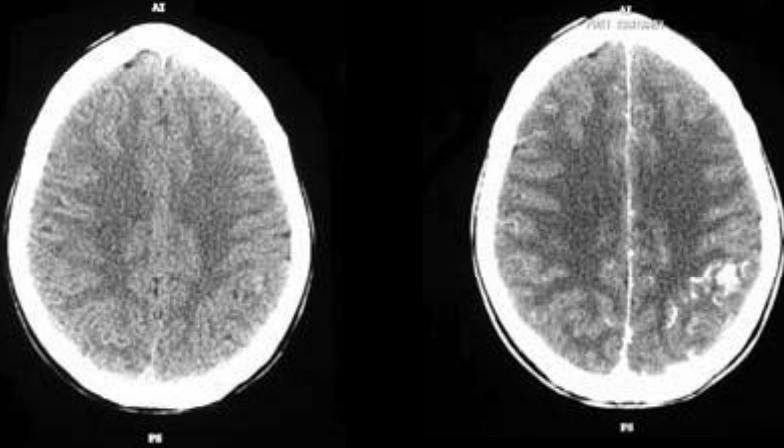
**Long term disability:** 10 to 20%

**Risk of rehemorrhage:** 6% to 18% for first year  
2 to 4% per year thereafter

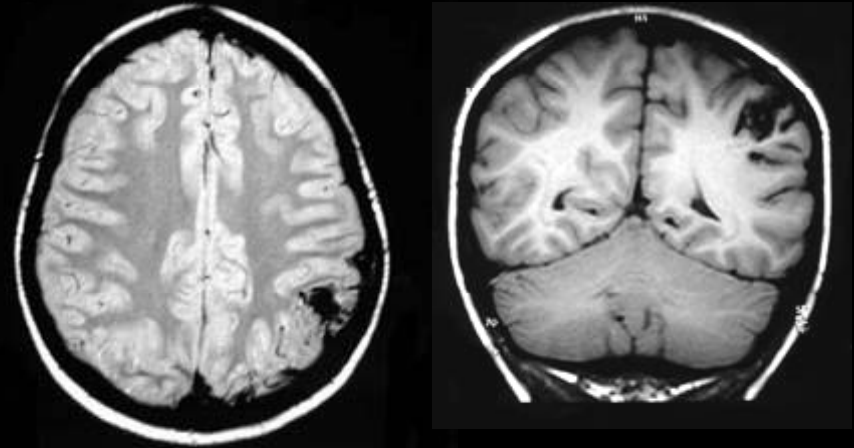


# ***AVM: evaluation***

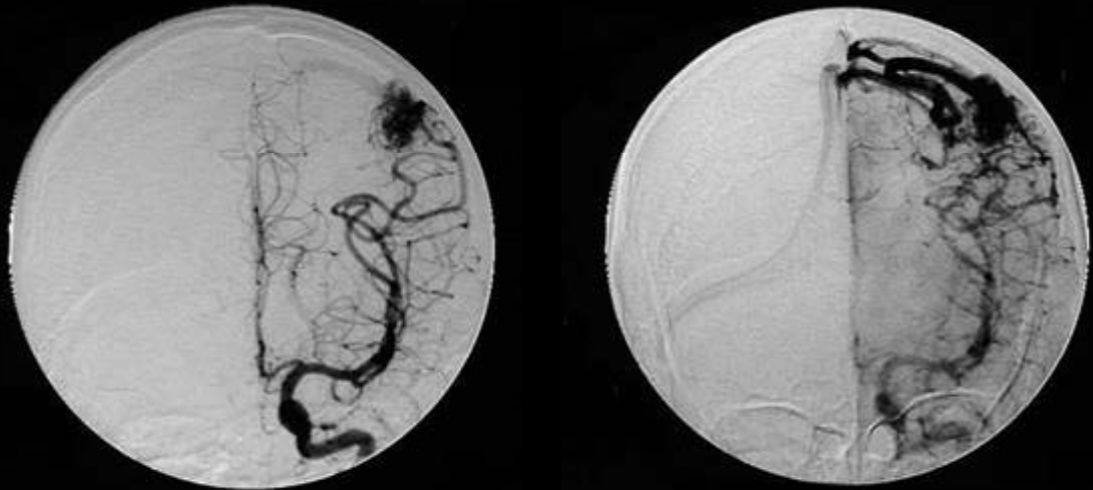
## **Computed Tomography**



## **Magnetic Resonance Imaging**



## **Angiography**



# ***AVM: evaluation***

## **Radiological parameters and hemorrhage risk:**

### **1. Size**

### **AVM size**

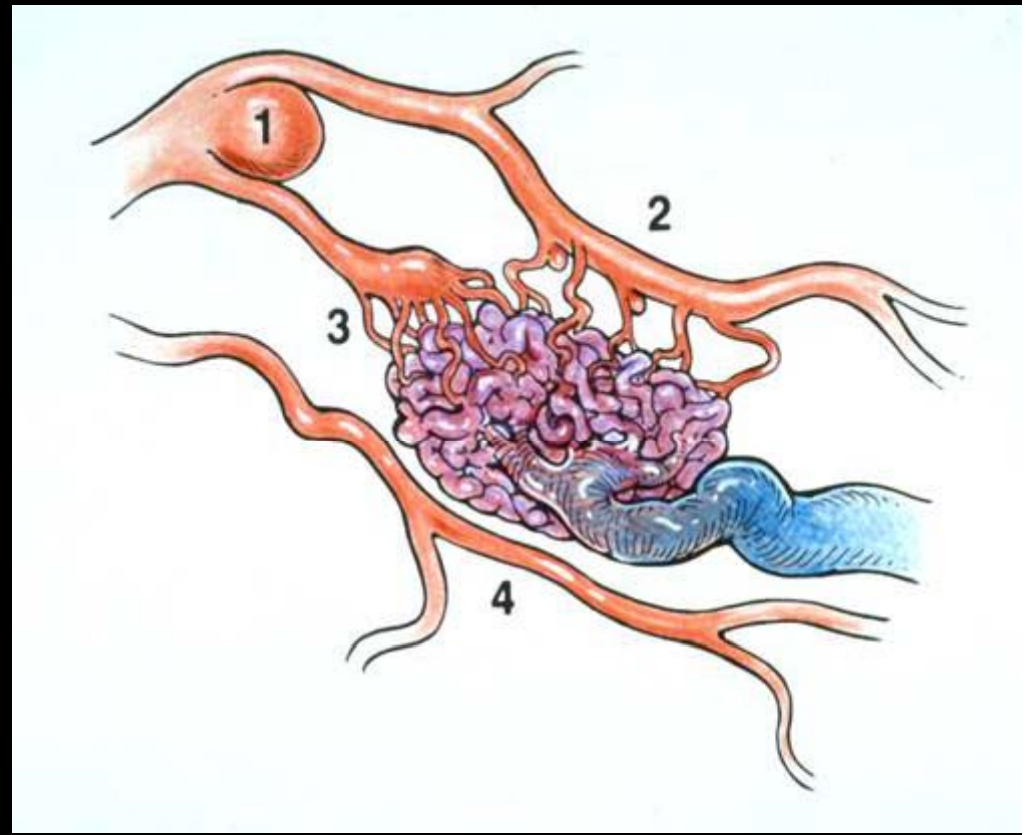
	<b>small (&lt; 3 cm)</b>	<b>medium (3 - 6 cm)</b>	<b>large (&gt; 6 cm)</b>
<b># bled / # AVMs</b>	<b>36 / 44 (82%)</b>	<b>9 / 31 (29%)</b>	<b>2 / 17 (12%)</b>
<b>hematoma size</b>	<b>4.9 cm</b>	<b>2.7 cm</b>	<b>2.0 cm</b>
<b>feeding artery pressure (mmHg)</b>	<b>66</b>	<b>47</b>	<b>35</b>

