# Neuroradiologie Interventionnelle

Journées Europharmat 2014

Denis Herbreteau (Tours)

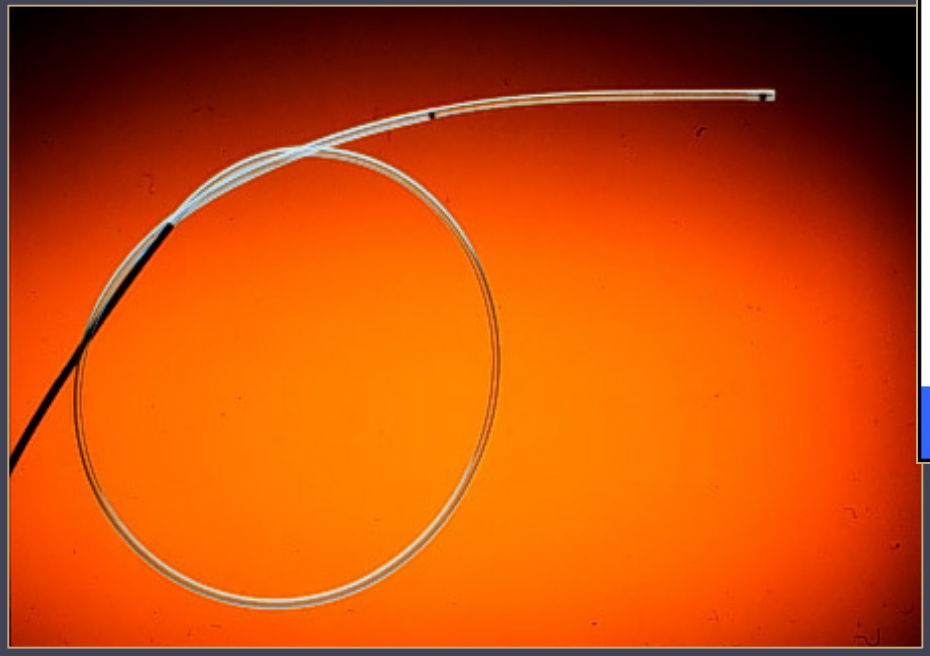
# BLOC OPERATOIRE + RX 1990

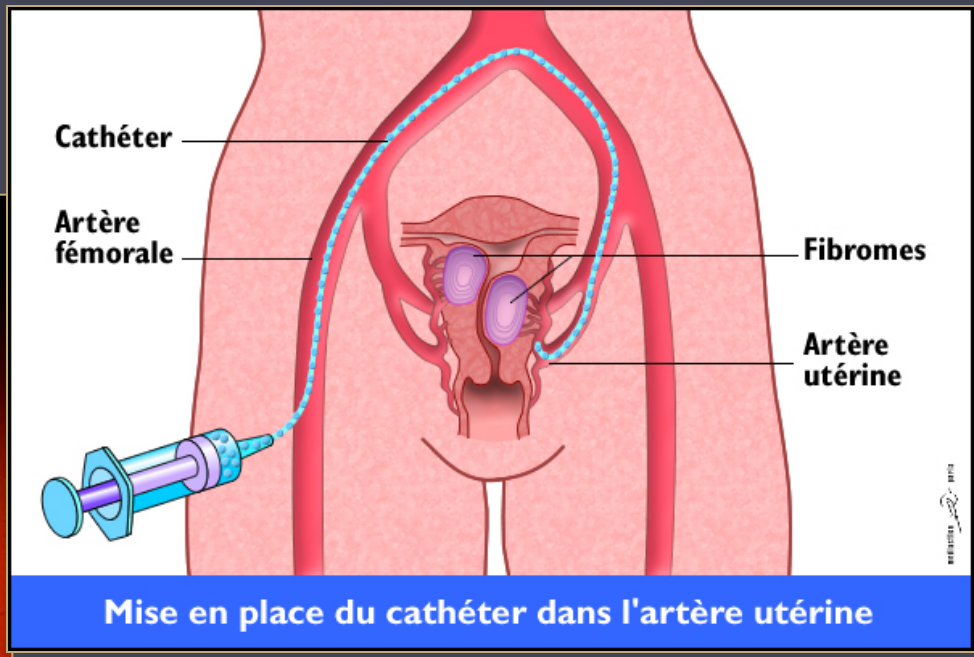
# VOIES D’ ABORD

# MATERIEL D' EMBOLISATION

- Sonde Porteuse

- Microcathéters



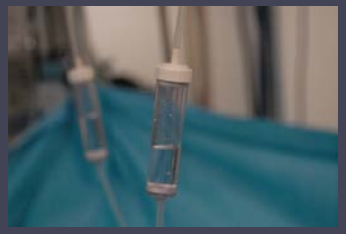


# Spécificité du matériel: Thrombose\Hémorragie

- MicroKT

  Perfusions
- Anticoagulation Antiagrégant

Perfusion



# Evolution de la machine

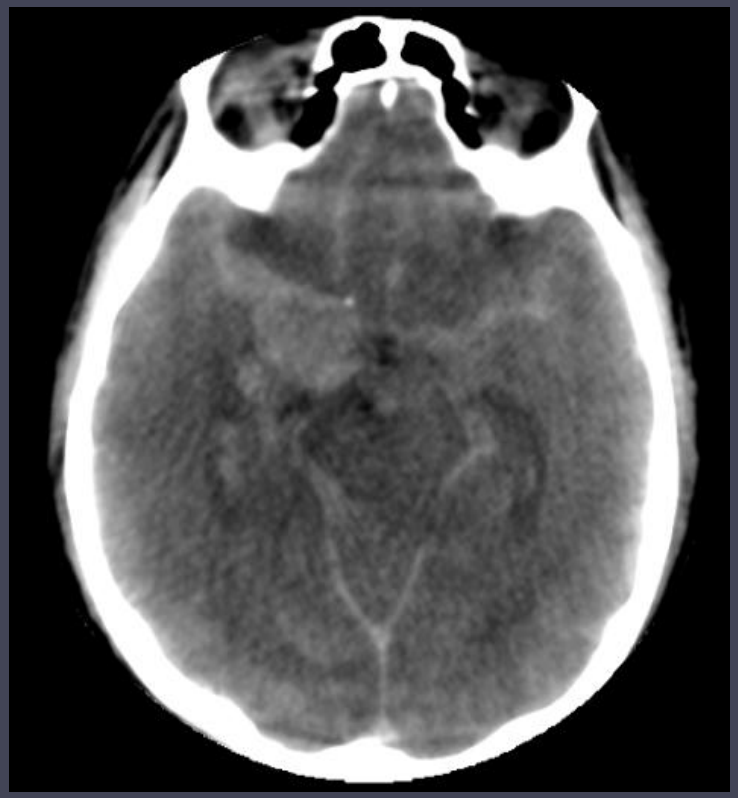
- Bi-Plan
- 3 Dimensions
- Réduction de dose RX
- Bloc Opératoire

# L’imagerie 3D rotationnelle CT-like

- Rotation sur 200˚
- 250, 350 ou 600 projections
- 50 images/sec
- Injection de 23cc


Une variété de rendu volumique pour mieux comprendre l’angioarchitechture

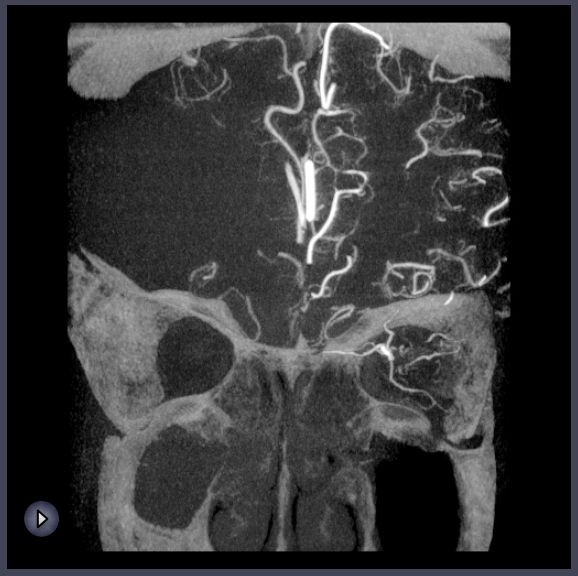
# 1 Des images CT-like plus uniformes pour la visualisation des tissus mous



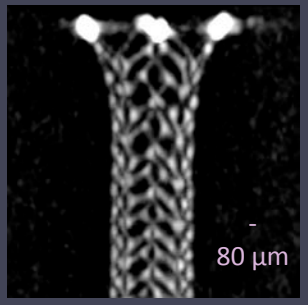
Permet d'évaluer une éventuelle hémorragie depuis la salle interventionnelle

**Évite de déplacer le patient → gain de temps et de sécurité**

# 2 Une résolution spatiale améliorée pour une meilleure visualisation des petites structures

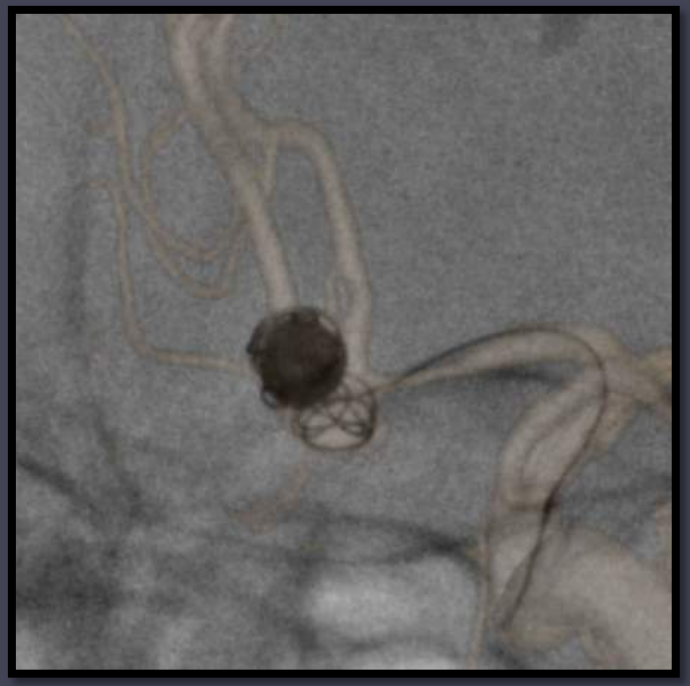


Visualisation des artères lenticulo-striées grâce à un plus petit foyer



# Guidage 3D : Fusion de la 3D sur le live fluoro

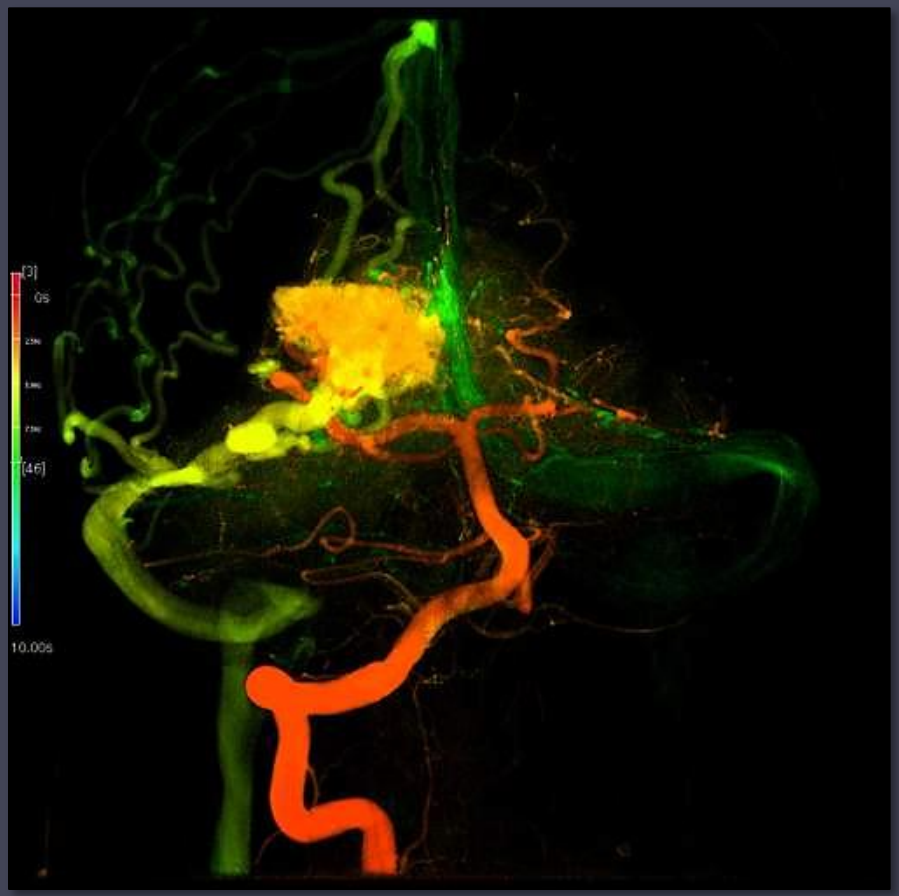
- Superpose une 3D acquise par Innova CTHD, IRM, ou CT-scan à la fluoro pour du 3D roadmapping
- S'ajuste automatiquement aux mouvements de table/arceau
- Gain potentiel en :
  - contraste
  - dose
  - temps



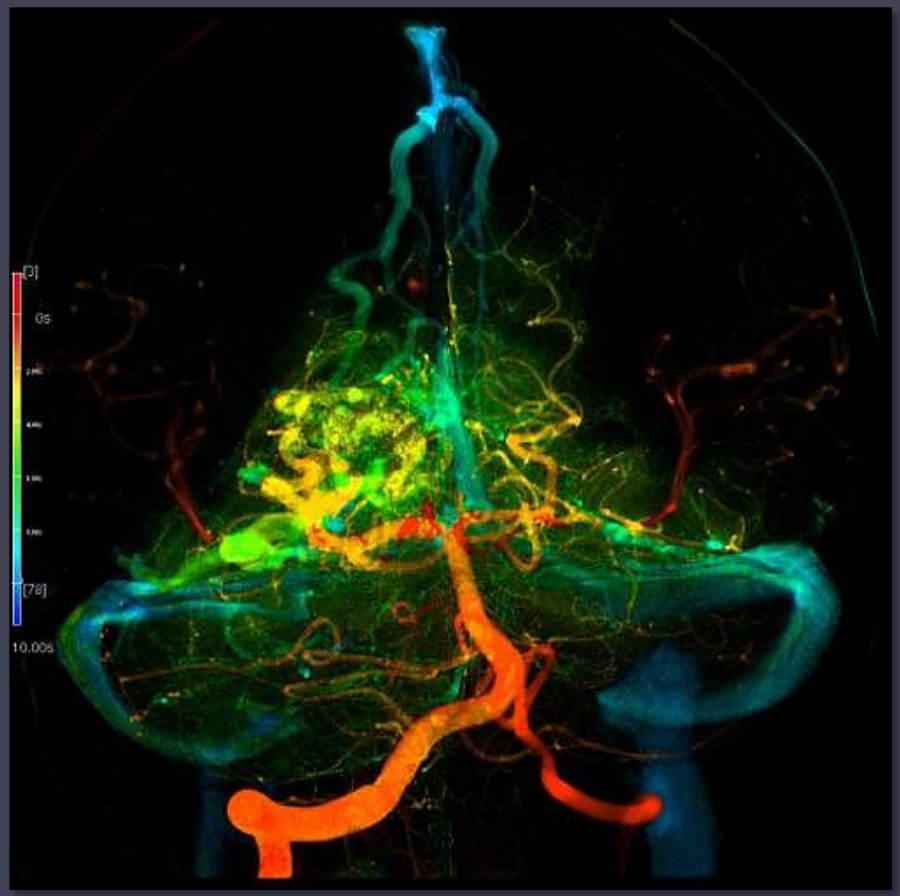
Embolisation d'anevrisme avec 3D roadmapping

Plan de travail optimal avec vue arrière virtuelle sans mouvement de l'arceau

# Visualisation du flux vasculaire

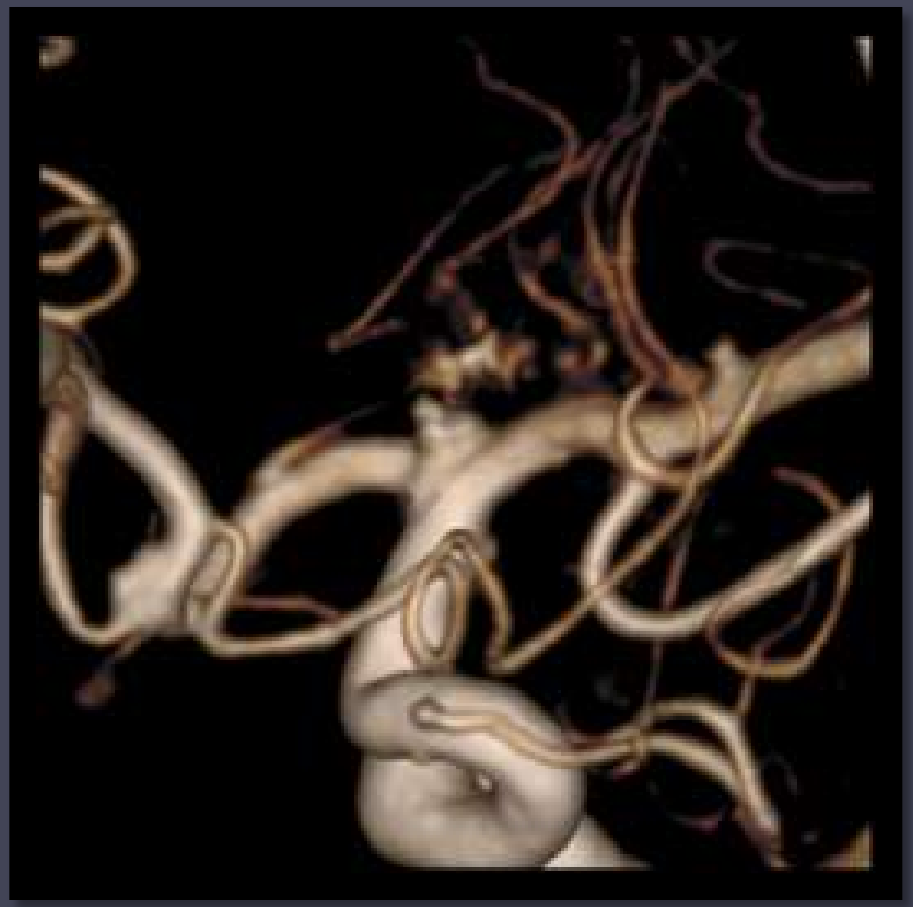



Pre-embolisation



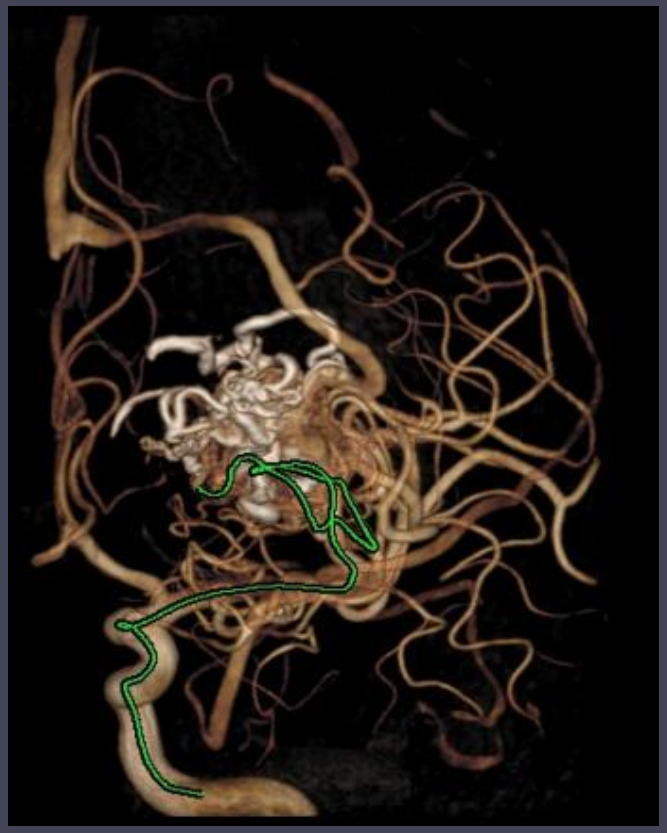

Post-embolisation

# 3D soustraite



**Extraction automatique de l’os et des coils pour évaluer l’exclusion totale de l’anévrisme**

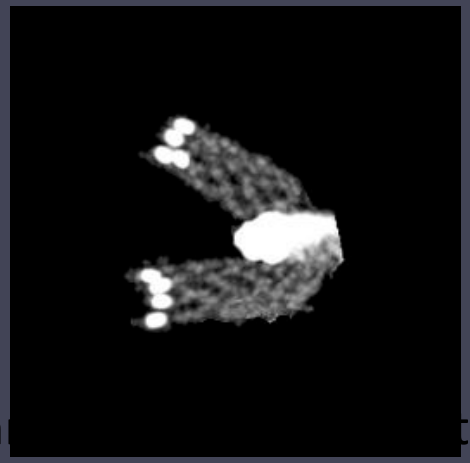
# Planification d’embolisation de MAV

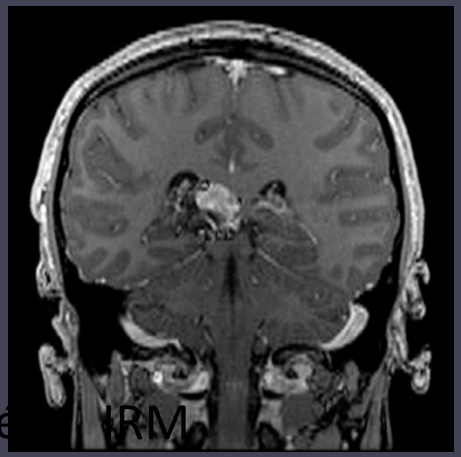


Extraction semi automatique des vaisseaux nourriciers et export des chemins sur le live fluoro pour un guidage 3D