### **2. Location - ? Periventricular/intraventricular**

# ***AVM: evaluation***

## **Radiological parameters: feeding arteries**

- 1. Arterial aneurysms (intranidal, proximal)**
- 2. Transit with participation (“en passage”)**
- 3. Terminal**
- 4. Adjacent (in proximity)**



# ***AVM: evaluation***

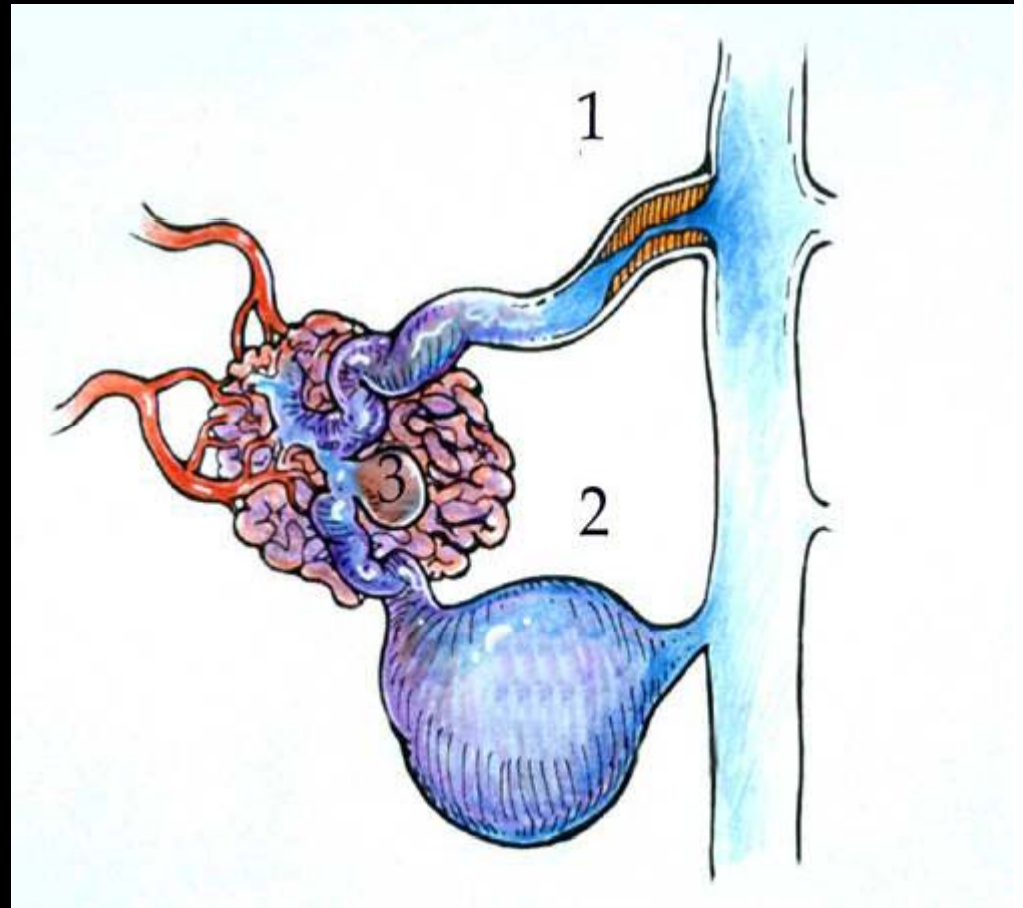
## **Radiological parameters: draining veins**

### **A. Types**

- superficial
- deep

### **B. Pathology**

1. venous outlet stenosis
2. venous varix
3. venous aneurysms



# ***AVM: grading the surgical risk***

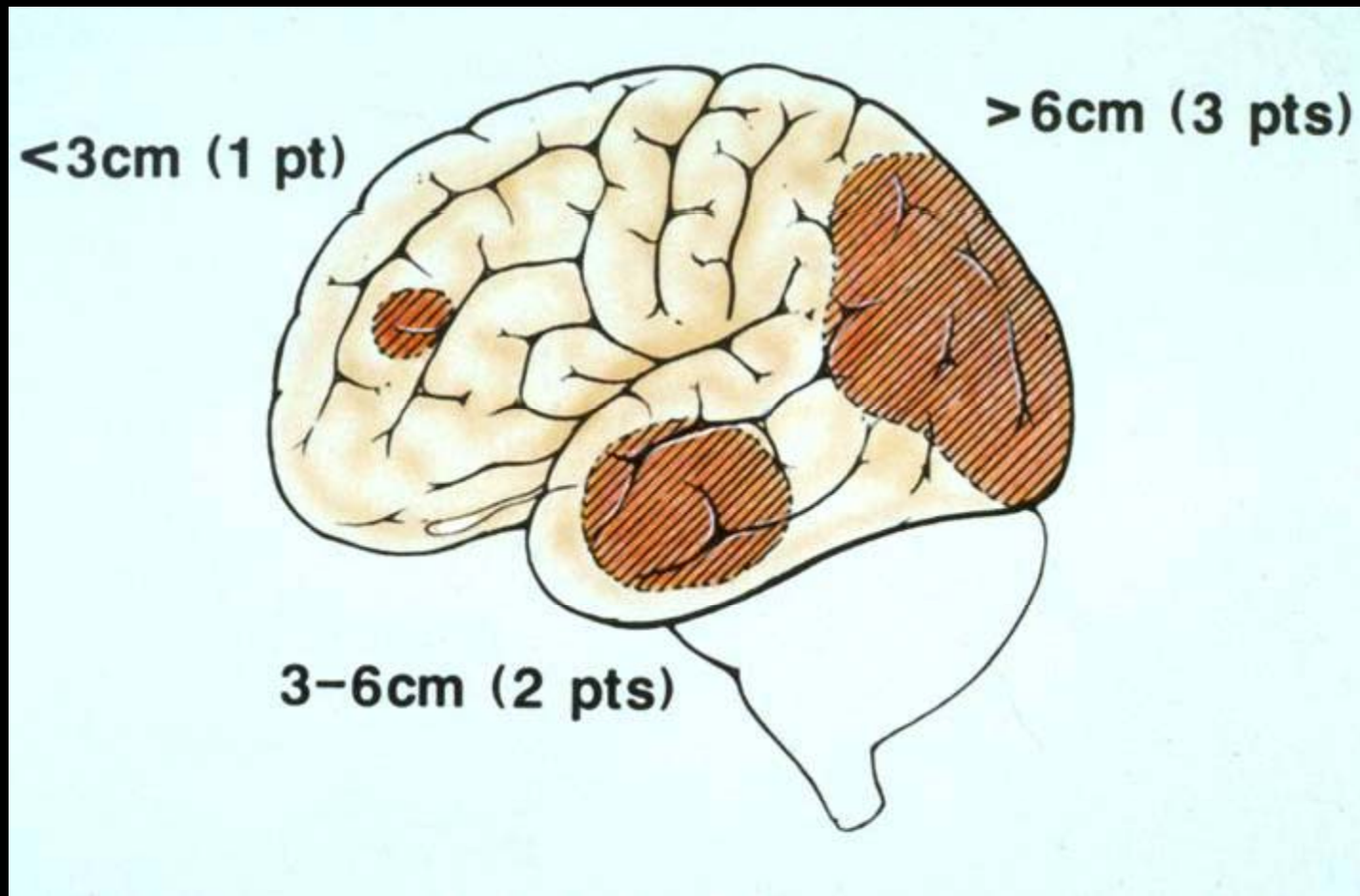
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- 1. Size . . . . . (0 - 3, 3 - 6, >6 cm)**
- 2. Location . . . . . (+/- eloquence)**
- 3. Venous drainage . . . (+/- deep)**

Spetzler, Martin. J Neurosurg. 1986;65:476-483.

# ***AVM: grading the surgical risk***

## **AVMs: size**

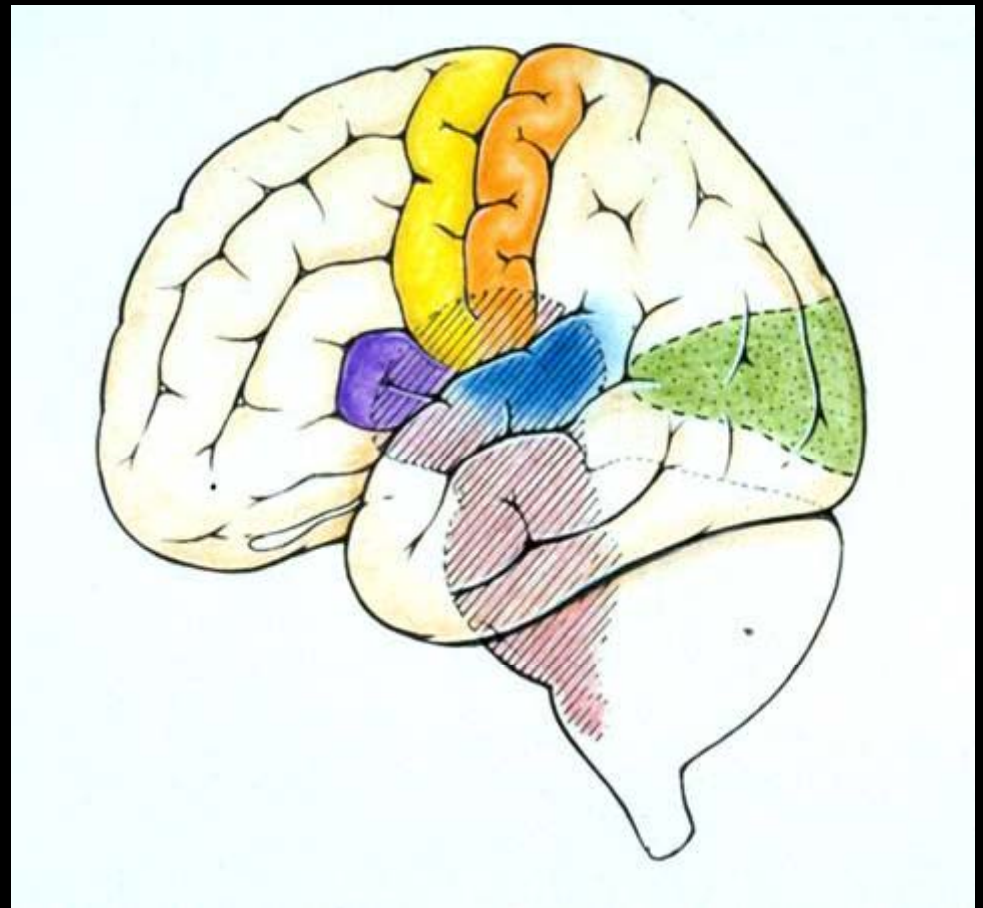


# ***AVM: grading the surgical risk***

## **AVMs: location**

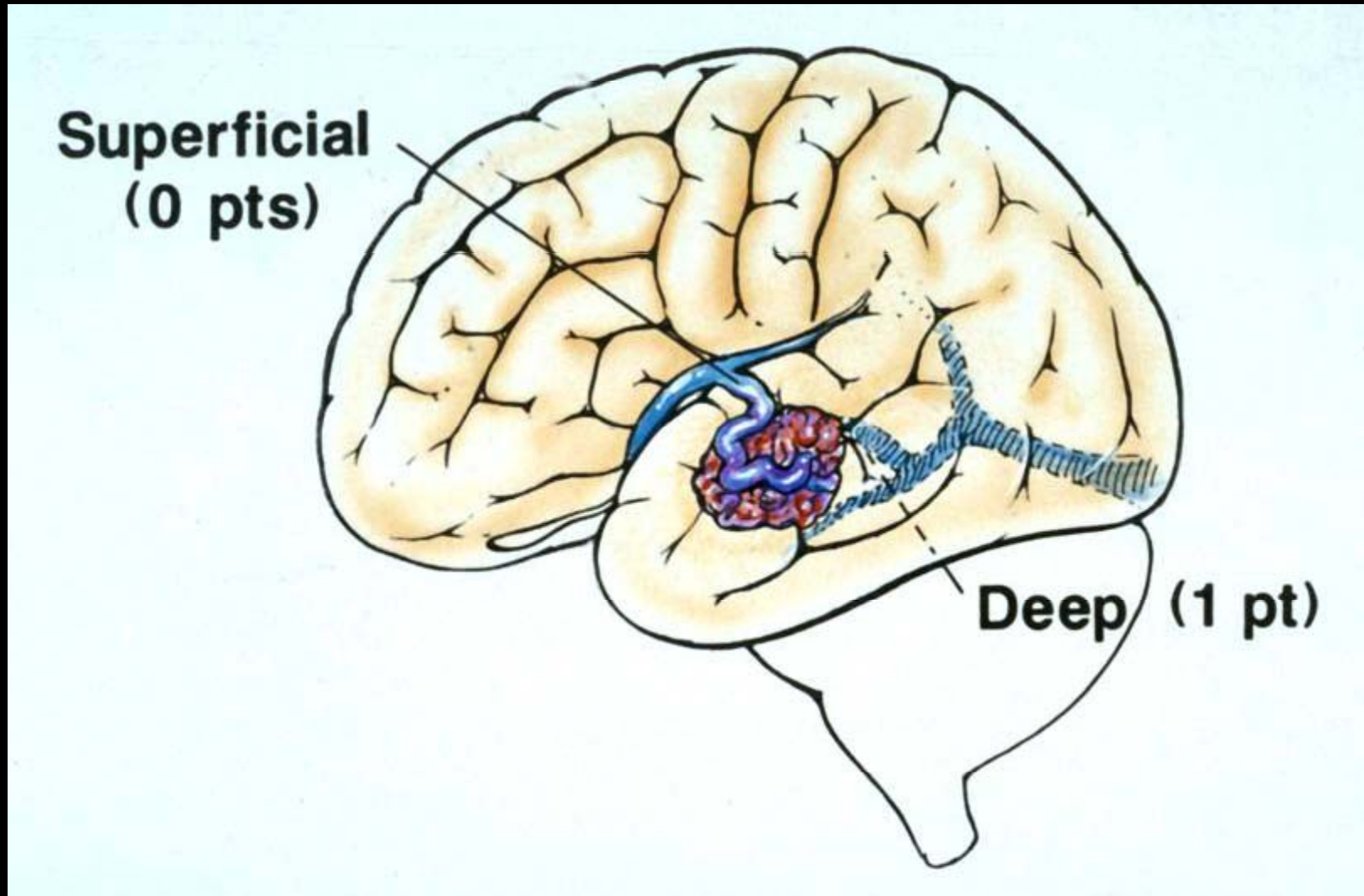
**Non – eloquent . . .0**

**Eloquent . . . . . 1 point**



# ***AVM: grading the surgical risk***

## **AVMs: venous drainage**



## ***AVM: grading the surgical risk***

<u>Total # of points</u>	<u>surgical risk</u>
1 . . . . .	very low
2 - 3 . . . . .	low
4 - 5 . . . . .	high
> 5 . . . . .	very high

**Must be calibrated by the individual neurosurgeon**

# ***AVM: surgical treatment selection factors***

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## **1. Natural history**

- a. Ruptured vs. unruptured**
- b. Feeding vessel arterial aneurysms**
- c. Intra-nidal aneurysms**
- d. Venous outlet obstruction**
- e. Periventricular location**

# ***AVM: surgical treatment selection factors***

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## **2. Surgical risks**

- a. Spetzler-Martin classification**
  - (1) size (0-3, 3-6, >6 cm)**
  - (2) location (± eloquence)**
  - (3) venous drainage (± deep)**
  