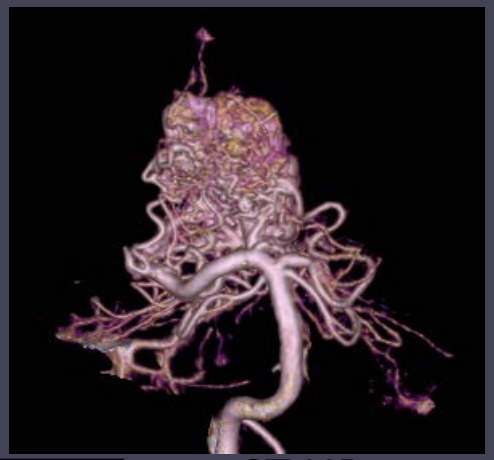
# Fusion d'images avec Integrated Registration

injecté

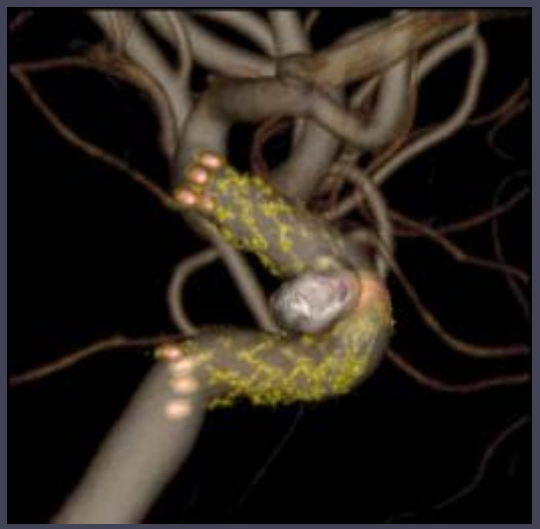




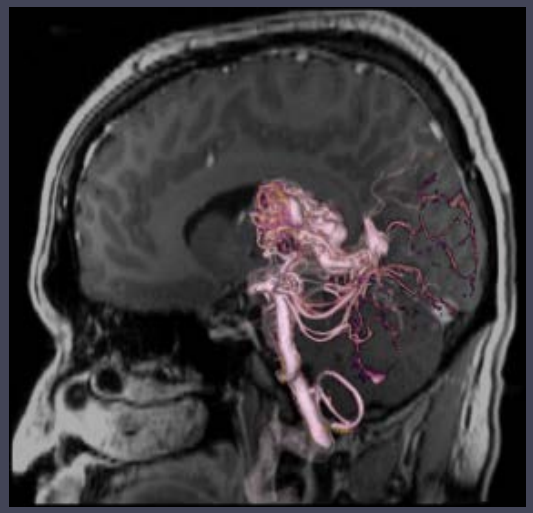
IRM



innova CT HD



Evaluer le bon positionnement du stent



Evaluer l'étendue du blush de la MAV sur le parenchyme

# Evolution du Matériel et des Matériaux

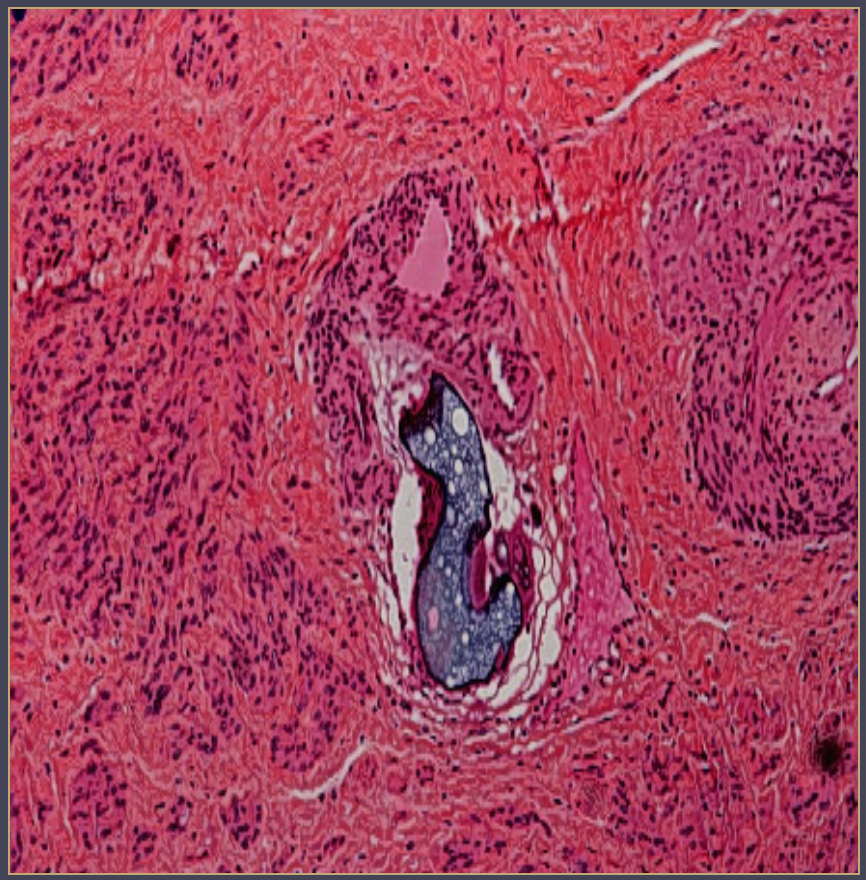
- Microcathéters

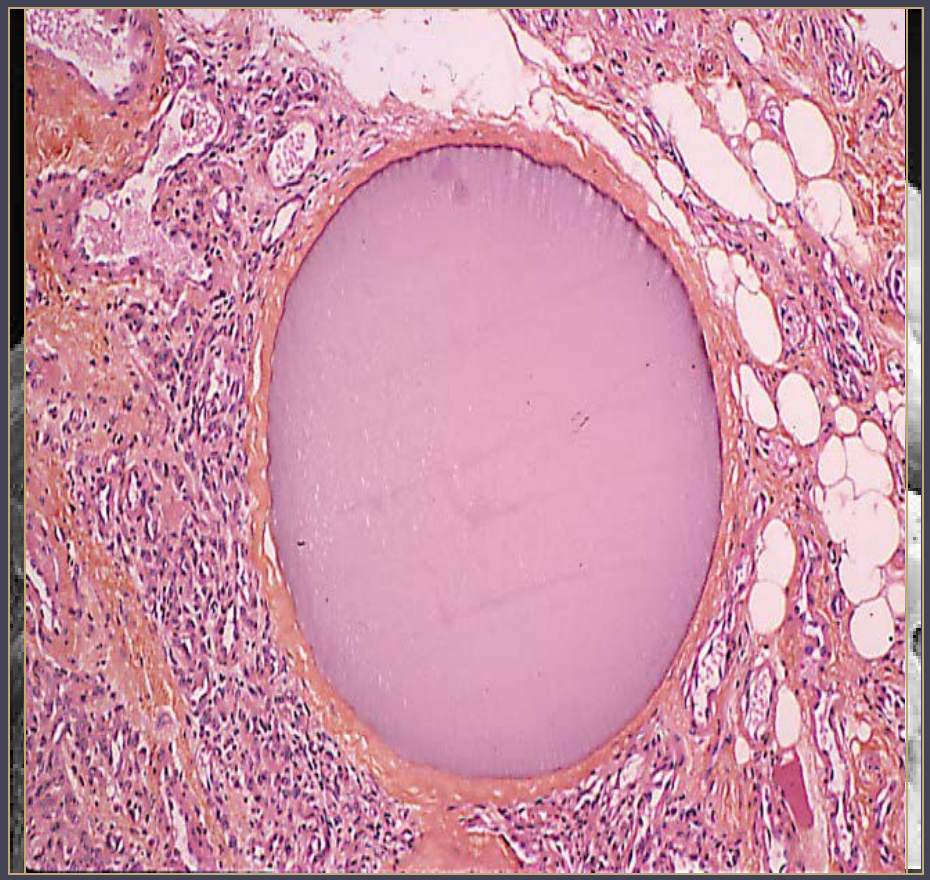
- Particules
- Colle
- Coils
- Stents

# AGENTS D'OCCLUSION

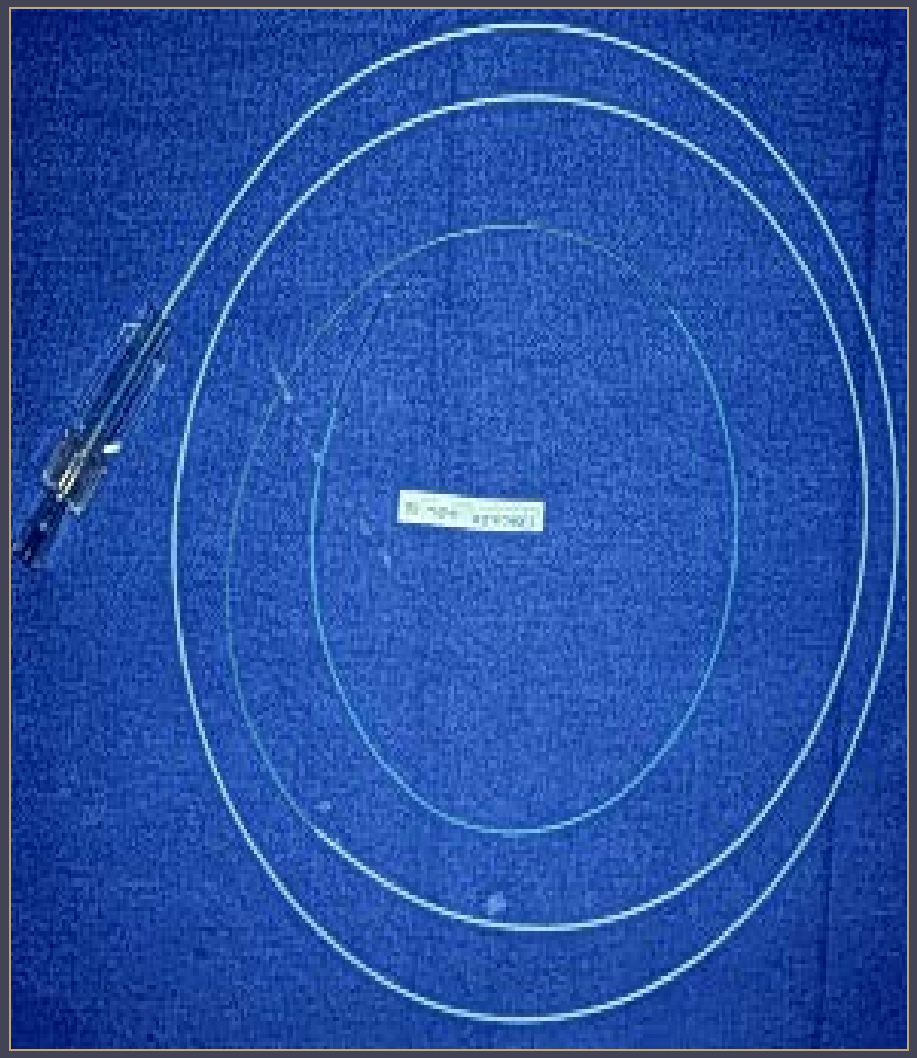
- Résorbable : gélatine, caillot
- Particules : PVA, trisacryl
- Implants : spires , ballons
- Liquides :
  - Sclérosant (alcool, polidocanol)
  - Polymérisant (colle, éthibloc, métacrylate)
  - Hydrogel (onyx)

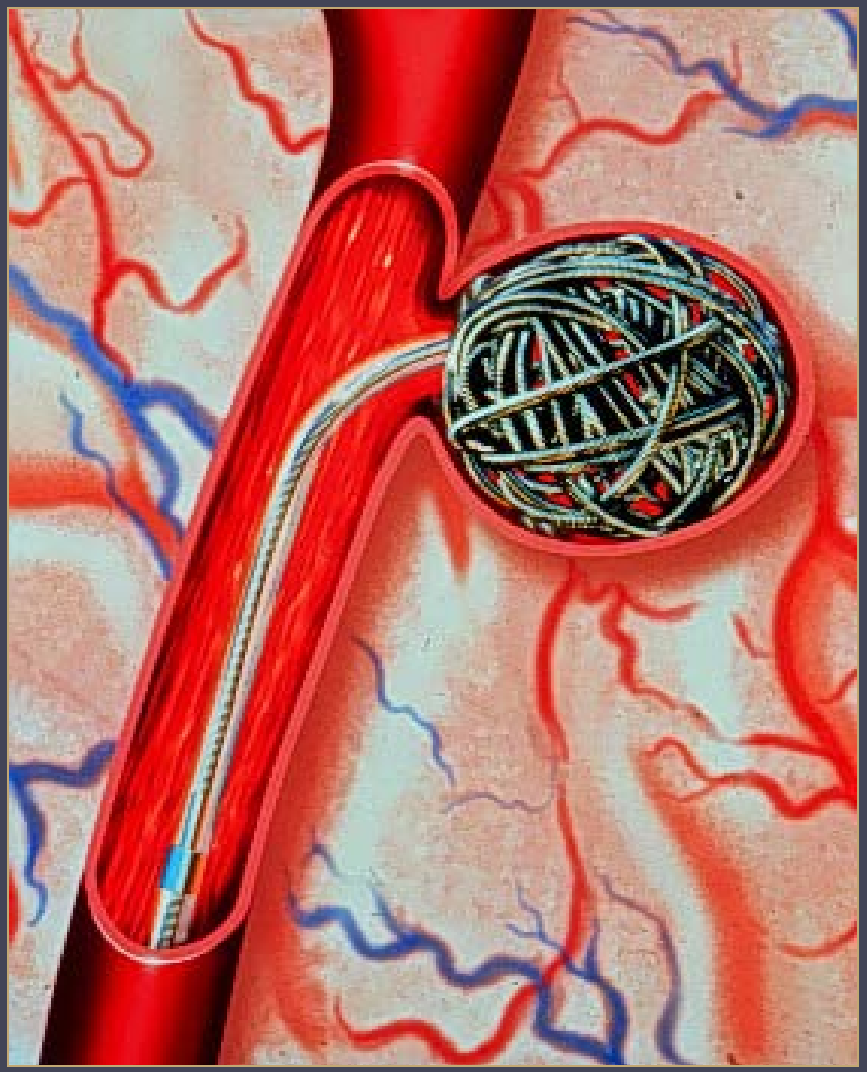
# PARTICULES





# MATERIEL IMPLANTS





# Principales Indications

-AVC hémorragiques

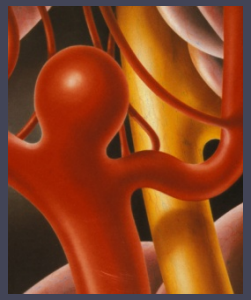
Anévrismes

MAV

FAV

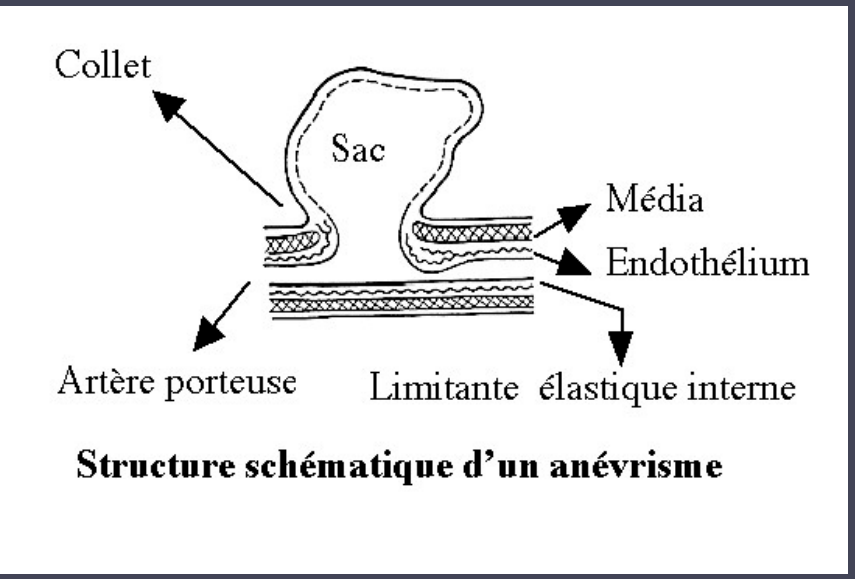
-AVC ischémiques

# ANEVRISMES



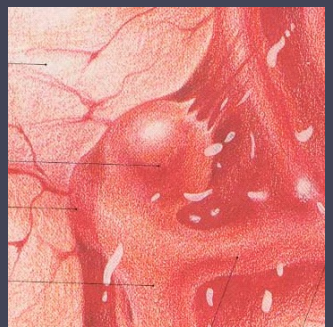
# Les anévrismes artériels

## Constitution
## Croissance
## Rupture



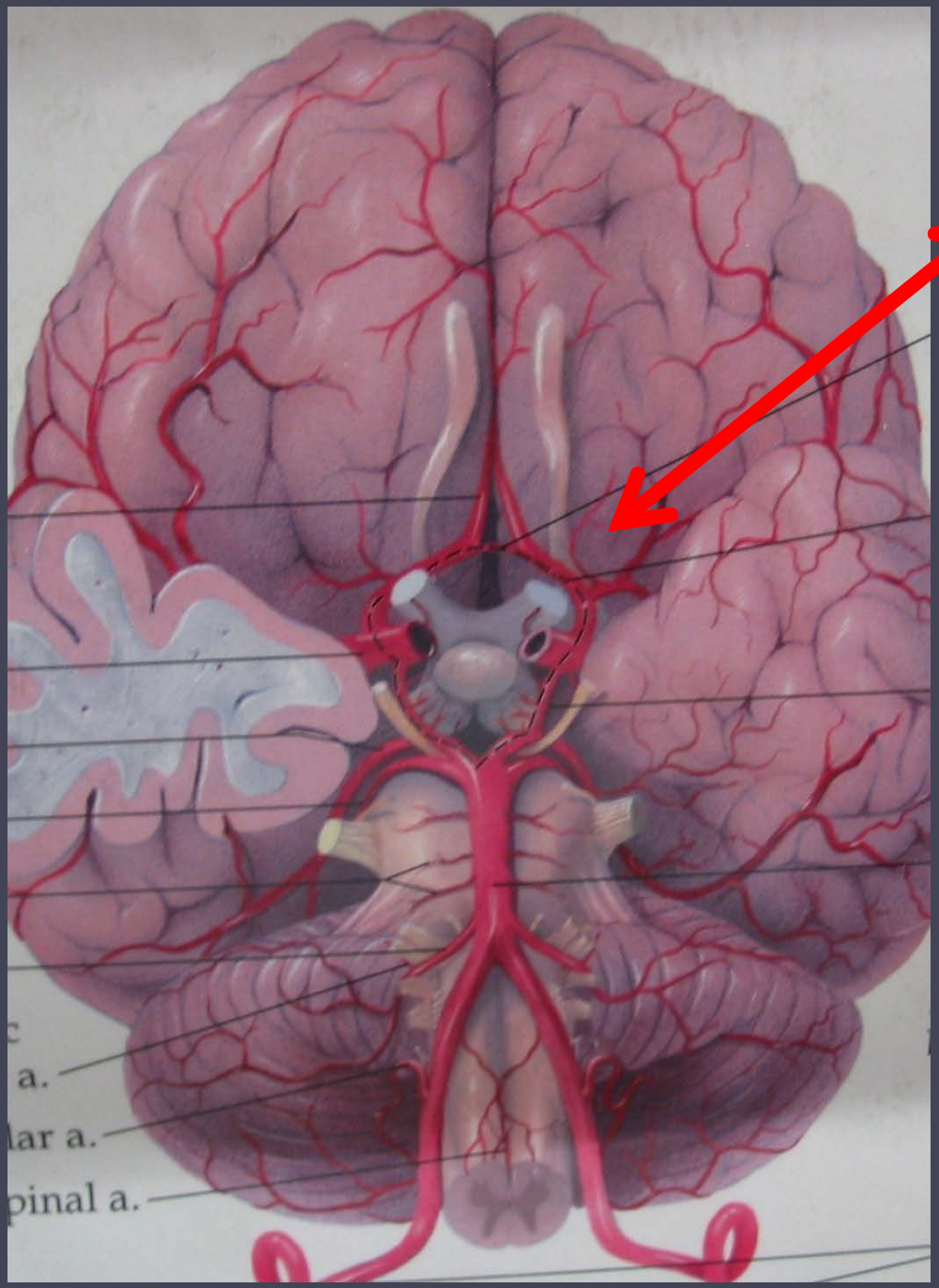
**Structure schématique d'un anévrisme**