- b. “tightness”, shape of nidus**
  
- c. High flow vs. low flow**
  
- d. Surgical experience**

# ***AVM: surgical treatment selection factors***

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## **3. Other factors**

- a. General health**
- b. Age**
- c. Availability of alternatives**
- d. Patient preference**

# ***AVM: management options***

1. No treatment
2. Treatment
  - a. **surgery**
  - b. radiosurgery
  - c. ± embolization



## ***AVM: management options***

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**Which treatment ?**

**Assess “Pros and cons”**

**Answer – lowest risk / highest efficacy**

# ***AVM: surgical treatment***

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## **Pro**

- 1. Eliminates rebleeding acutely**
- 2. Seizure control**
- 3. Psychological factors**

## **Con**

- 1. Hospitalization**
- 2. Invasive**
- 3. Surgical risks**
- 4. Prolonged recovery**
- (5) Costs**

# ***AVM: embolization***

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## **Pro**

- 1. Limited “cure” rate**
- 2. Facilitates surgery and radiosurgery**

## **Con**

- 1. Acute hemodynamic changes**
- 2. Recanalization**
- 3. # of procedures**
- 4. (Cost)**

# ***AVM: radiosurgery***

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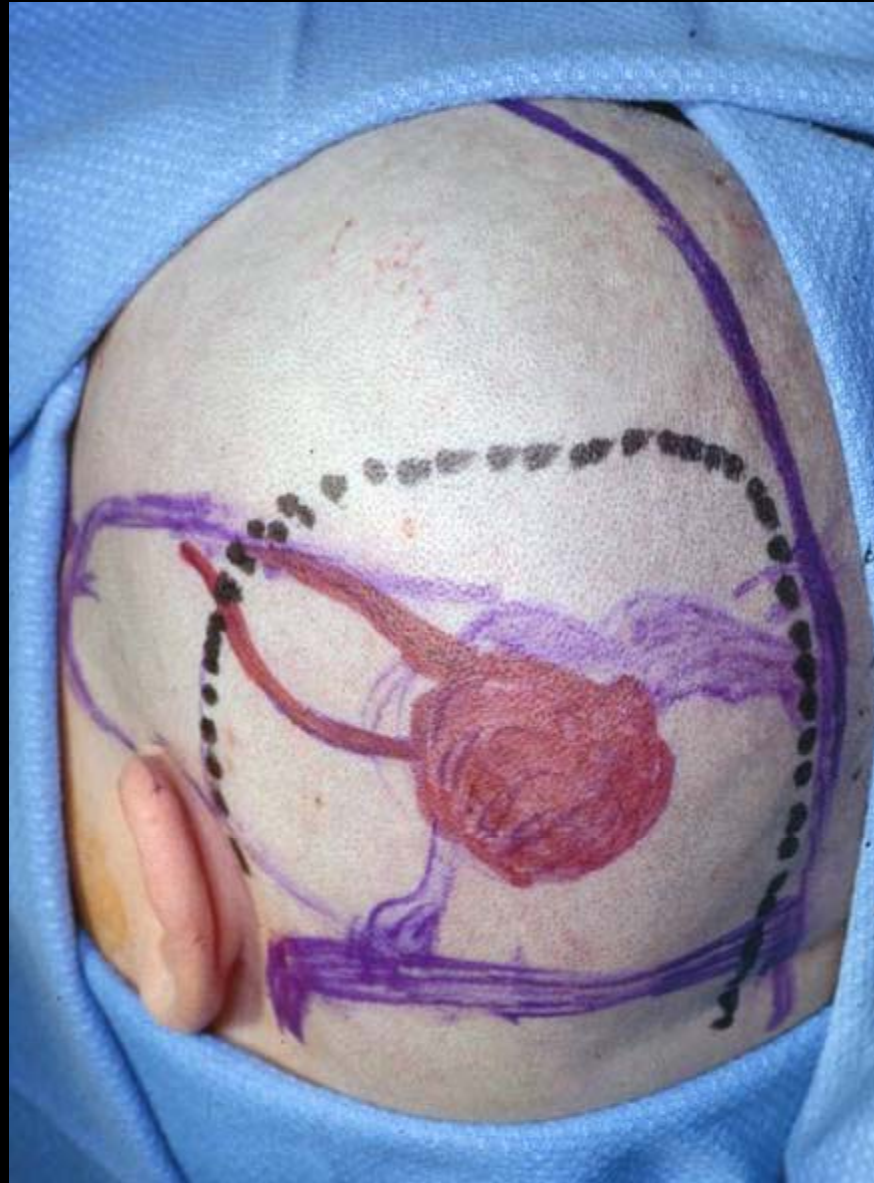
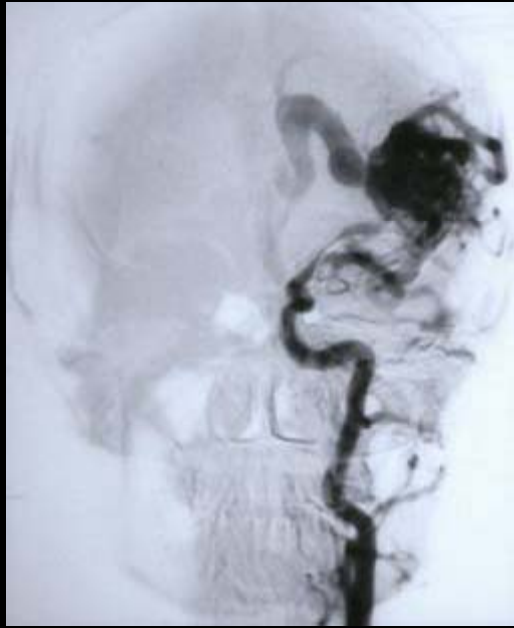
## **Pro**

1. Outpatient procedure
2. “non-invasive”
3. Gradual reduction in AVM flow
4. No recovery period
- (5) Costs

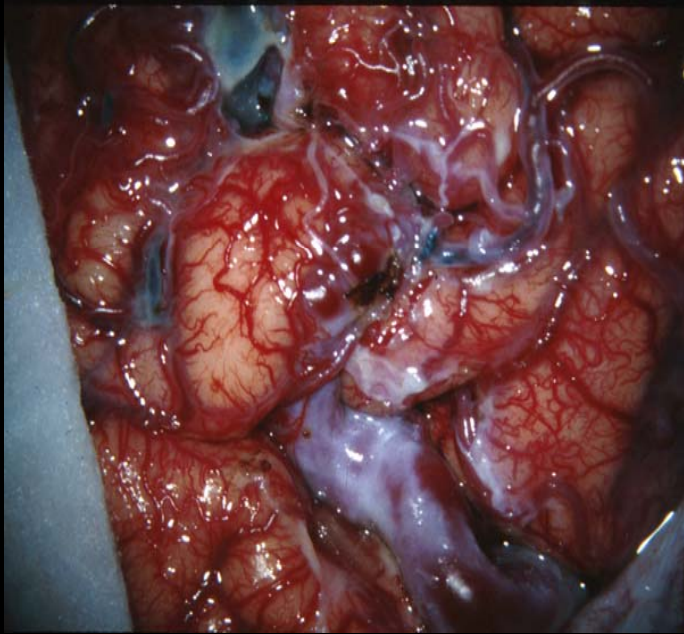
## **Con**

1. Delayed action: 1-3 years
2. Rebleeding risks
3. Limits with larger lesions

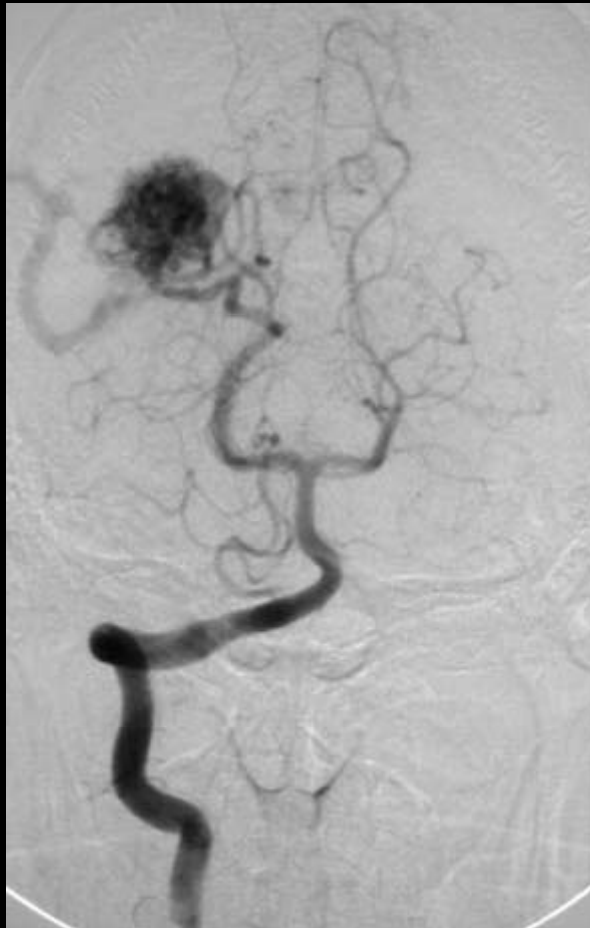
# ***AVM: surgery – case 1***



# ***AVM: surgery – case 1***



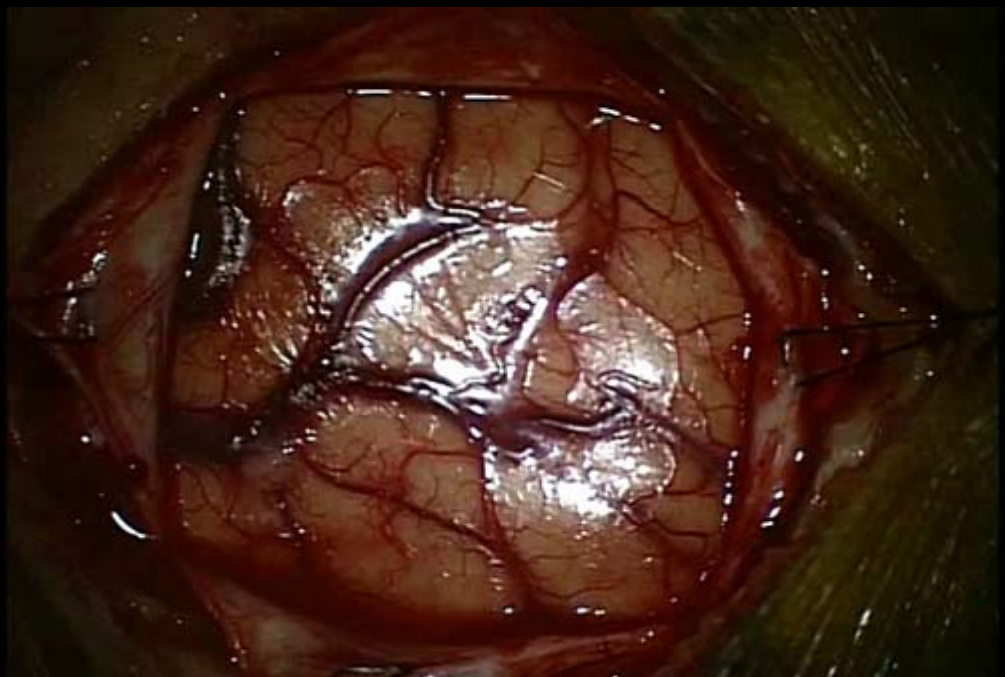
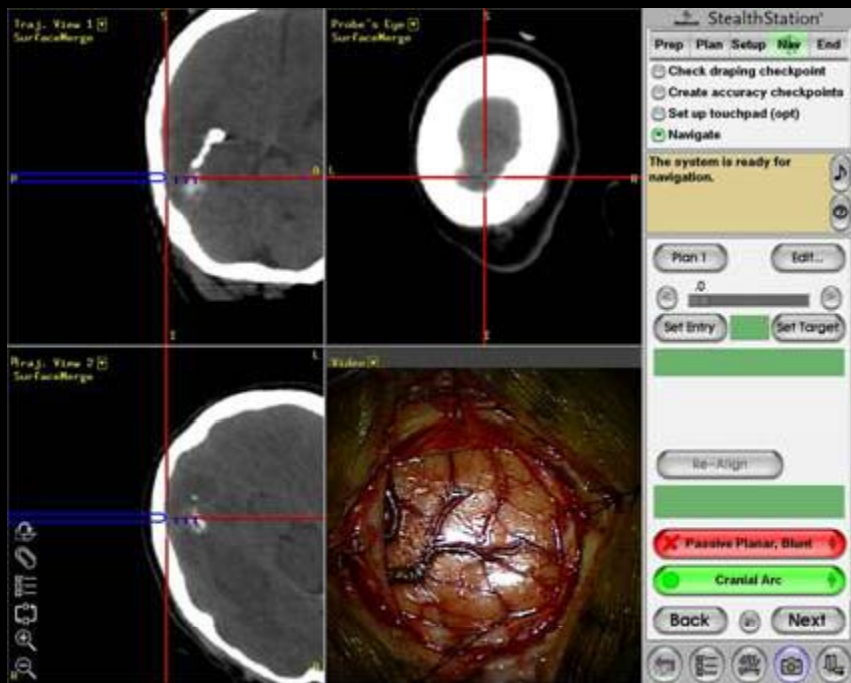
# ***AVM: surgery – case 2***