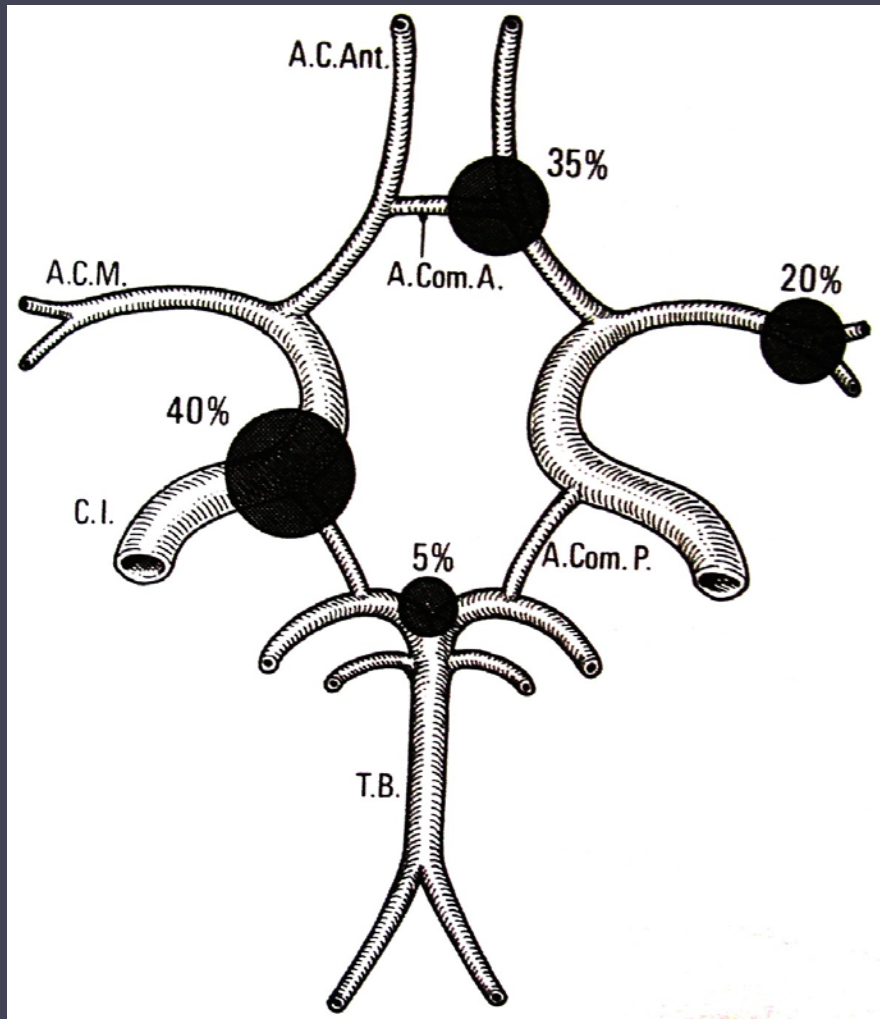
- Non congénitaux mais…
- un défaut de la paroi artérielle acquis ou congénital
- permet l'éclosion de l'anévrysme qui…
- grossira sous l'influence de facteurs hémodynamiques (PA)
- Morphologie : Sac-Collet



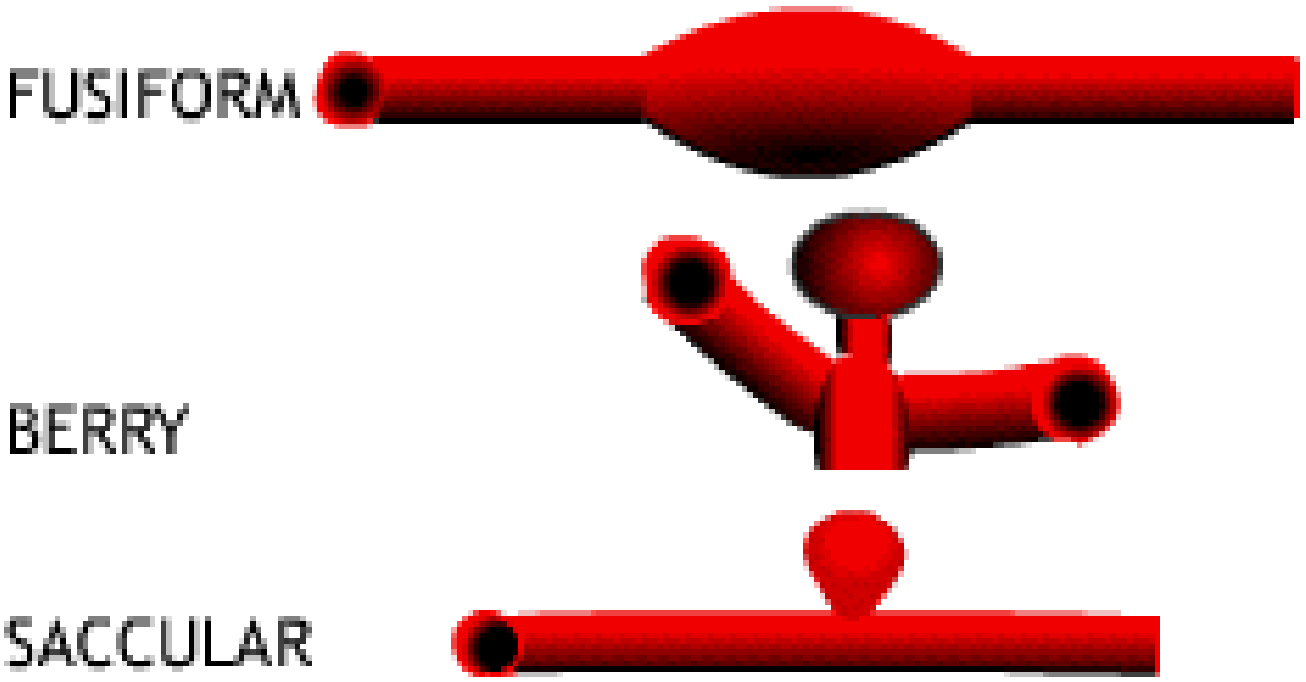
# Anévrismes du polygone de Willis

Unique ou multiples



# TYPES OF CEREBRAL ANEURYSMS



# facteurs de risques

- prédisposition génétique (famille, polykystose rénale)
  tabagisme (1er)
  contraceptifs oraux
  consommation excessive d'alcool

- élévation soudaine de la pression = rupture
  .poussée HTA .exercice physique intense
  .stress .orgasme

- 2 à 8%  de la population  (série autopsique )

- 35 et 60 ans  (3F:2H)

- France: 5000/ans  dont 2500 ruptures

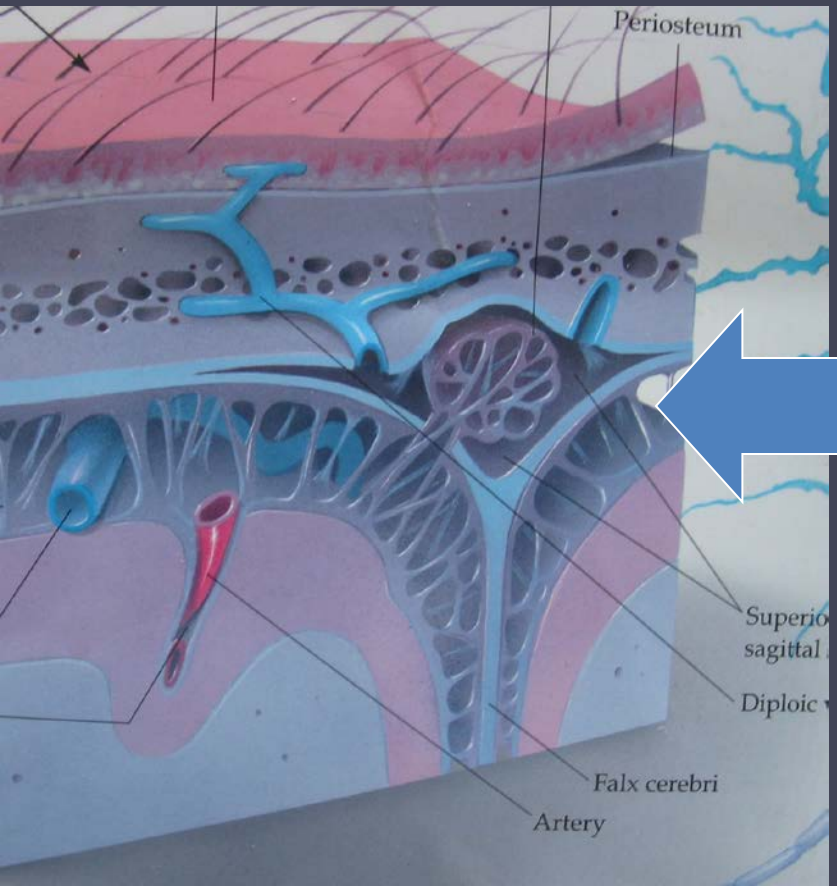
-Incidence  rupture  faible: environ 1/10 000 habitants/an

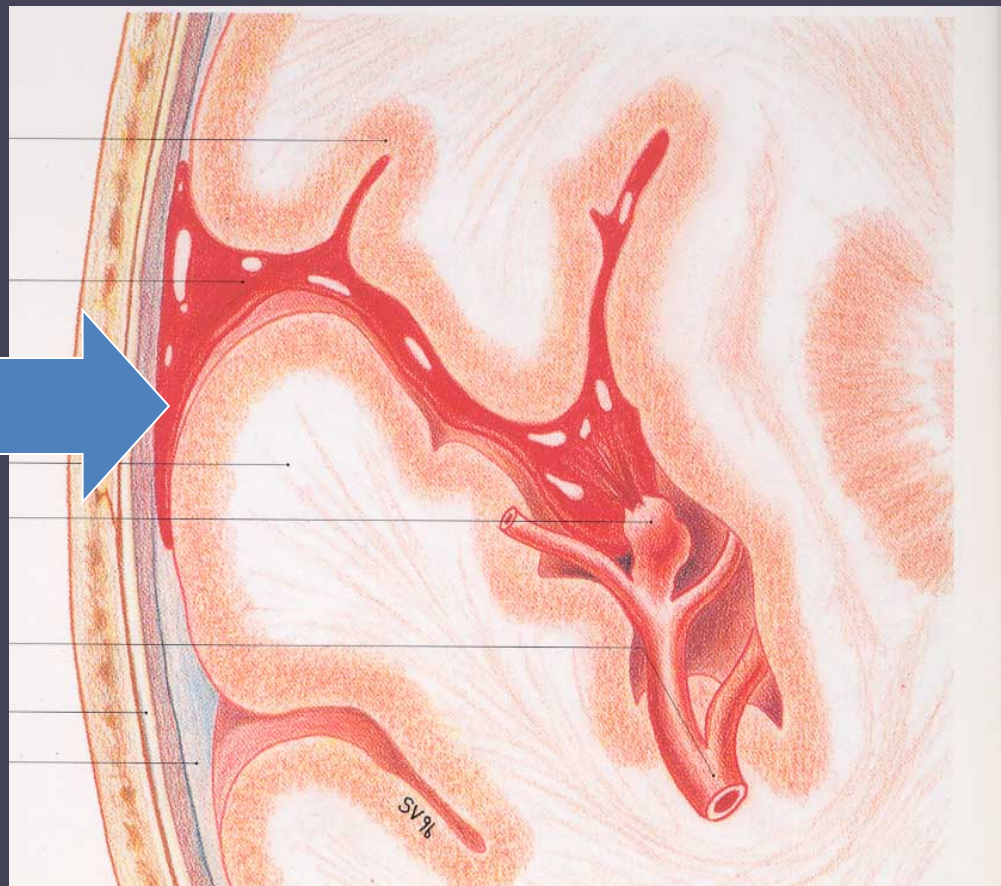
-Finlande, Japon

# Hémorragie méningée

# =

# Hémorragie sous arachnoïdienne



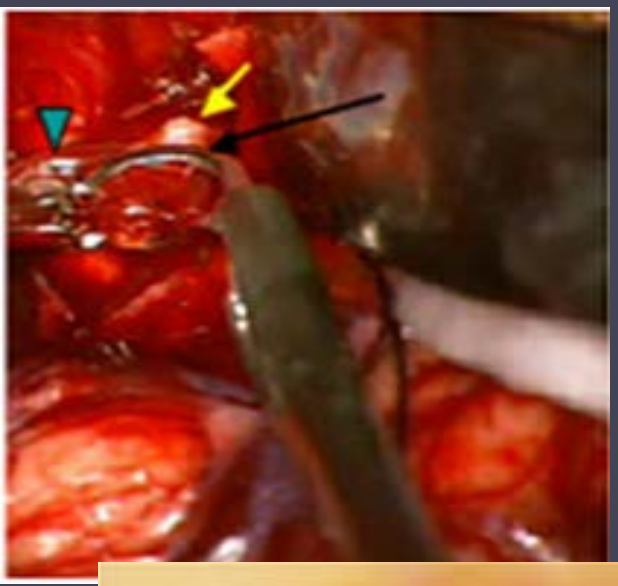



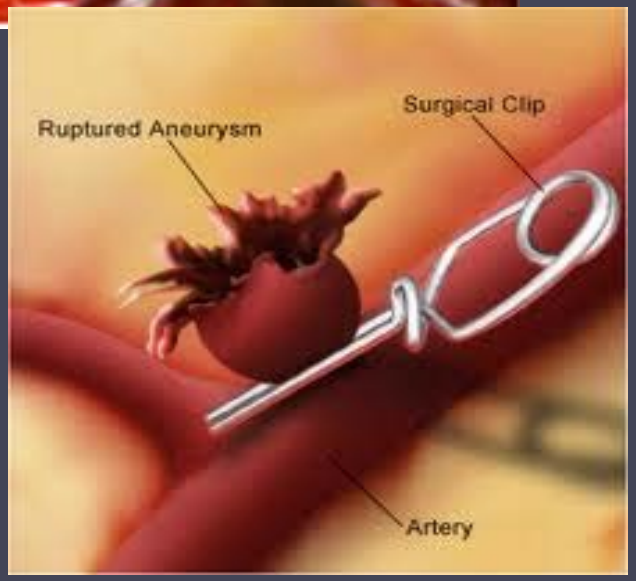
# TTT PRECOCE

- J1: risque d'hémorragie secondaire est de 4%, puis à 1-2% /j au cours des semaines suivantes.
- M3: risque cumulé est de 30-50%.

- anévrisme non rompu symptomatique (par ex. parésie oculomotrice) risque accru de rupture 6%/an.

# Traitements






# Results of ISAT: Outcome at one year

**Modified Rankin Score > 2 :**

**Surgery: 30.6%**

**EVT: 23.7%**

**Absolute risk reduction in dependency or death : 7 %**

**Relative risk reduction in dependency or death : 23 %**

***(Lancet 2002; 360: 1267-74)***

# A MULTICENTER STUDY OF 700 RUPTURED ANEURYSMS TREATED WITH GDC COILS

CHU de Tours, Poitiers, Reims, Angers, Clermont-Ferrand, Toulouse.

GALLAS S, PASCO A, COTTIER JP, DROUINEAU J, GABRILLARGUES J, COGNARD C, HERBRETEAU D.

AJNR Am J Neuroradiol 26: 123-1731, August 2005

# Treatment of Unruptured Aneurysms with GDC: Review of Literature and results about 321 consecutive unruptured aneurysms

Sophie Gallas, Jacques Drouineau, Jean Gabrillargues, Anne Pasco, Christophe Cognard, Denis Herbreteau.