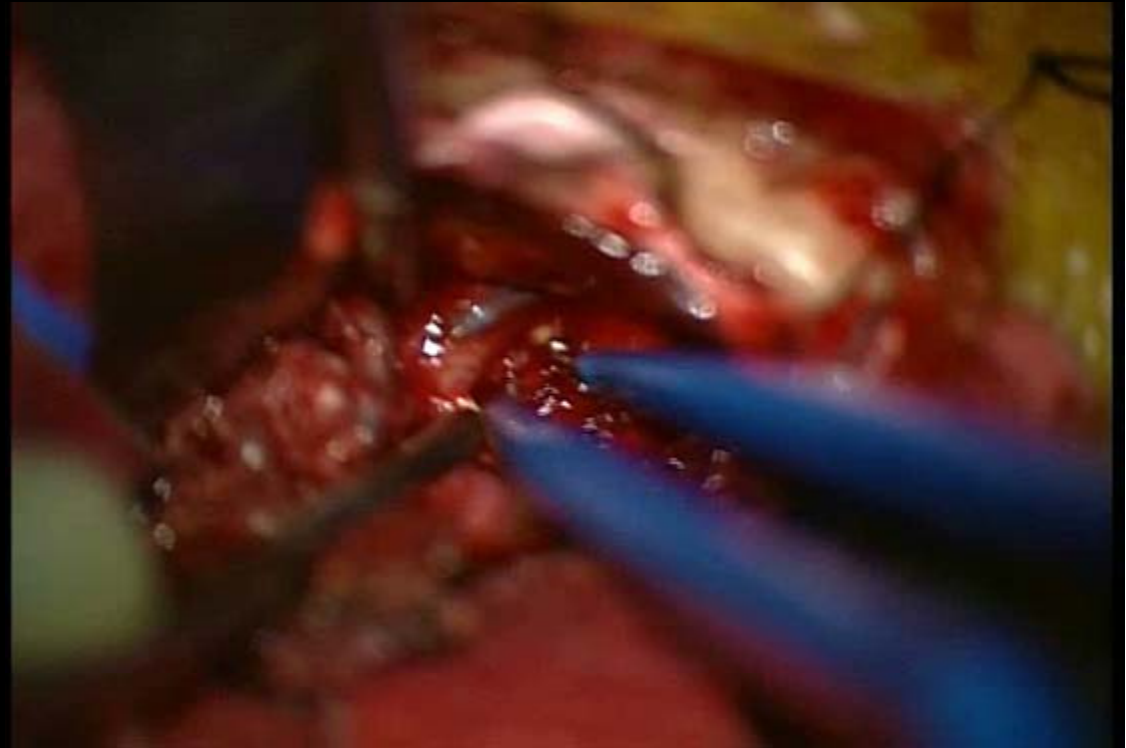
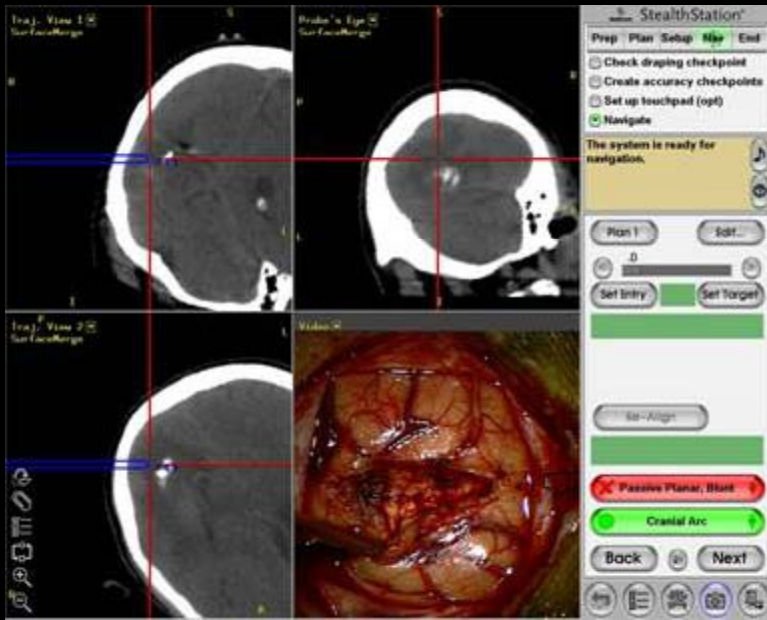
# **AVM: surgery – case 2**



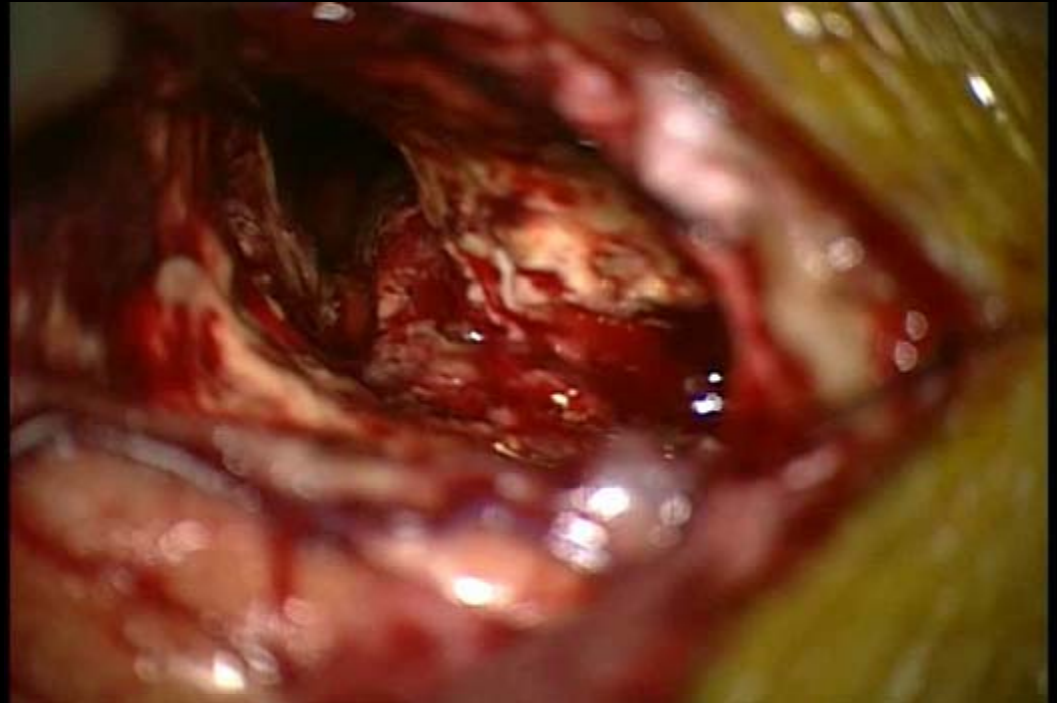
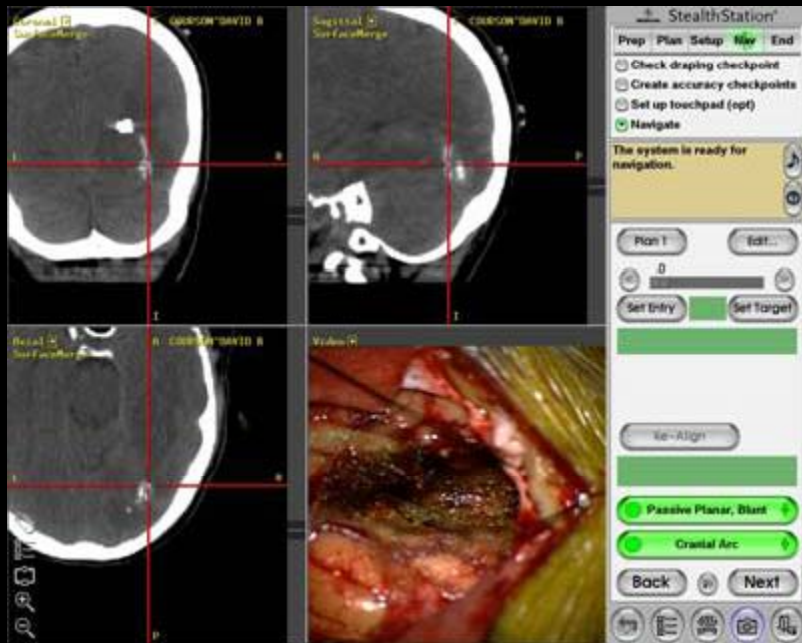
# ***AVM: surgery – case 2***