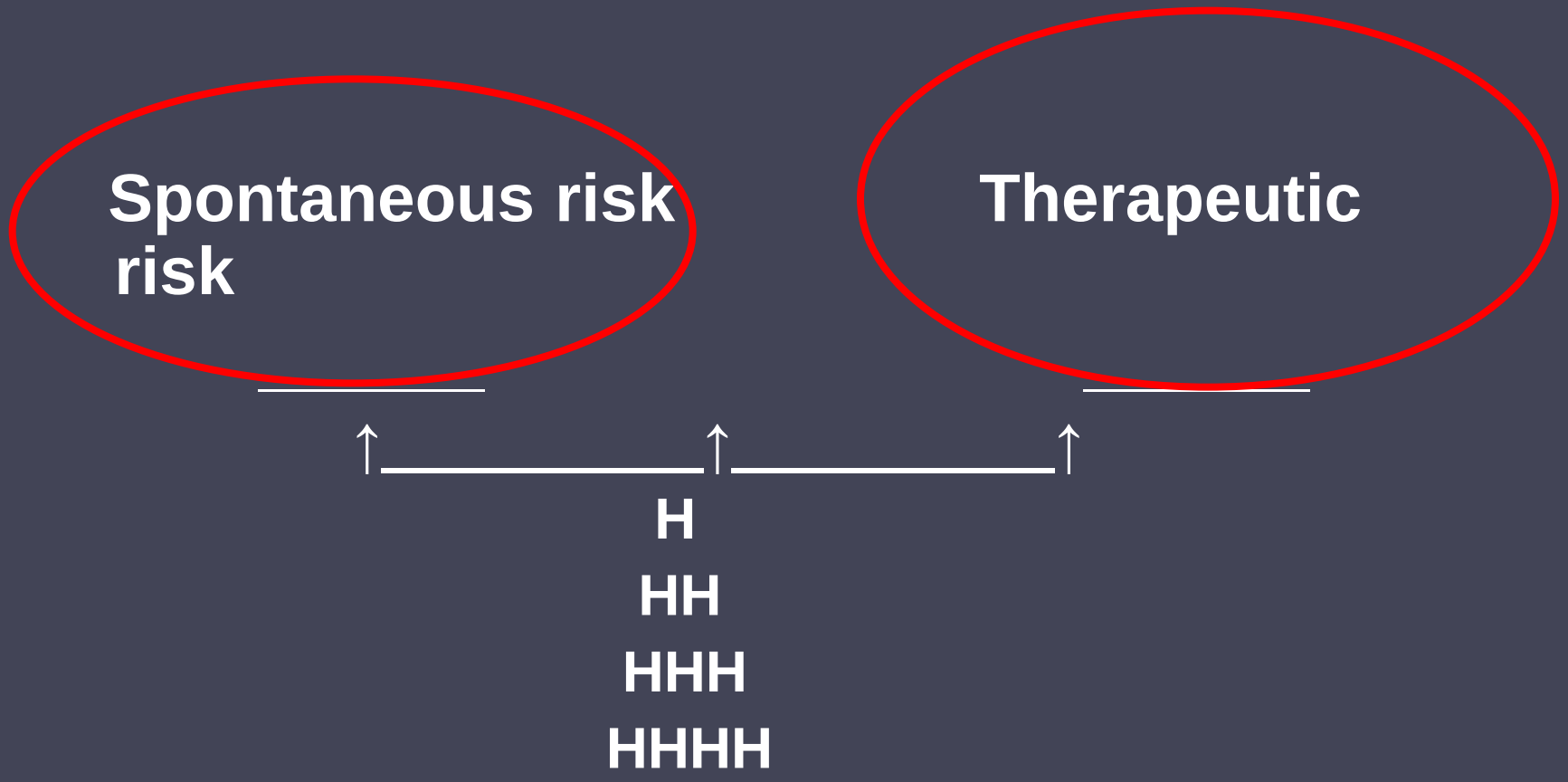
CHU de Angers,Clermont-Ferrand, Poitiers, Reims, Tours, Toulouse.

FRANCE

*The 65TH Annual meeting of the Japan Neurosurgical Society*

# Unruptured aneurysms?

- **Therapeutic strategy?**



# « Critical size ? »

EVT is an option for tt of aneurysms

- Wiebers < 7mm good natural evolution
- Weir observed SAH with small A

We had 80 % of small A in our ruptured study

- Small aneurysms must be treated or not???

## Anévrisme à collet étroit

⇨ positionner des **coils (ou hydro-coils)** au sein de la poche anévrismale

# COILS

= petite spire d'acier, de nitinol ou de platine, utilisée pour permettre l'embolisation (obturation d'un vaisseau)

**Coil 2D**

Forme hélicoïdale,
1ère génération de coil, utilisé pour constituer le maillage

**Coil alternance 2D/3D/2D**

Forme permettant une augmentation de facilité de placement du coil

**Coil 3D**

Forme sphérique,
2éme génération de coil, utilisé pour constituer la cage

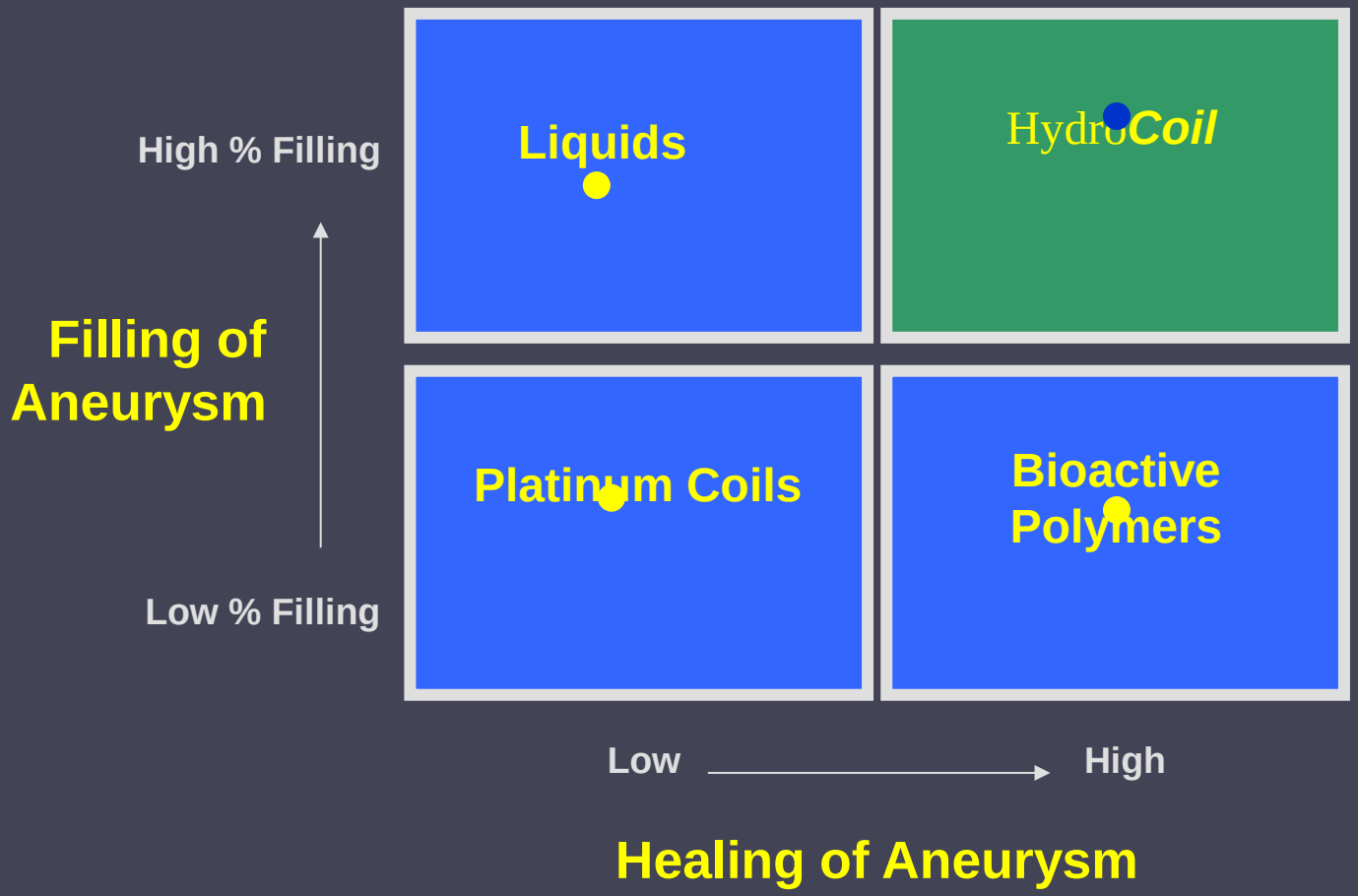
# HYDRO-COILS

Coils munis d'un copolymère inerte qui gonfle au contact du sang afin que celui-ci ne vienne pas taper sur la paroi artérielle et réouvrir l'anévrisme. Gel intelligent ("intelligel") qui prend la place restante permettant ainsi d'éviter la présence de pressions mécaniques et qui permet de combler l'anévrisme avec moins de matériel.

**Copolymère hydrophile interne au coil**

**Copolymère hydrophile externe au coil**

# Aneurysm Treatment Moves Towards Filling and Healing



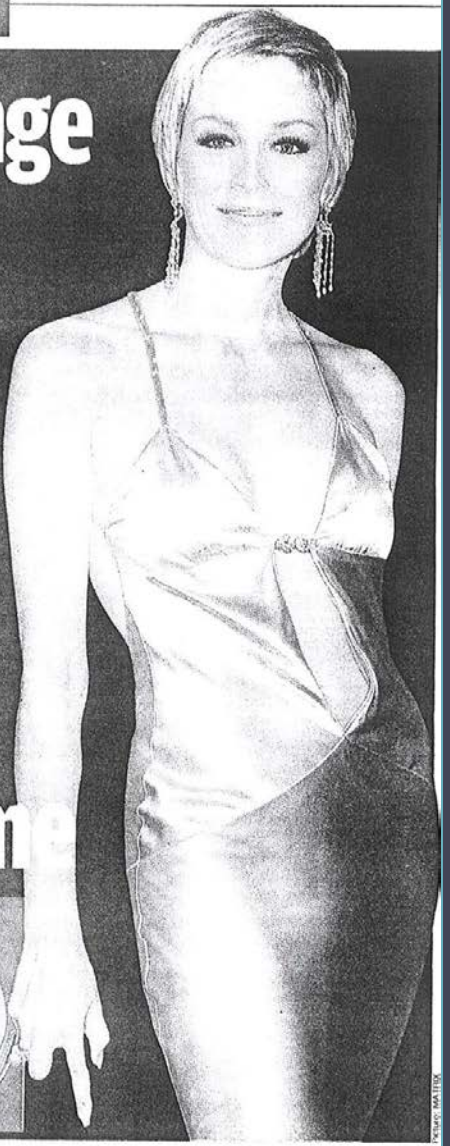
# **Hydro***Coil* Healing
## 3-month Follow Up

**Canine bifurcation Model, Beth Israel**

GoodHealth

Daily Mail, Tuesday, December 27, 2

# Magic sponge can stop ruptured arteries that might have killed Sharon Ston



By ROGER DOBSON

A REMARKABLE expanding sponge is being used to plug aneurysms — potentially fatal defects in arteries that supply the brain.

When it comes into contact with blood, the sponge swells up to 11 times its original size to fill the aneurysms and stop them from bursting.

Aneurysms are bubbles or sacs that can occur in artery walls and rupture, causing searing pain. This often results in strokes and death.

The new device consists of a platinum coil coated in a sponge that absorbs moisture. It is fed in a catheter or tube from the groin through the arteries until it reaches the site of the aneurysm, where scans confirm it is in place.

Over the next 20 minutes, it expands to fill the aneurysm. When that happens, there should no longer be a risk of a rupture and bleeding.

Around 5 per cent of people over 40 have an aneurysm — sufferers include actresses Sharon Stone and Jane Lapotaire — but in most people they are not an issue.

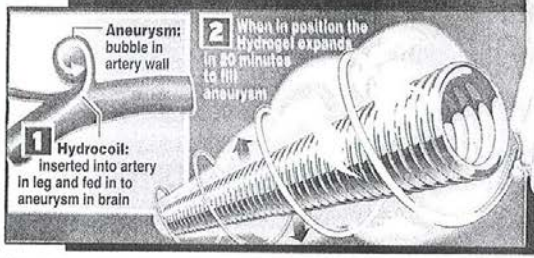
Problems occur only in those cases where the aneurysm ruptures and bleeds into the brain and the spaces around the brain. Ruptures can compress brain tissue or nerves, and are a common cause of strokes or death.

Most aneurysms are the result of an abnormality of the inside lining of an artery. Some people may have a genetic predisposition, and cigarette smoking and excess alcohol have been shown to increase the risk of rupture.

Although most patients have no warning signs of a rupture, around 40 per cent do have some symptoms, including pain above and behind the eye, headache, neck or upper back pain, and nausea.

Until a decade ago, the most common treatment was open brain surgery, where a clip was put over the neck of the bubble at the point where it branches from the artery. That cuts off the blood supply to the aneurysm so that the blood left inside becomes a clot and will not cause a dangerous bleed.

Although it works, it carries the risks that come with surgery and recovery time can be up to one year. More recently tiny metal coils have been fed through arteries and packed into the aneurysm. Clots then form between the coils.




THE DOWNSIDE is that they fill only around 20 per cent of the sac, so the clot could break down, leading to renewed bleeding and the risk of another rupture. The new device, which has just begun a trial, is implanted via a cannula, a flexible tube, inserted through an artery in the leg.

In addition, a gel used in the device seems not only to block future ruptures, but also to trigger growth in healthy tissue on the lining of the artery, making it stronger than before.

'This new device we are using in the trial has tremendous advantages,' says Dr Robin Sellar, interventional neuroradiologist at Western General Hospital in Edinburgh. 'There has been a search for ways to stop renewed bleeding, and this seems to do that. The results are encouraging.'

After actress Sharon Stone suffered a brain aneurysm, four years ago, she described herself as 'very, very lucky' to be alive.

The 47-year-old actress said the first sign anything was wrong was when she was struck down with 'the most painful headache in my life' one Saturday night. 'I felt as though I had been shot in the head,' she said.

She was driven straight to the casualty unit of a San Francisco hospital by her worried husband, newspaper editor Phil Bronstein.

The star, whose films include Basic Instinct and Sliver, had suffered a subarachnoid haemorrhage — a type of stroke that is immediately fatal for one in three victims and kills a further third in the following weeks.

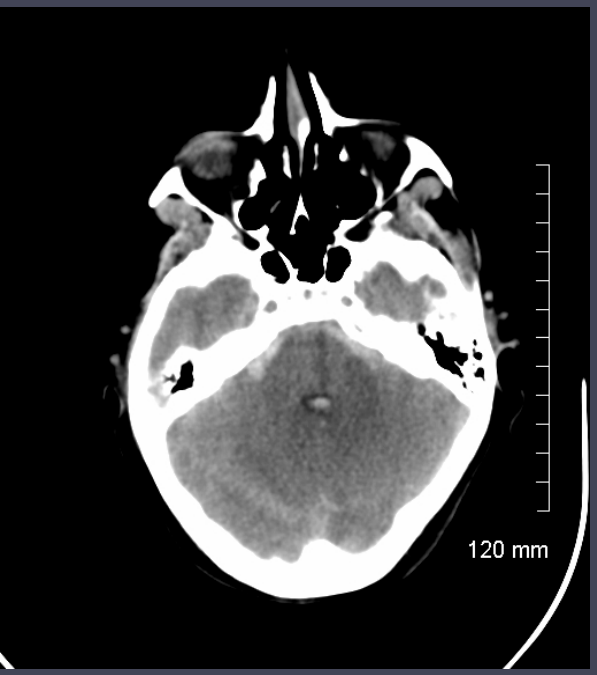
Stone, a health fanatic who works out regularly with a personal trainer, said doctors had told her that she appeared to have escaped further complications.

She said: 'So far, it appears I've fallen into the 5 per cent category that when it blows, it blows itself up. So I didn't have to have brain surgery. I've been treated with medication.' Initially, it was feared that surgeons would have to operate to clear what they suspected was a huge haemorrhage in the actress's brain. But tests later showed the bleeding was limited.

Stone considers herself lucky, but is aware of how dangerous her condition could have been: 'My illness affected me so profoundly that my life will never be the same again.'

# En pratique quotidienne

– Les étapes: repérer
monter
confirmer
traiter

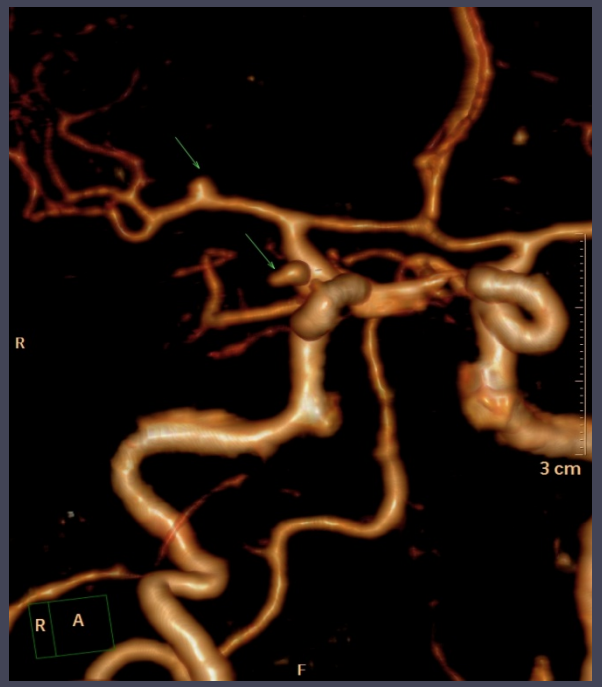

120 mm

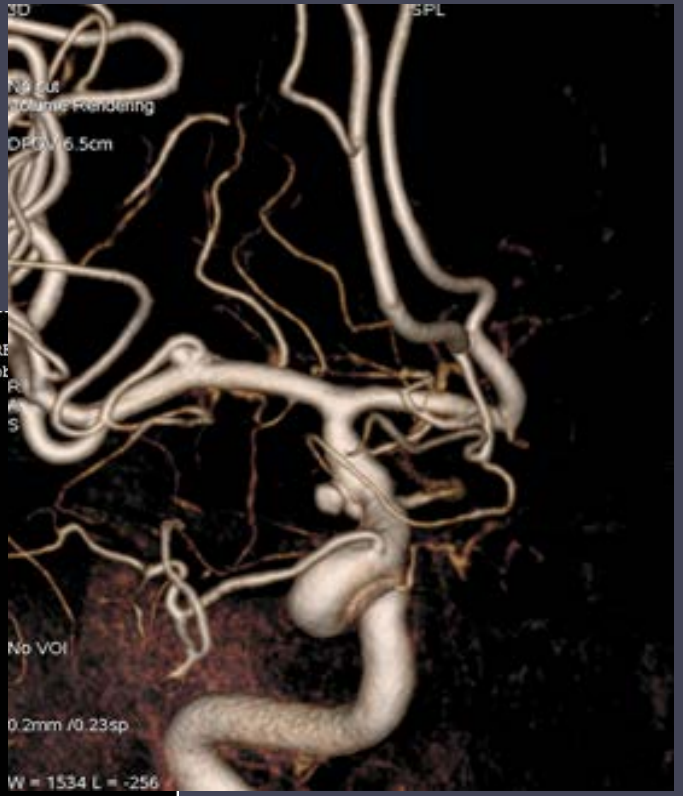

120 mm


120 mm


50 mm

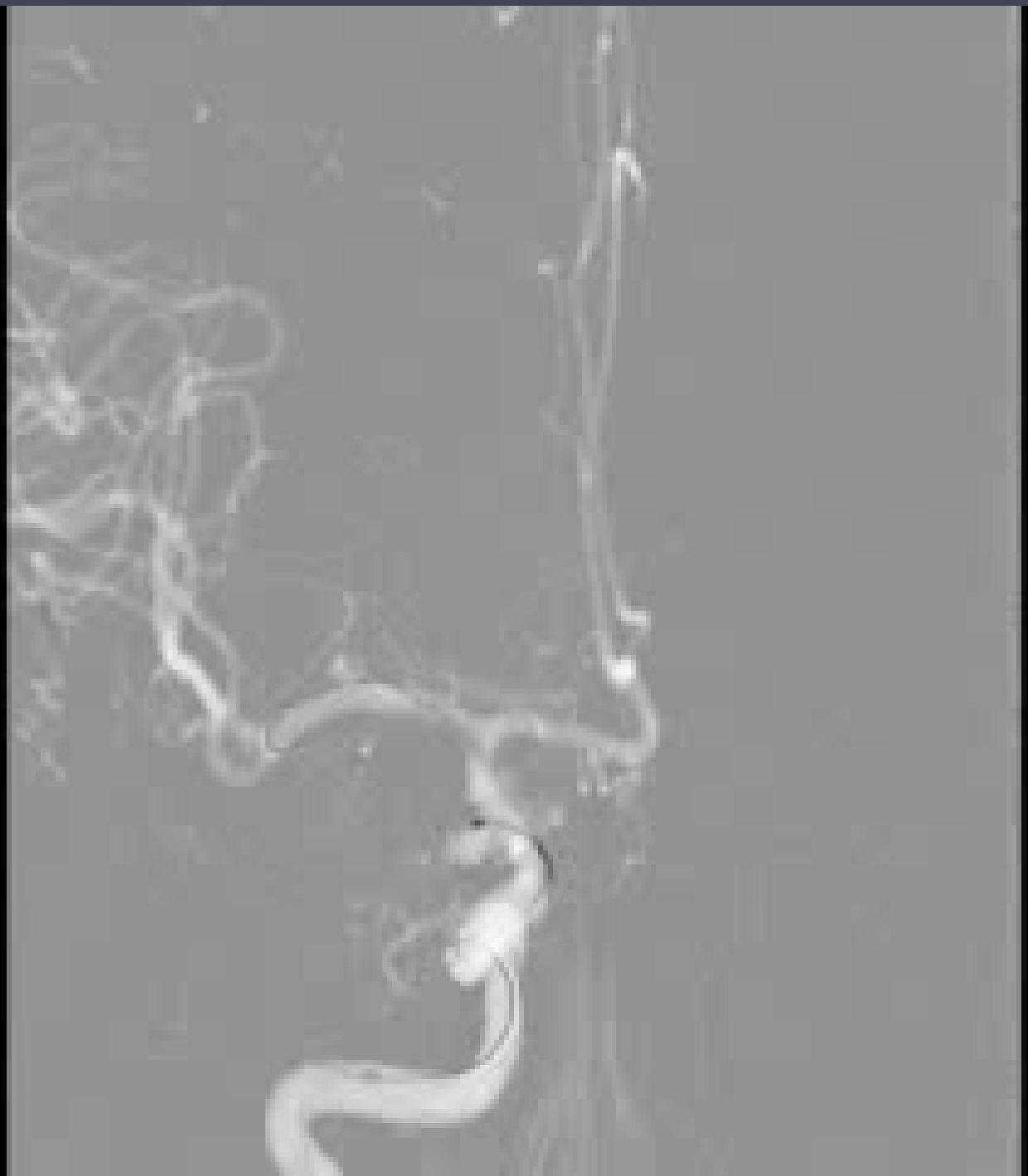

50 mm

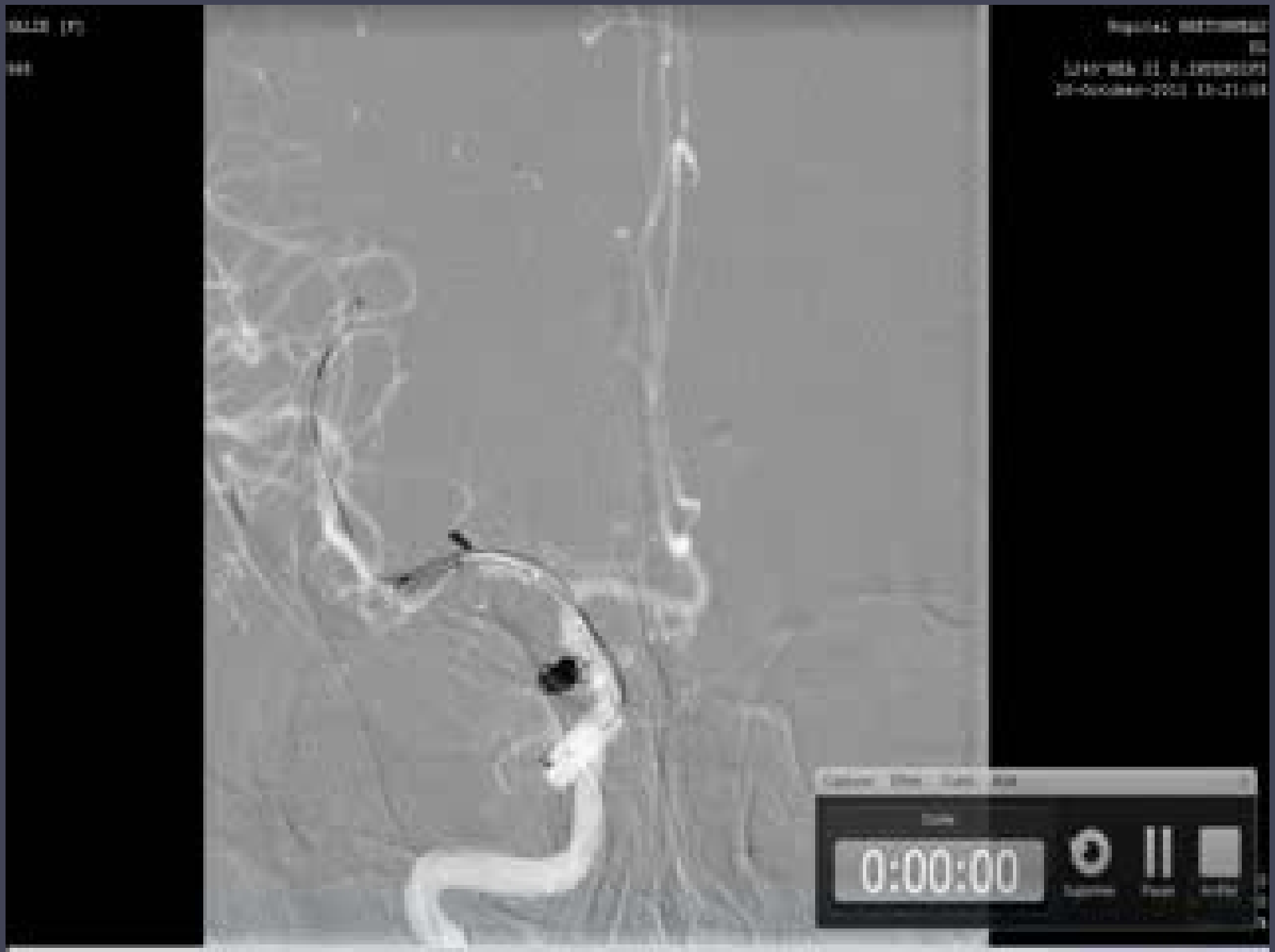

R
3 cm
R
A
F

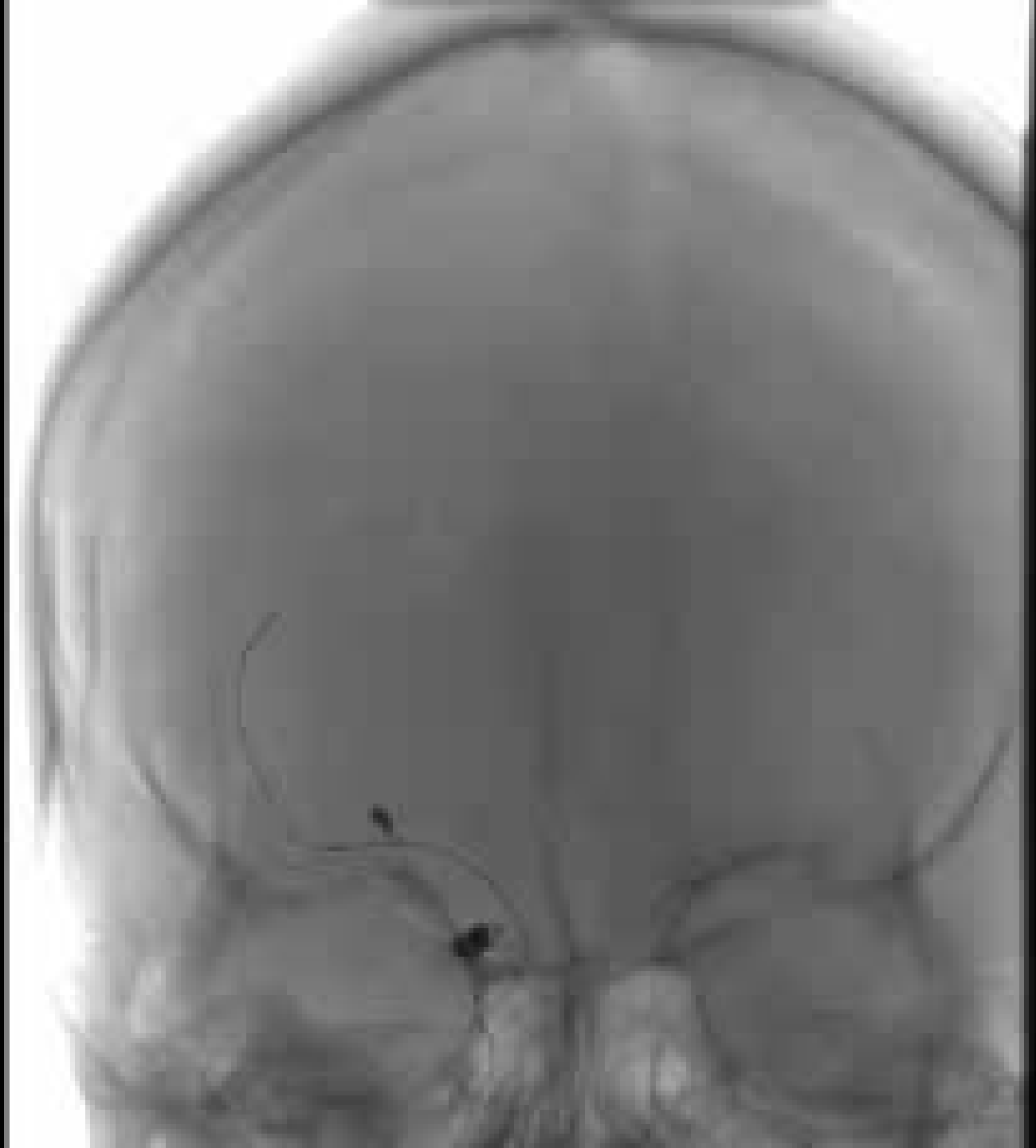

No VOI
W = 1534 L = -256

# Choix technique

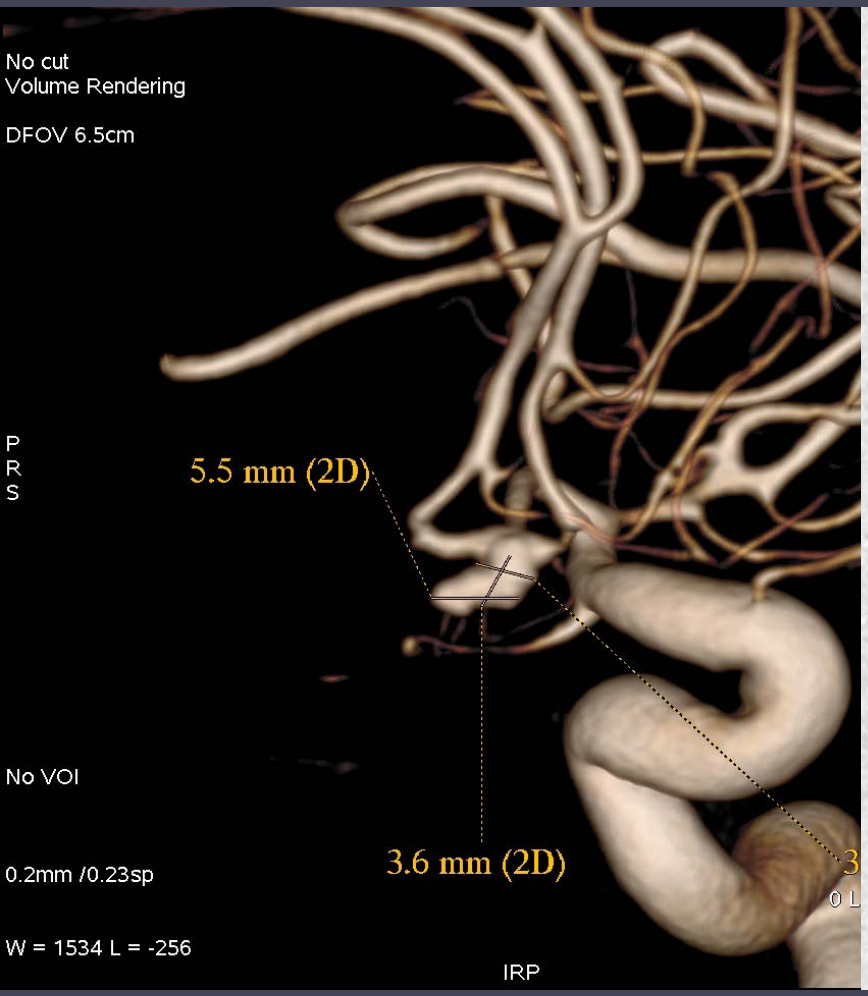
- Incidence pour dégager le collet
- Choix microcathé et microguide
- Taille et choix des coils
- “remodeling”: ballon++, stent…
- Anticoagulation