# **AVM: surgery – case 2**



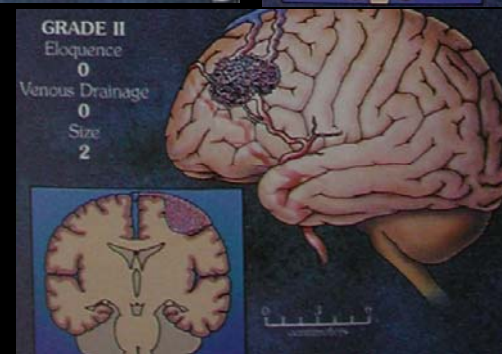
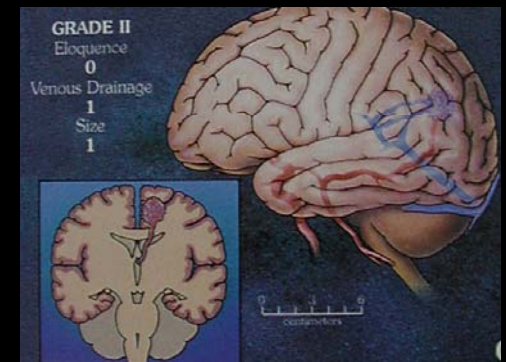
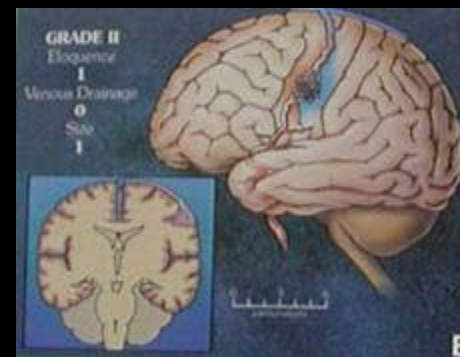
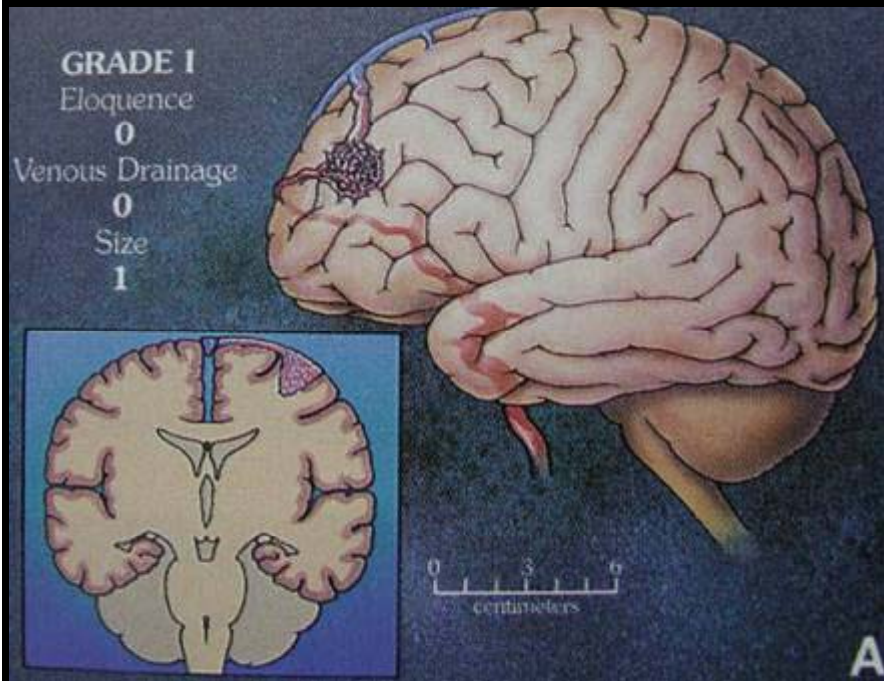
# ***AVM: surgery – case 2***



# ***AVM: conclusions***

## **1. Spetzler - Martin grade I and II:**

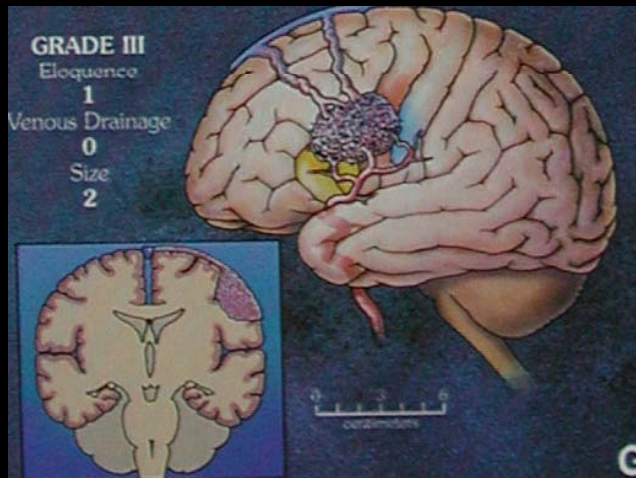
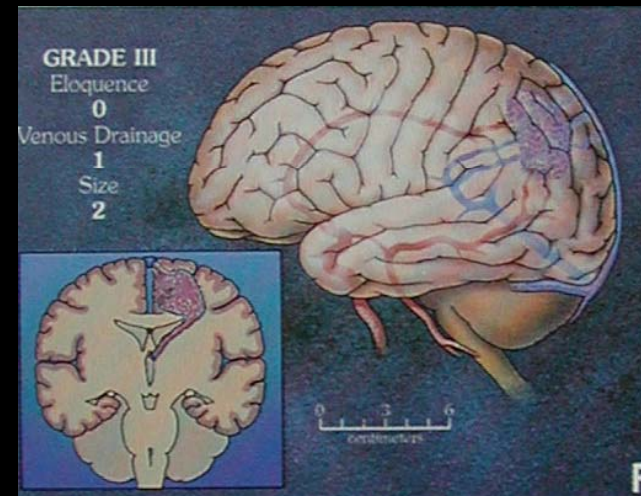
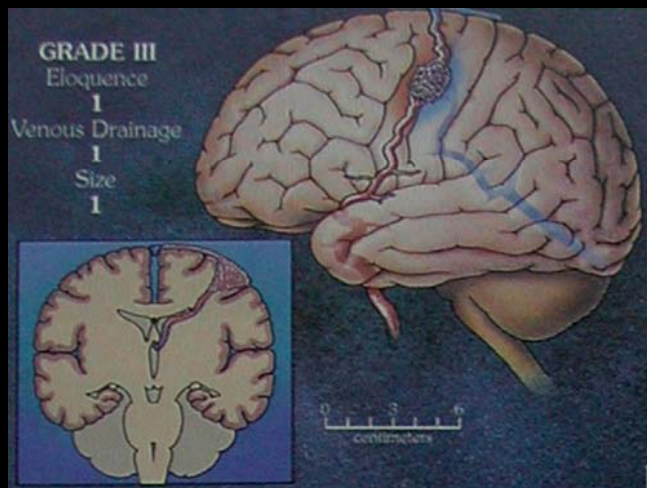
- Surgical extirpation should be strongly considered as the primary mode of therapy
- Small lesion in eloquent area consider SRS



# ***AVM: conclusions***

## **2. Spetzler-Martin grade III:**

- Combined approach (embo + surgery)**



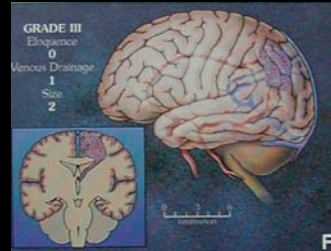
# ***AVM: conclusions***

## **2. Spetzler-Martin grade III:**

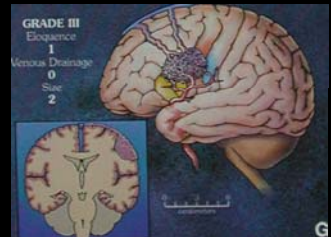
- Lawton et al, J Neurosurgery 2003



**S1V1E1 = low risk microsurgical resection**



**S2V1E0 = moderate risk microsurgical resection**



**S2V0E1 = high risk microsurgical resection**

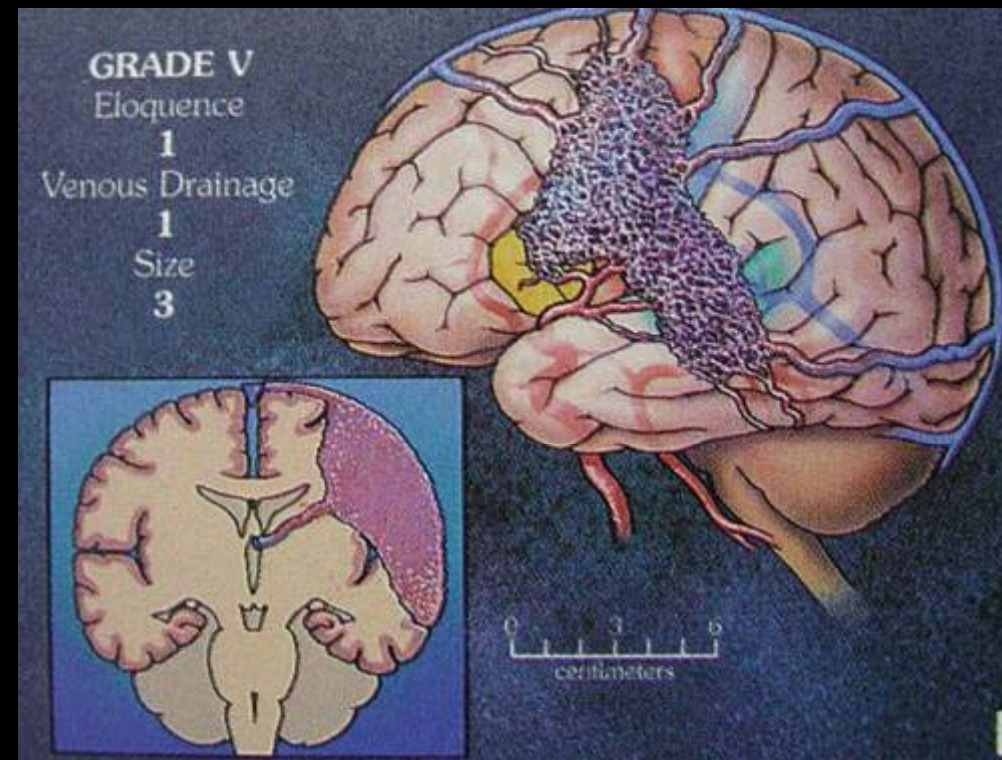
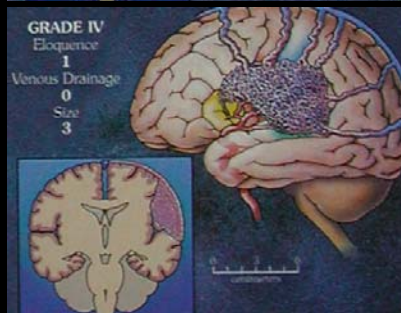
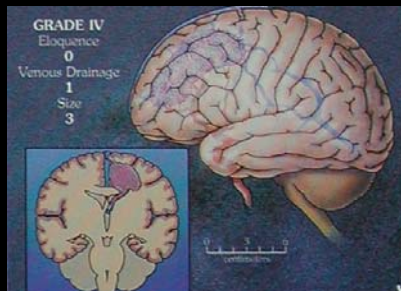


**S3V0E0 = non existent or rare**

# ***AVM: conclusions***

## **3. Spetzler-Martin grade IV, V:**

- Surgical treatment high risk and not routinely recommended**



# ***AVM: University of Florida***

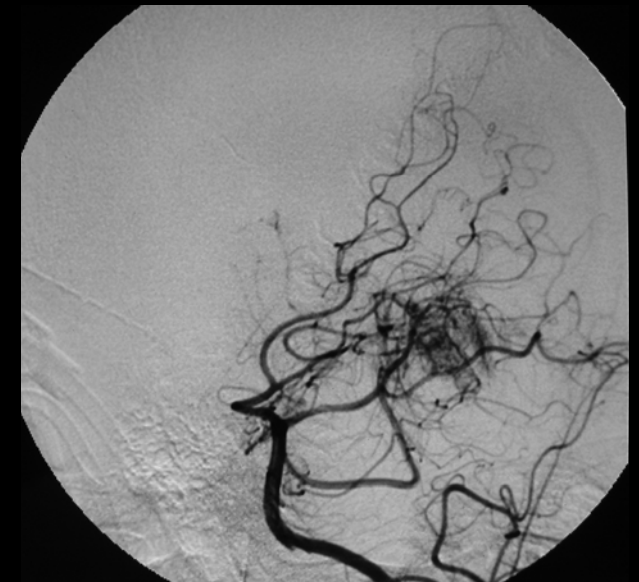
## **AVM surgery**

**12 months**

**25 AVM, 3 dural AV fistulas**

**Presurgery embolization in 15**

<b>Type</b>	<b>SM1</b>	<b>SM2</b>	<b>SM3</b>
<b>Frontal</b>	<b>3</b>	<b>2</b>	
<b>Parietal</b>	<b>1</b>	<b>3</b>	<b>1</b>
<b>Interhem.</b>		<b>2</b>	
<b>Occipital</b>	<b>2</b>	<b>3</b>	
<b>Sylvian F</b>	<b>1</b>	<b>1</b>	
<b>Cerebellar</b>	<b>5</b>	<b>1</b>	

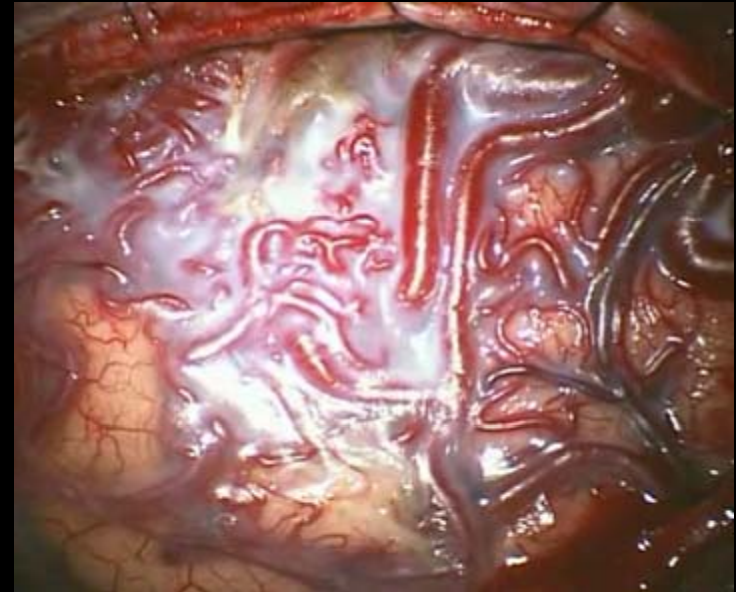


# ***AVM: University of Florida***

## **AVM surgery**

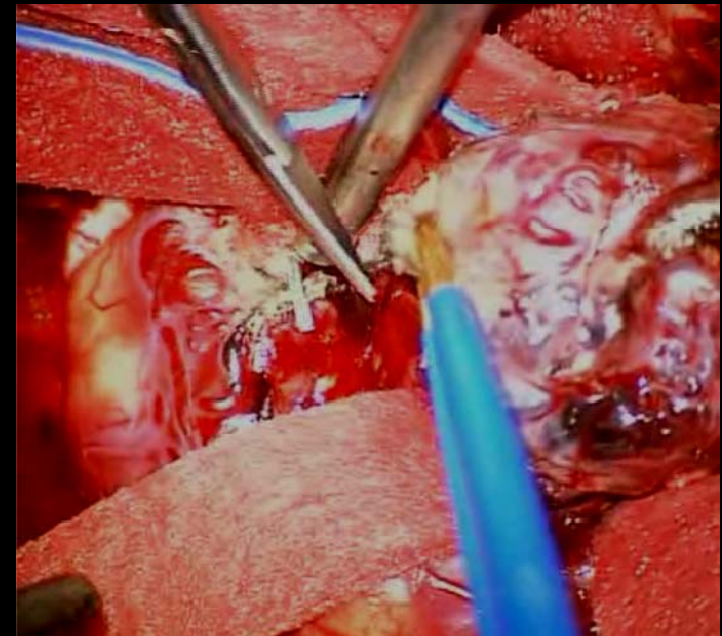
### **Preoperative embolization:**

- all still had arterial input
- 1 hemorrhage
- 2 transient deficits



### **2 early poor outcomes:**

- cerebellar hemorrhage
- premotor SM III



## ***AVM: conclusions***

### **The multimodal team approach**

- Direct surgery
- Endovascular neurosurgery
- Stereotactic radiosurgery

**Patient specific treatment**