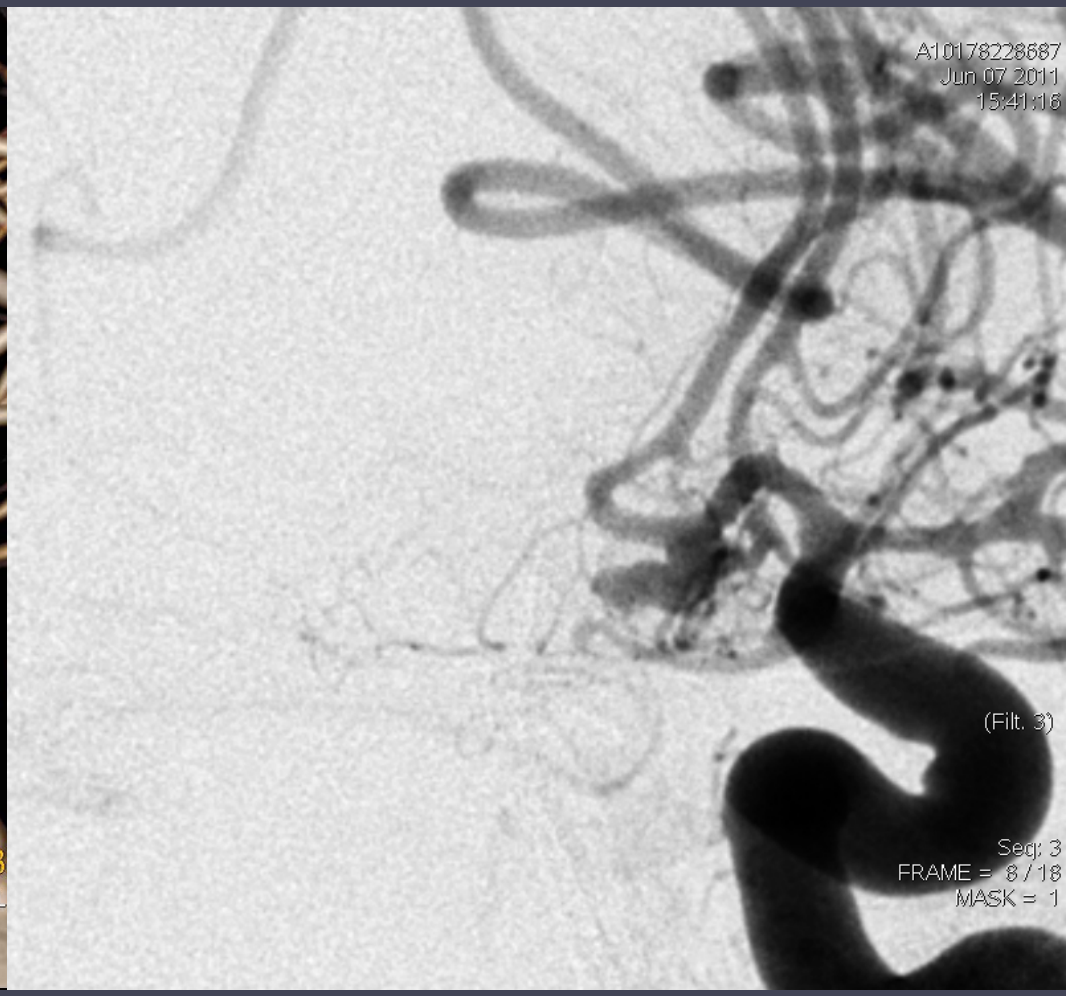


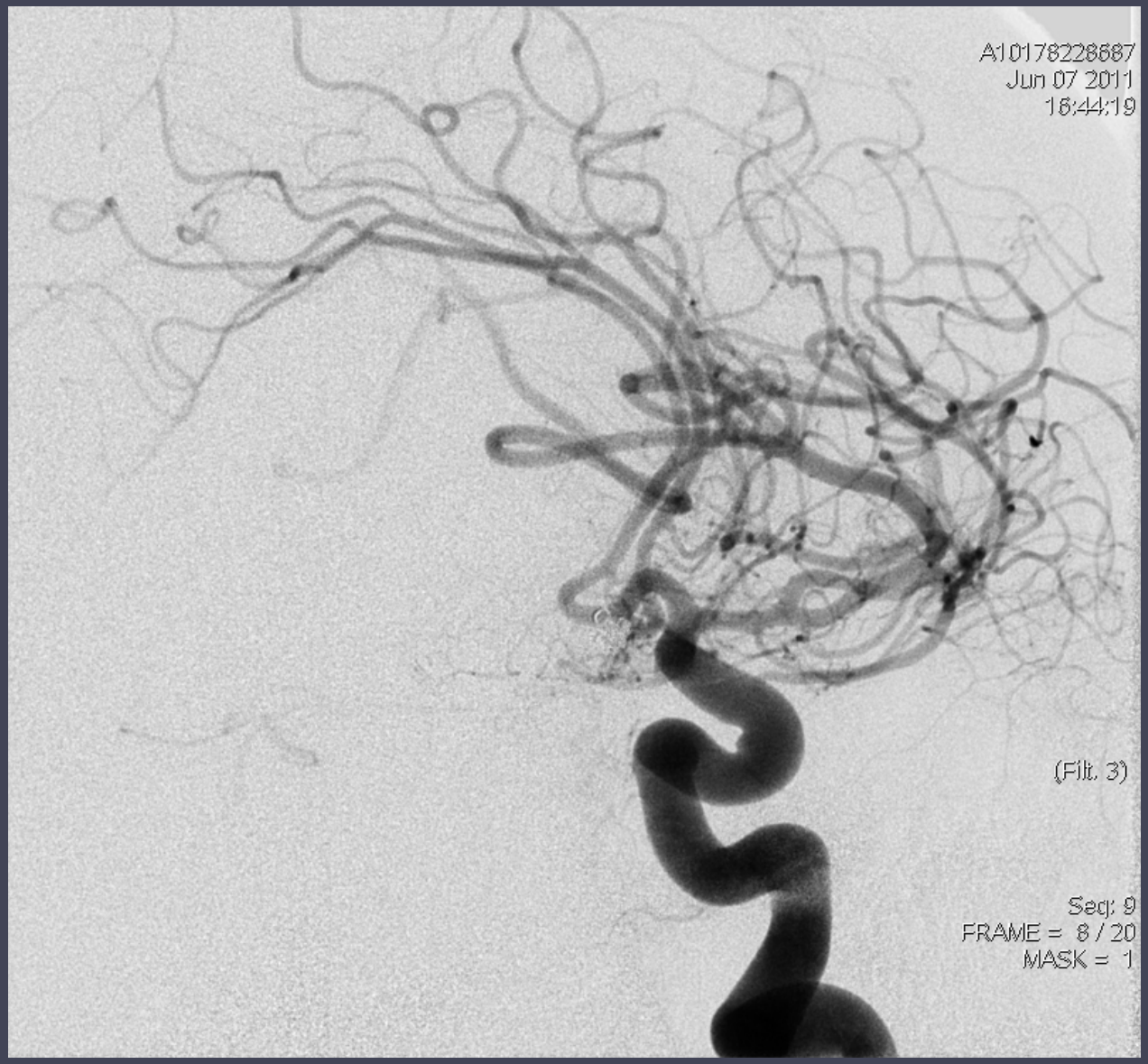

0:00:00



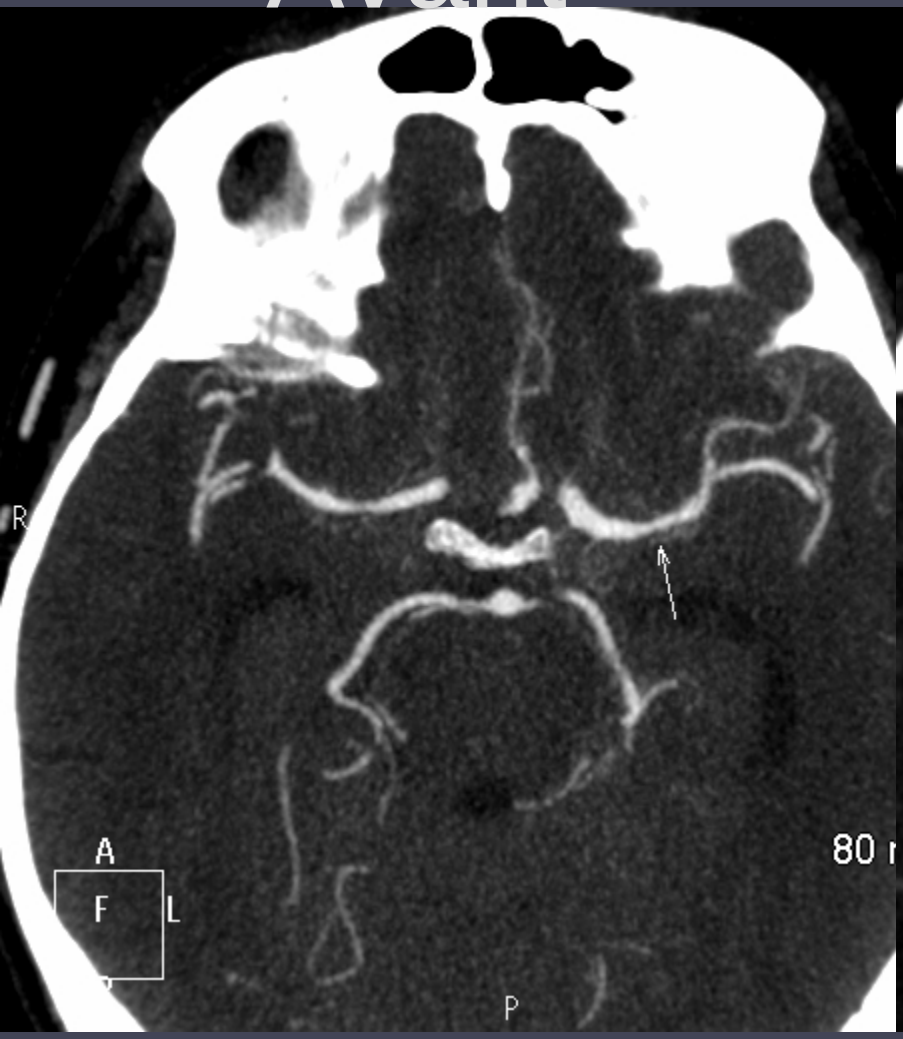
# Vasospasme
# hydrocéphalie

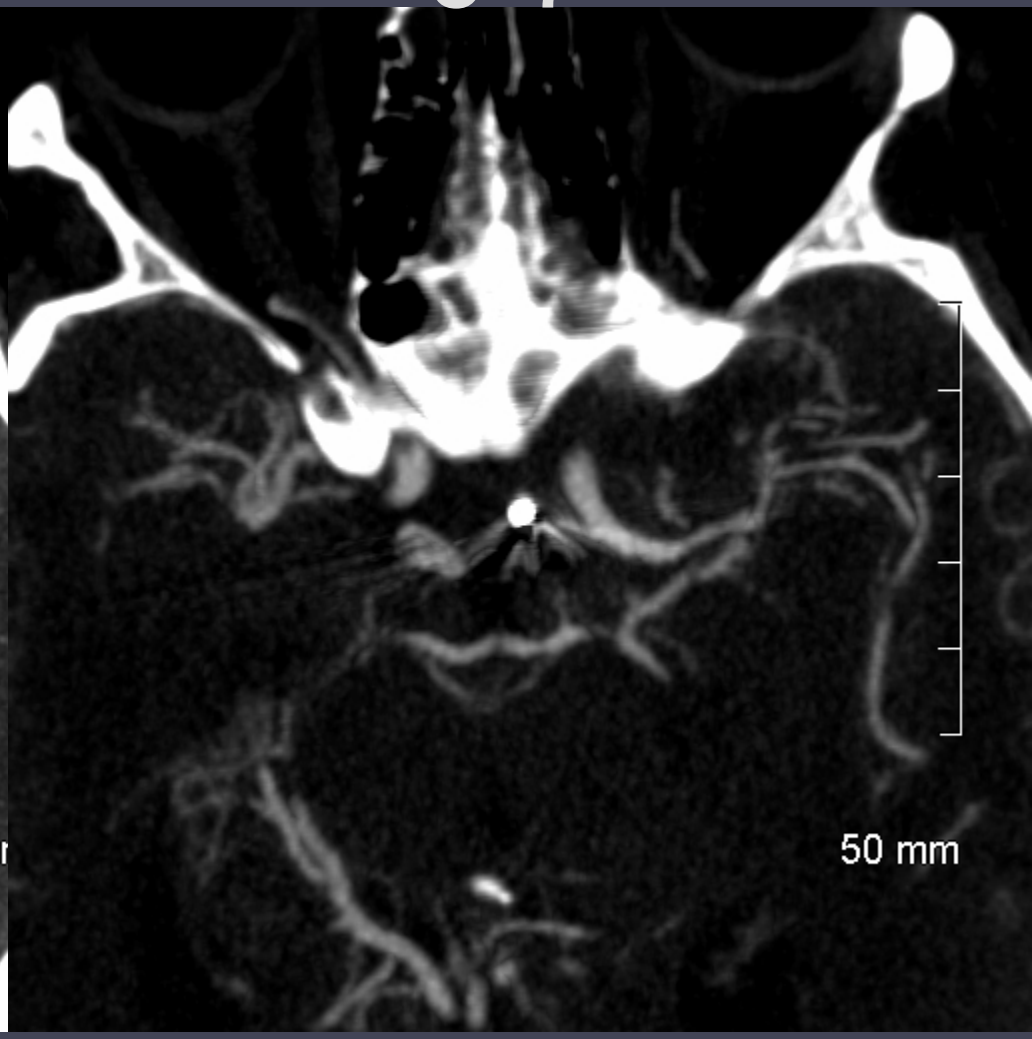

No cut
Volume Rendering
DFOV 6.5cm
P
R
S
5.5 mm (2D)
No VOI
3.6 mm (2D)
0.2mm /0.23sp
W = 1534 L = -256
IRP


A10178228687
Jun 07 2011
15:41:16
(Filt. 3)
Seq: 3
FRAME = 8 / 18
MASK = 1


A:10178228687
Jun 07 2011
16:44:19
(Flt. 3)
Seq: 9
FRAME = 8 / 20
MASK = 1

# Avant J 7



# Dilatation (ballon)

# Surveillance: Artério AngioMR

6 mois et 18 mois puis annuel et espacer

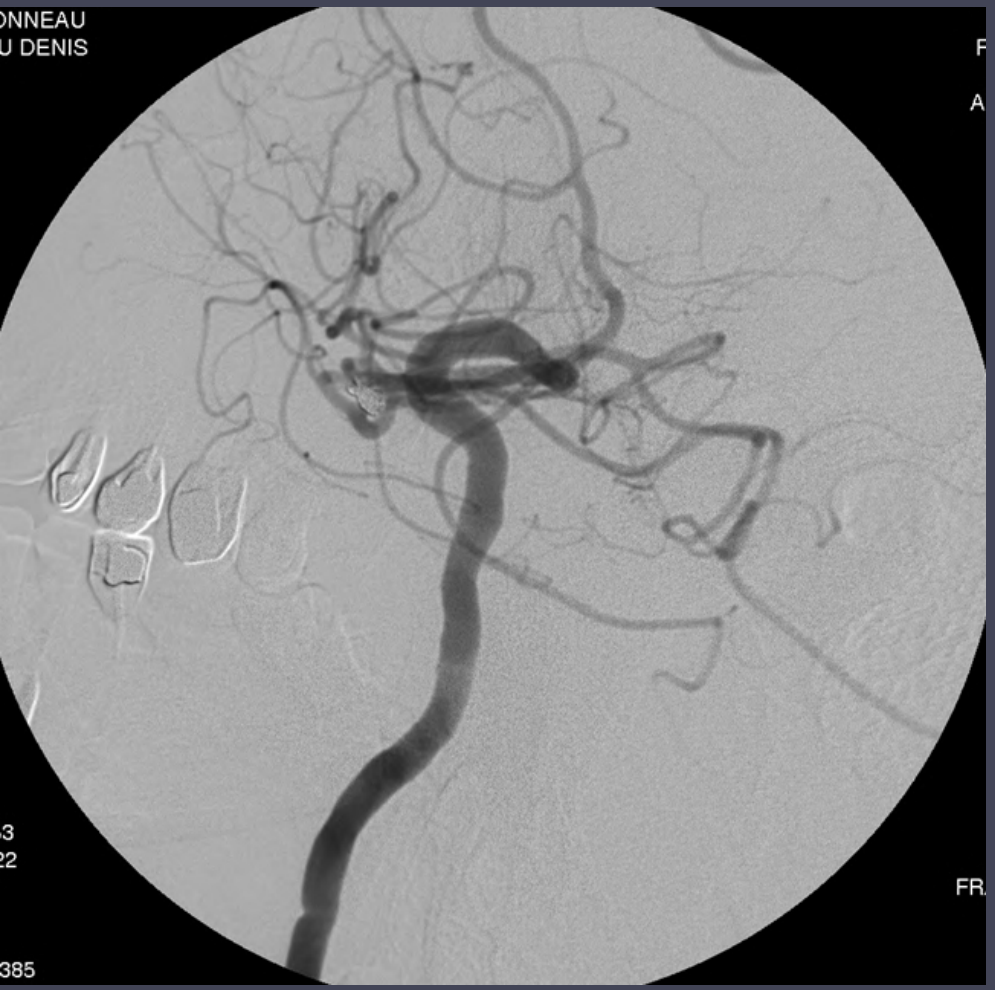
Si stable  = ne bougera pas sauf 1%

Si bouge = 6% reTTT

# Embolisation Mai 2007

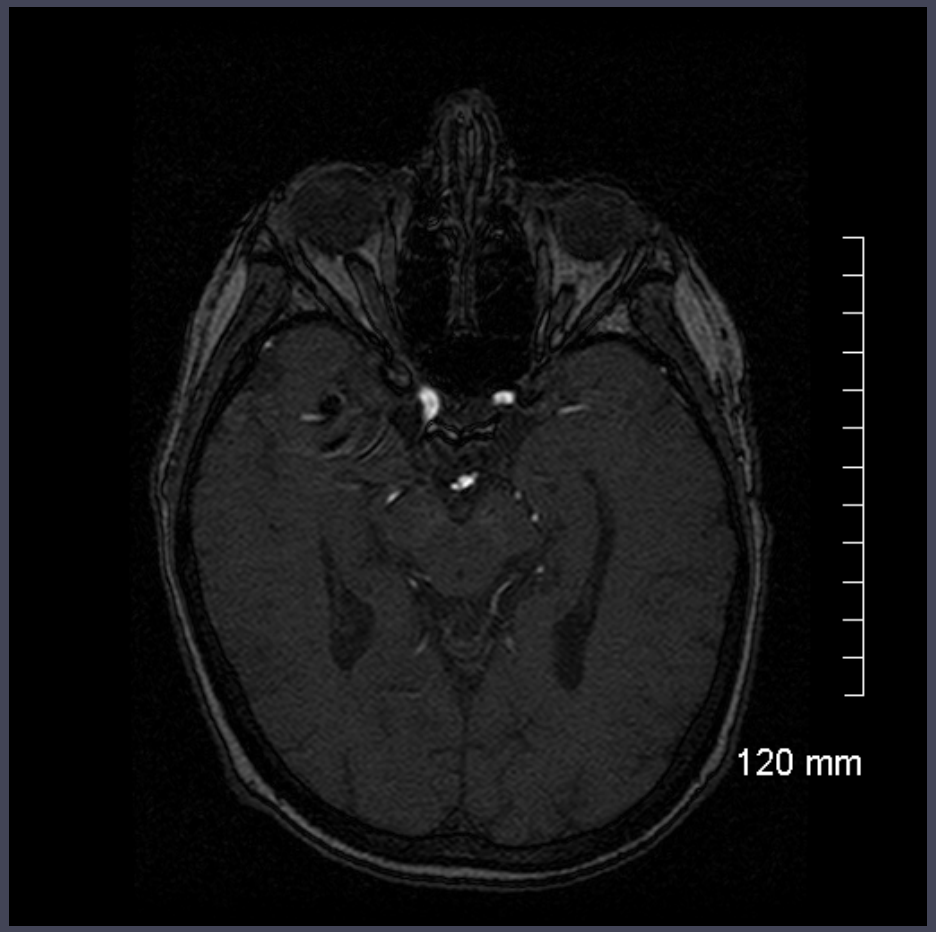

# Contrôle à 6 mois

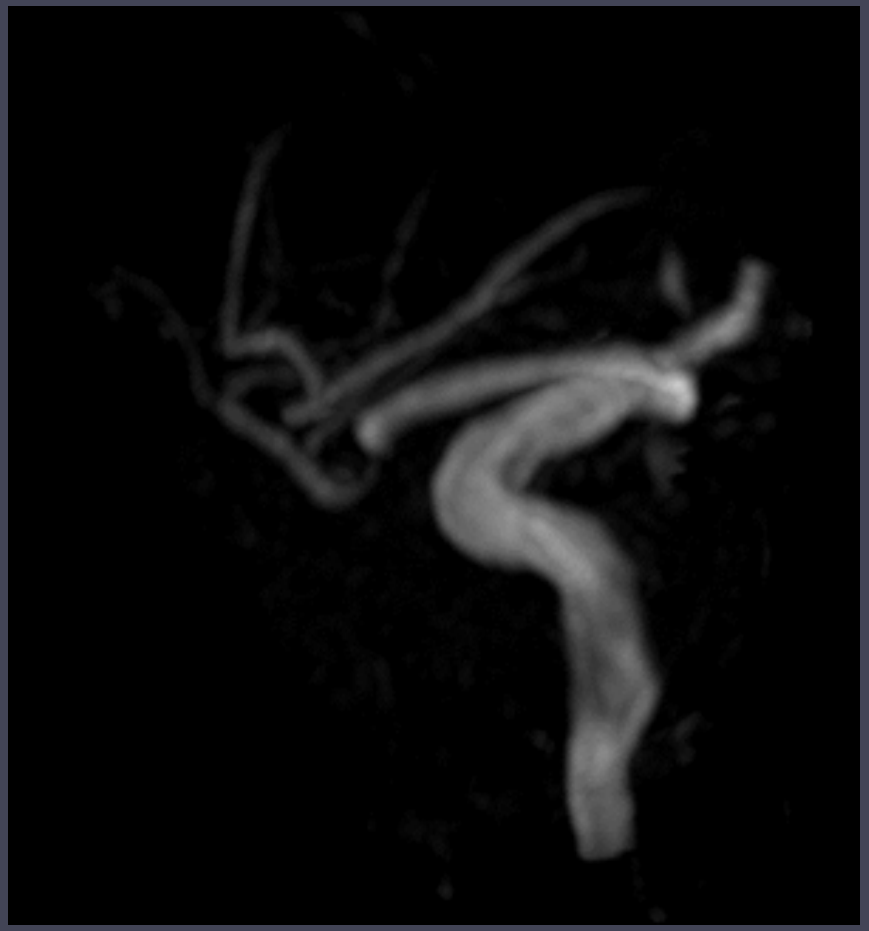
## exclusion stable




# Contrôle à un an

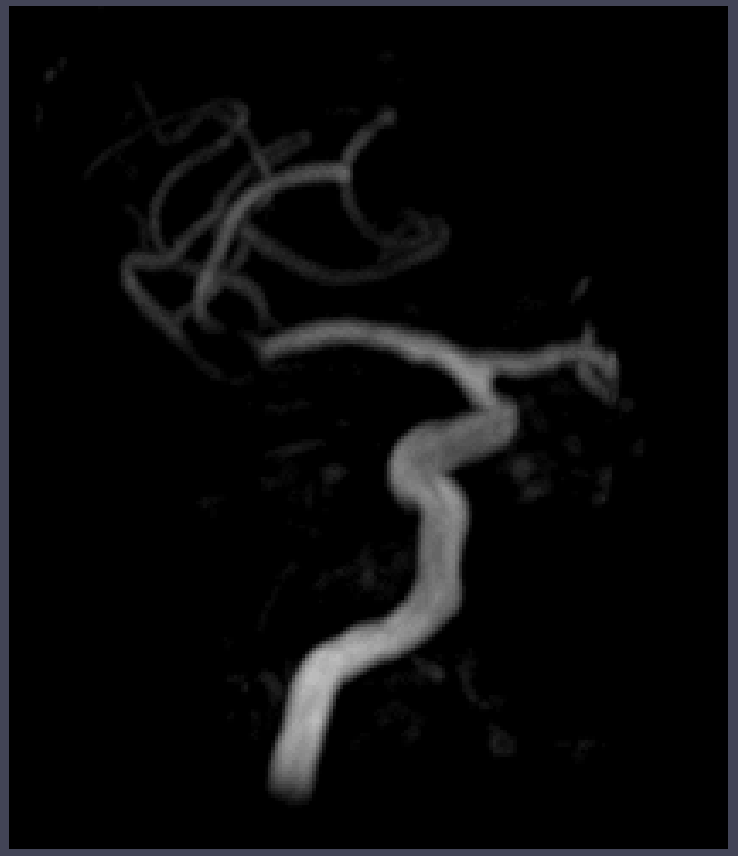
## exclusion stable



# Contrôle à 3 ans

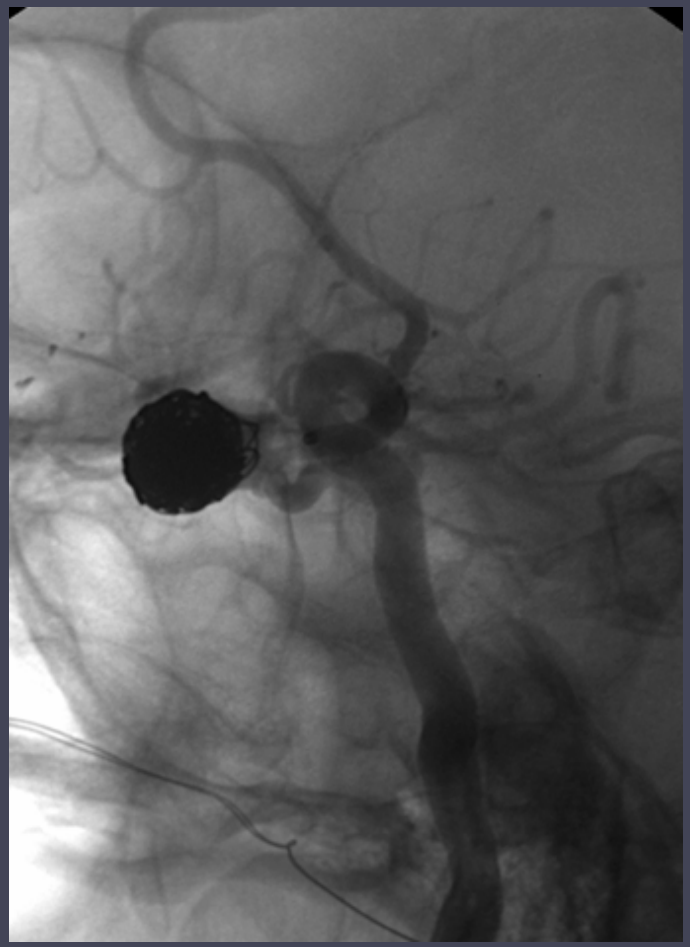
## exclusion stable

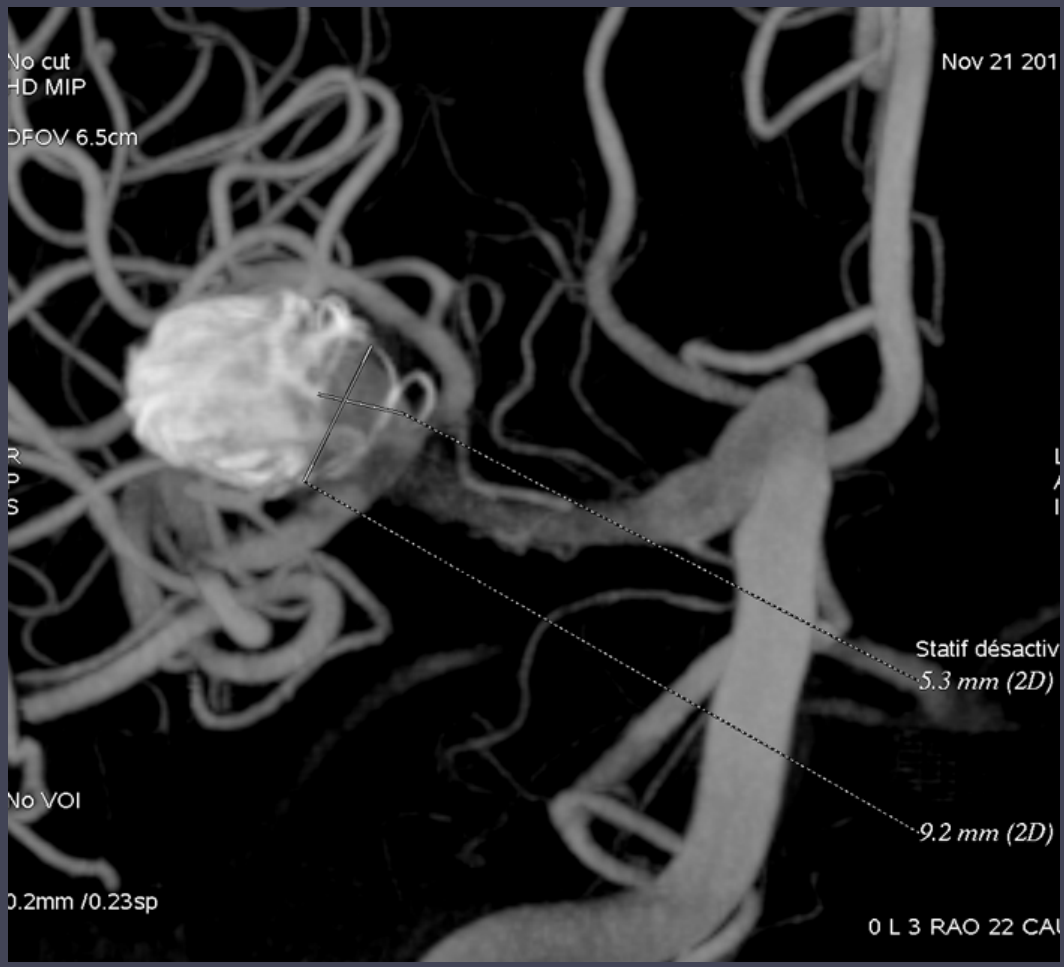
# Cas 2


olume Rendering No cut
FOV 6.5cm
APAGIANNAKI CHRYSAN
12.4 mm (2D)
10.9 mm (2D)
40 mm

# 1ère embolisation



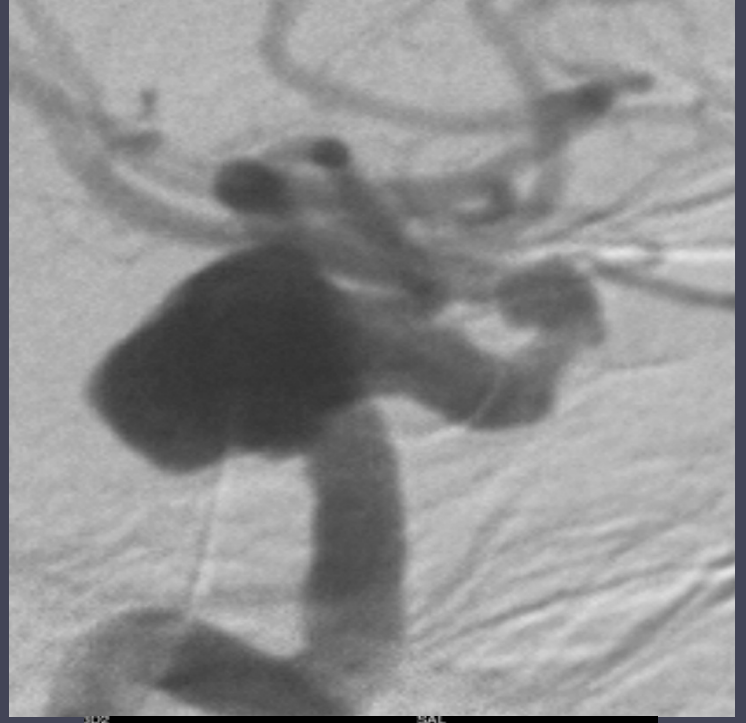
# Contrôle à 6 mois
## recanalisation = reTTT

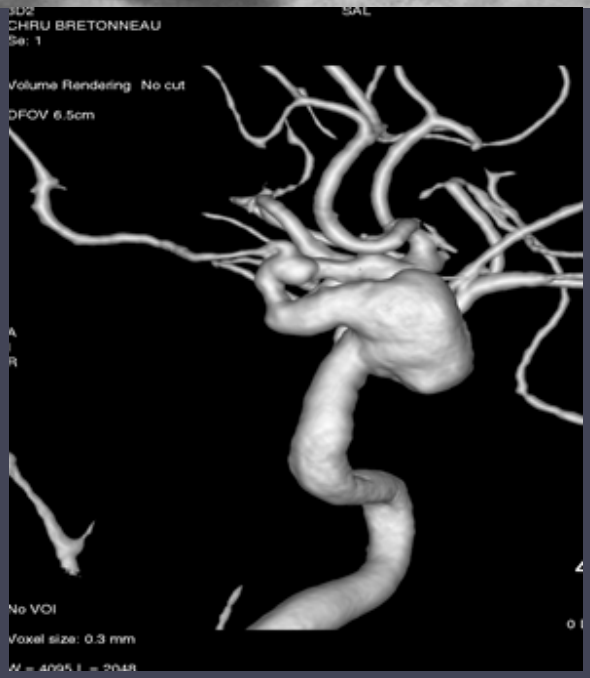


# 2ème embolisation : bof !

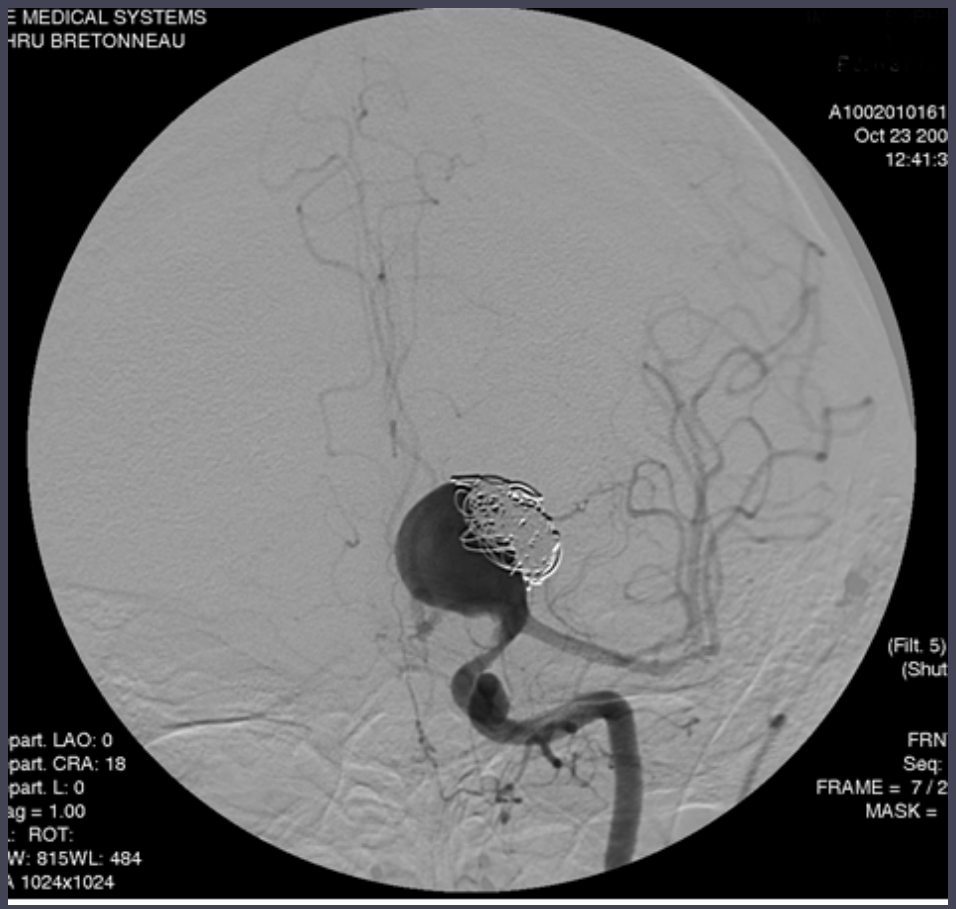
# Anévrismes Particuliers

# VOLUMINEUX:sacrifice carotide

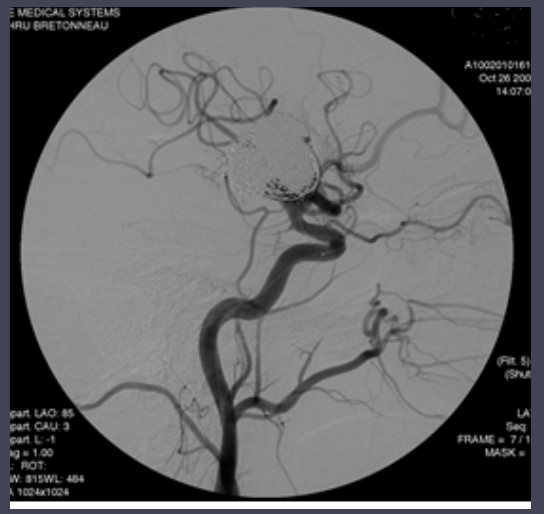





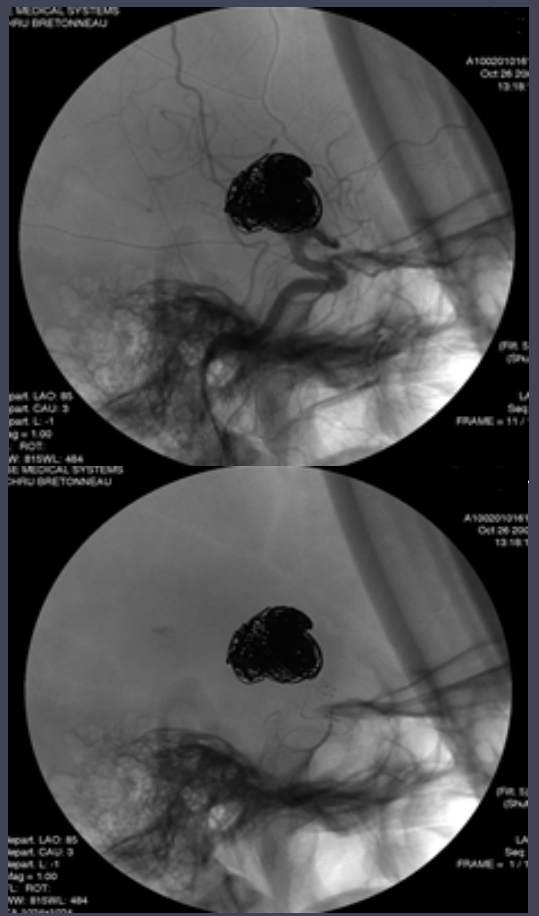
# Anévrismes sur dissection

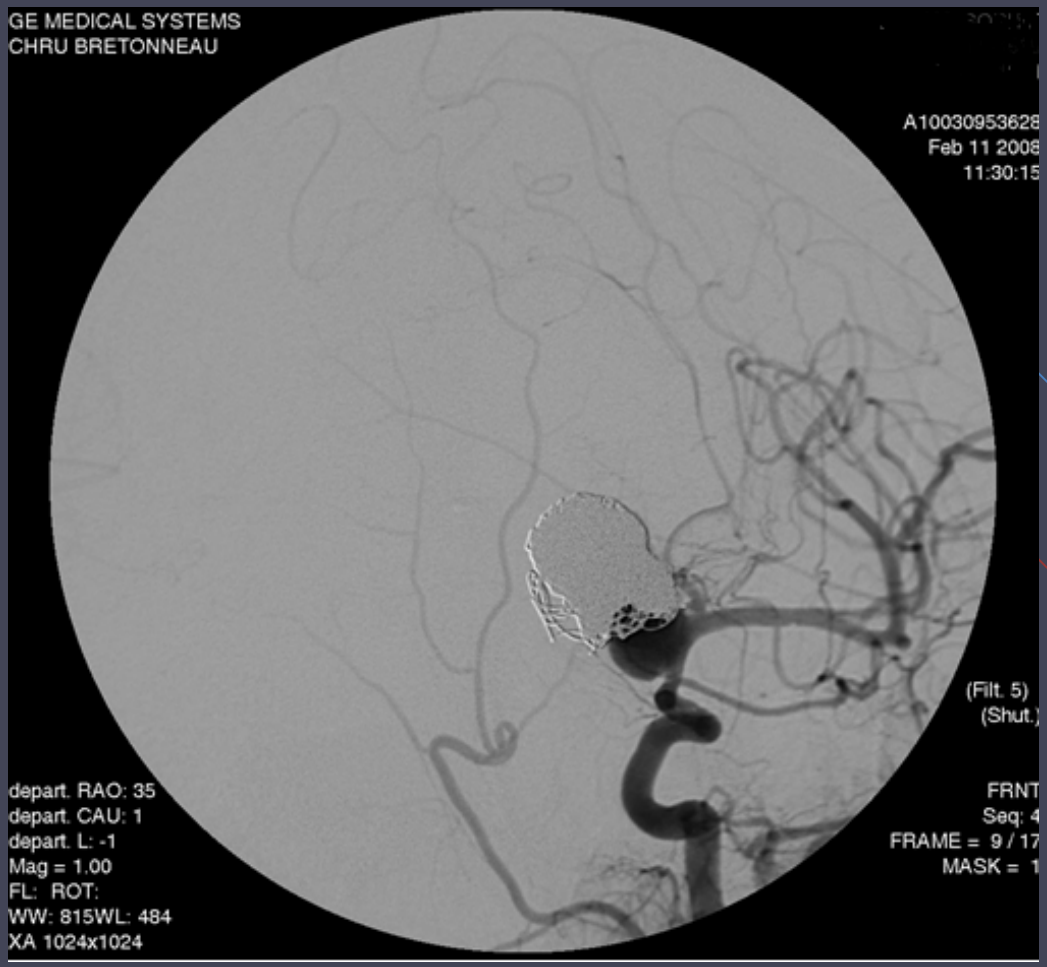


E MEDICAL SYSTEMS
HRU BRETONNEAU
A1002010161
Oct 23 200
12:41:3
(Filt. 5)
(Shut
part. LAO: 0
part. CRA: 18
part. L: 0
ag = 1.00
: ROT:
W: 815WL: 484
A 1024x1024
FRN
Seq:
FRAME = 7 / 2
MASK =

coil



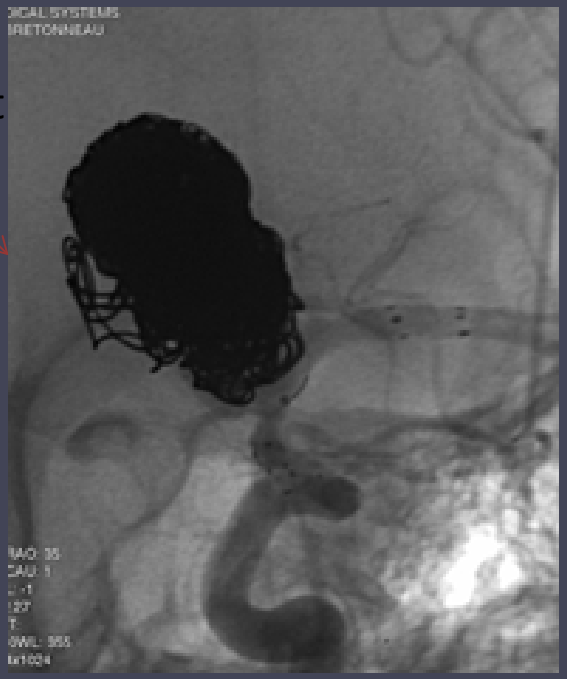
stent

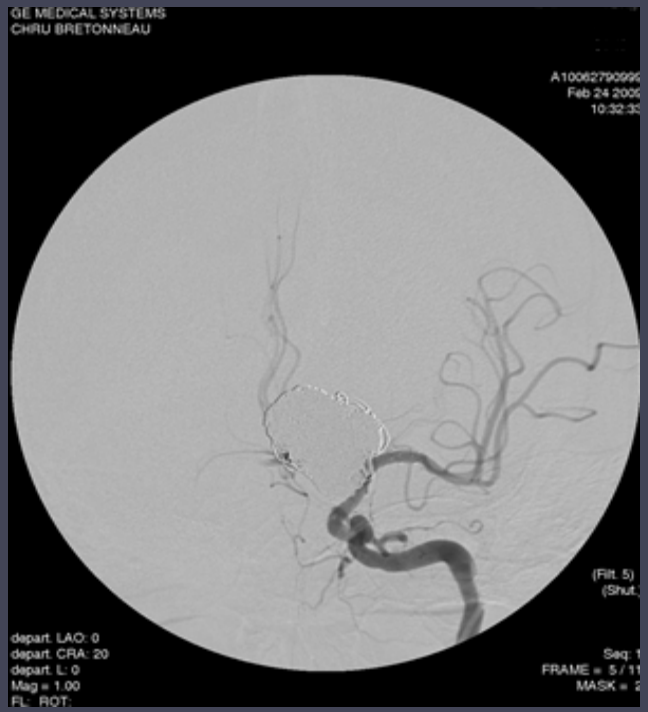



GE MEDICAL SYSTEMS
CHRU BRETONNEAU
A10030953628
Feb 11 2008
11:30:15
(Filt. 5)
(Shut.)
depart. RAO: 35
depart. CAU: 1
depart. L: -1
Mag = 1.00
FL: ROT:
WW: 815WL: 484
XA 1024x1024
FRNT
Seq: 4
FRAME = 9 / 17
MASK = 1

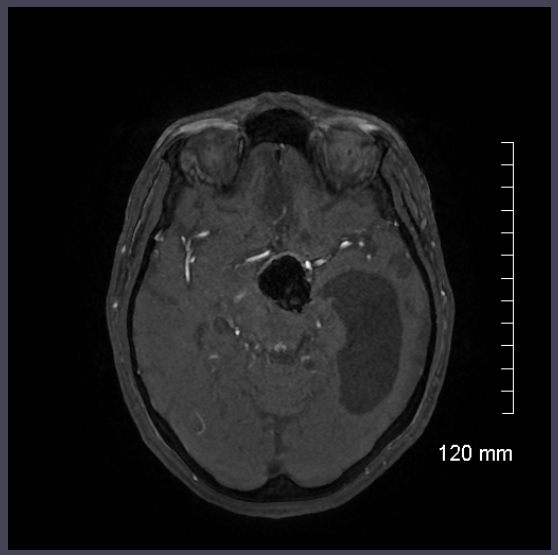
coil

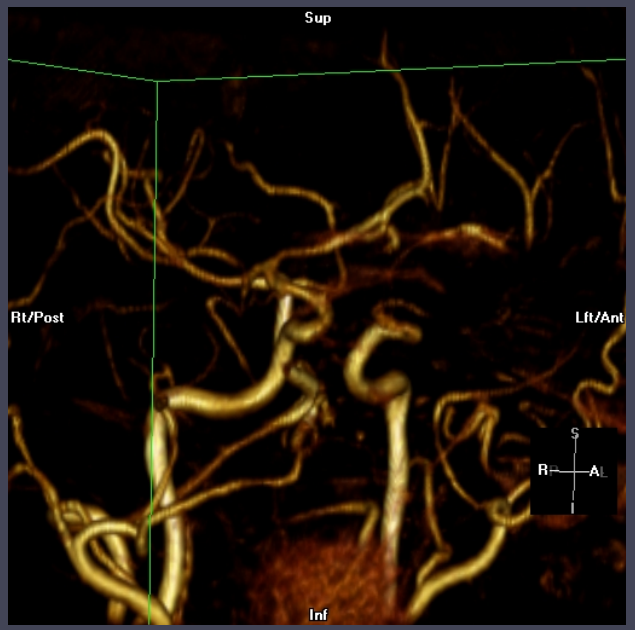
2 stent




GE MEDICAL SYSTEMS
CHRU BRETONNEAU
depart. LAO: 0
depart. CRA: 20
depart. L: 0
Mag = 1.00
FL: ROT:


CHRU BRETONNEAU
depart. RAO: 41
depart. CRA: 3
depart. L: -1
Mag = 1.00
FL: ROT:
WW: 810WL: 355
XA 1024x1024


120 mm


Sup
Rt/Post
Lft/Ant
Inf
S
R
A
I

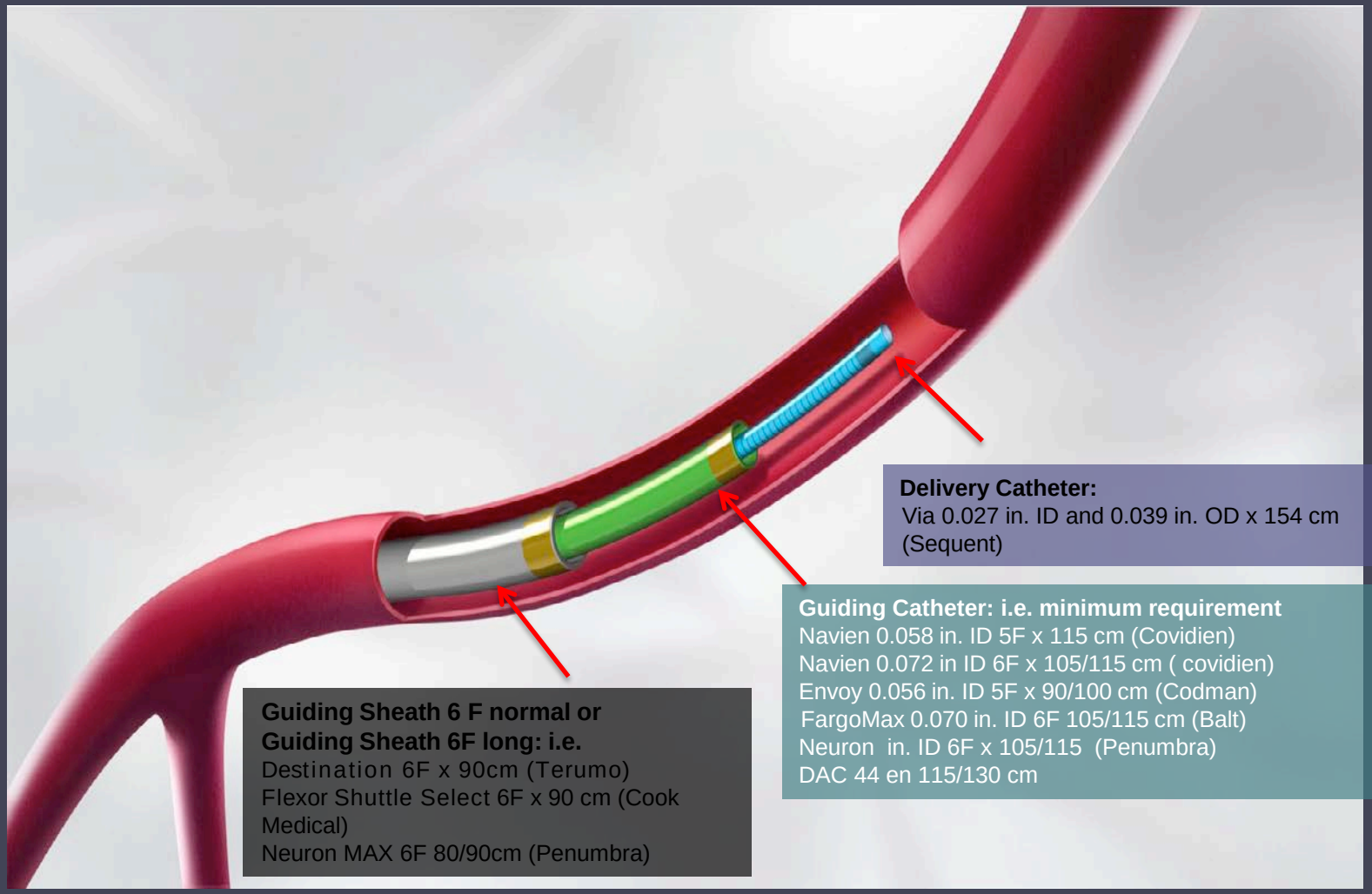
# Besoin de nouveaux Matériaux

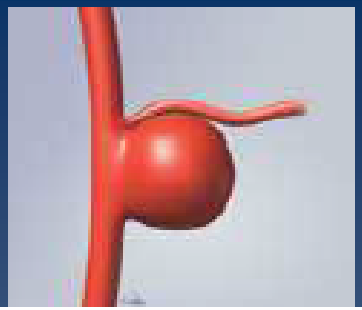
Les coils pas suffisants

Echec des liquides

Stents puis diversion de flux

# Telescope Technique with Sequent VIA .027 Micro-Catheter



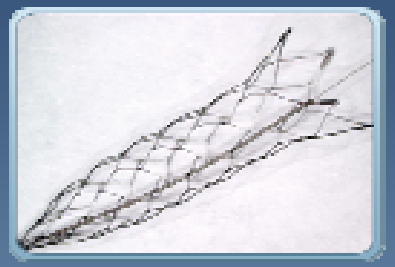


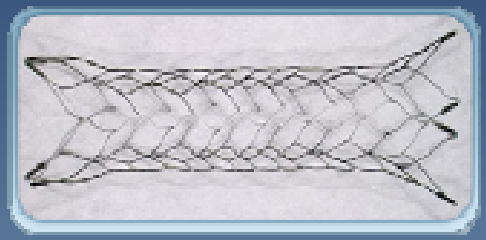
## Anévrisme à collet large

⇨ positionner au préalable un **stent** au niveau de l'artère afin de maintenir les **coils** dans la poche anévrismale

## STENTS

= dispositif métallique maillé et tubulaire, glissé dans une cavité naturelle humaine pour la maintenir ouverte. Essentiellement utilisés dans les artères au cours d'une angioplastie



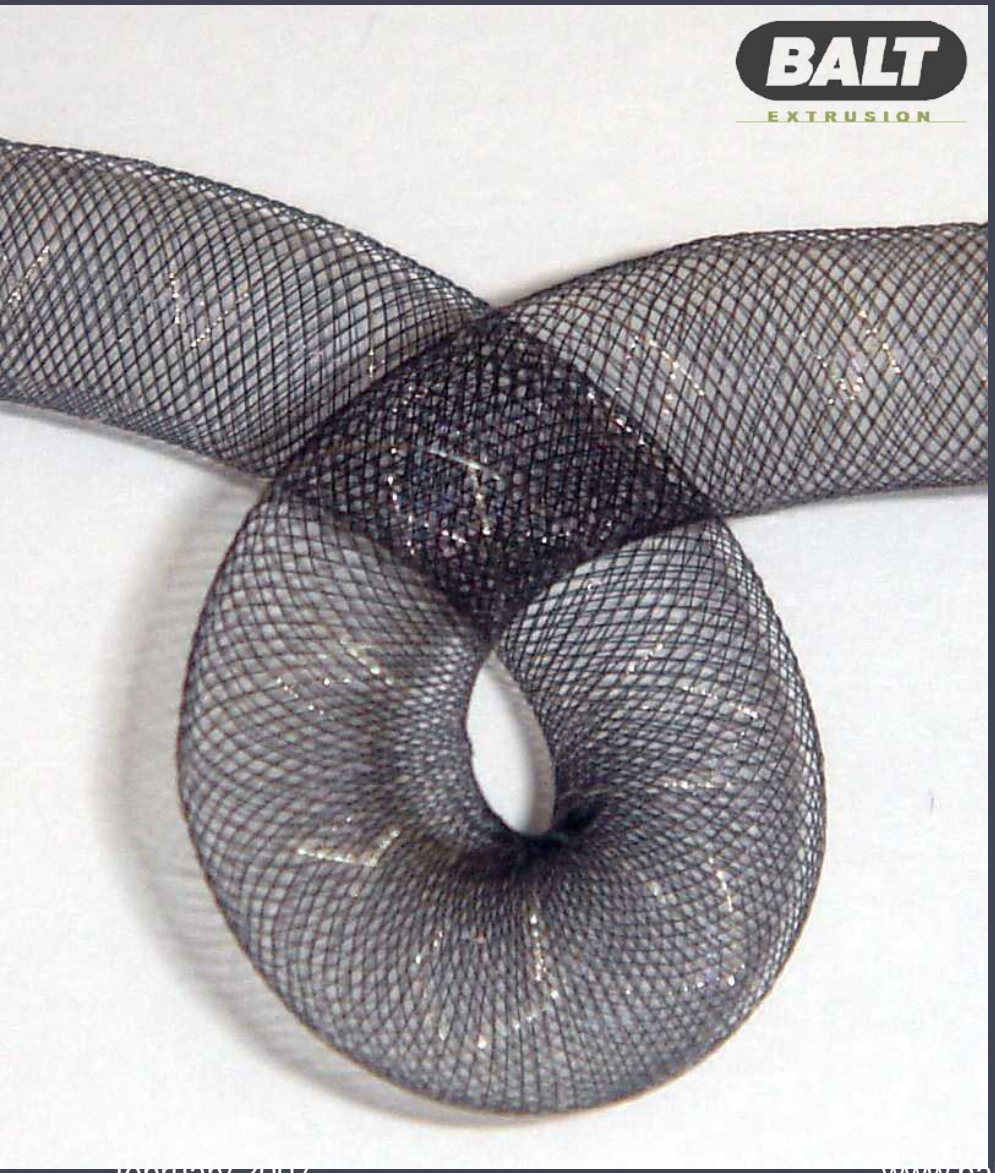


### Stent Silk

= stent particulier qui possède, grâce à son maillage plus dense, une meilleure flexibilité. Ne nécessite pas la pause de coils, car permet à lui seul de stopper les flux turbulents et donc de traiter l'anévrisme, tout en conservant les flux laminaires indispensables à la bonne circulation du sang dans les artères nourricières.

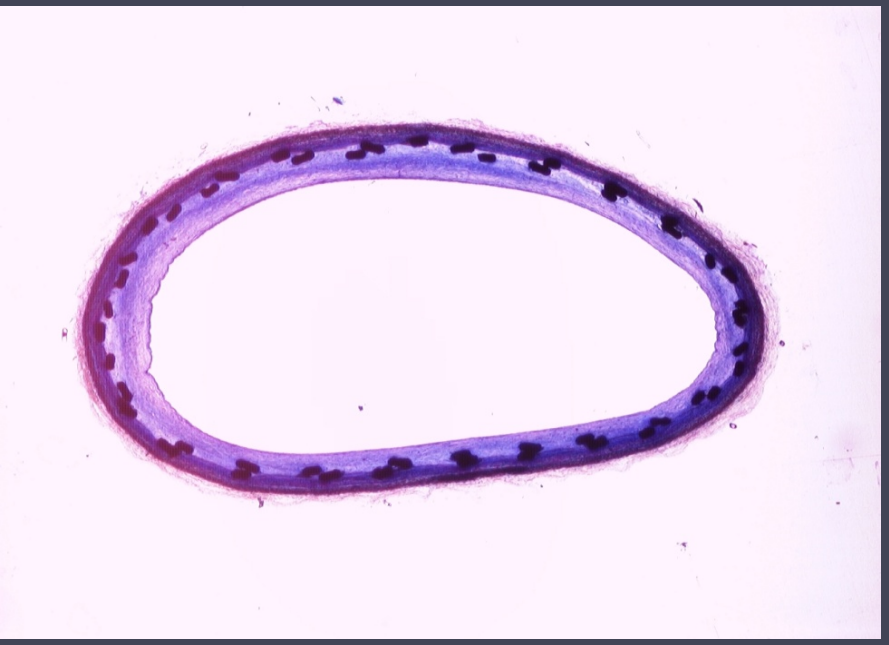

High density braiding : 48 wires (LEO+ : 16wires)
Conformability ,Trackability
Kinking resistance ,Full length radio-opacity
Flared ends ,internal guidewire
repositionable up to 90 % deployed ,Easy delivery system

# « Semi covered » stent

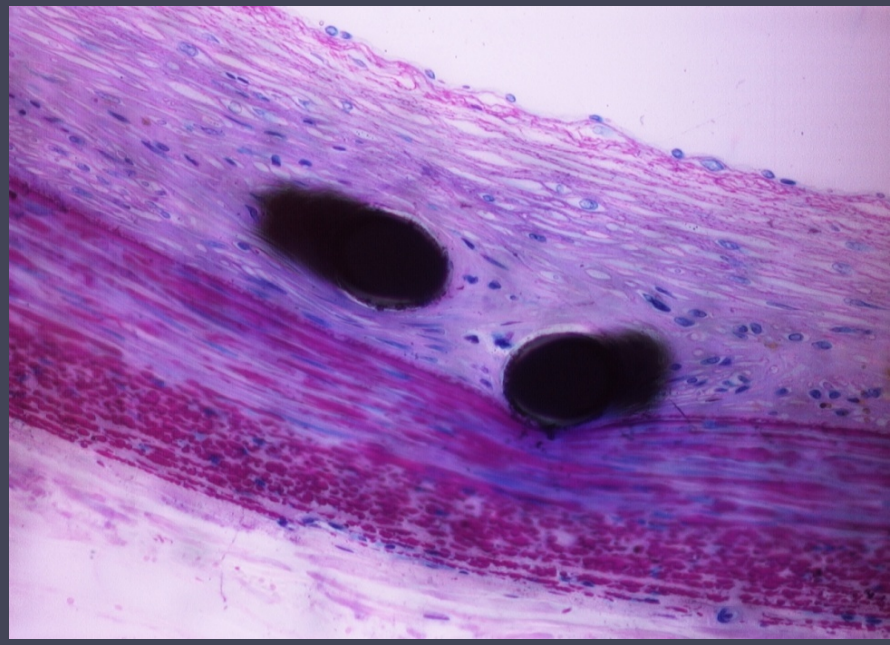



- High density braiding : 48 wires (LEO+ : 16wires)
- Conformability
- Trackability
- Kinking resistance
- Full length radio-opacity
- Flared ends
- internal guidewire
- repositionable up to 90 % deployed
- Easy delivery system

# Histological study

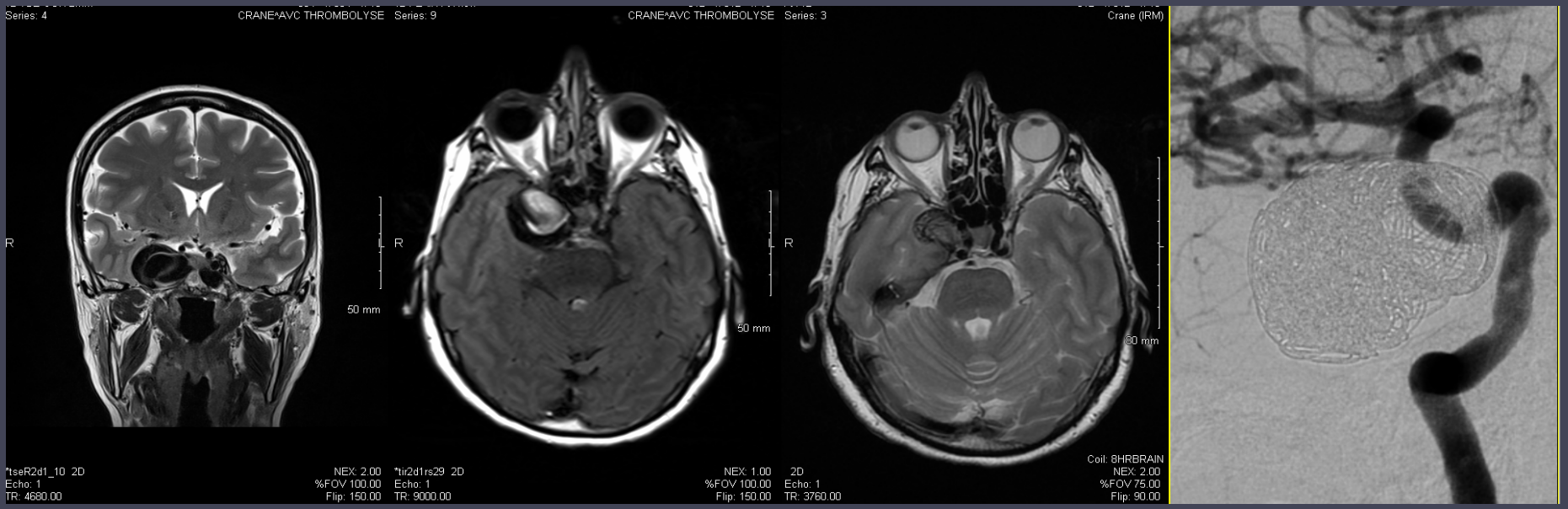


6 months endothelialisation



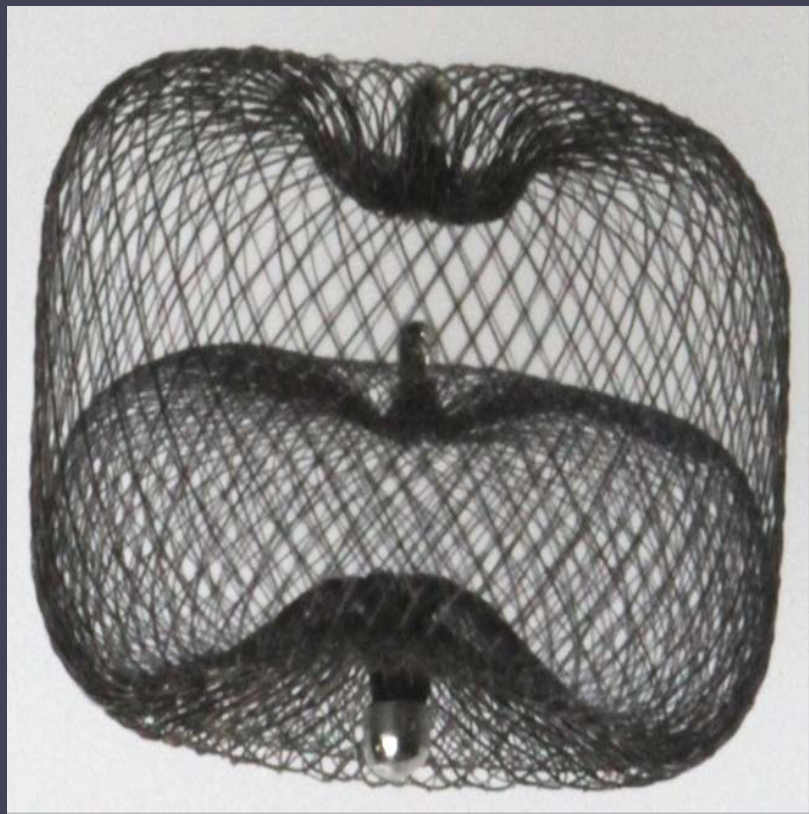
- No damage on the media layer of the artery
- No inflammatory reaction


3D
SAR
RABINEAU AGNES
No cut
Volume Rendering
Oct 30 2012
DFOV 6.5cm
5.5 mm (2D)
8.4 mm (2D)
Statif désactivé
20 mm
No VOI
6.9 mm (2D)
0.2mm /0.23sp
0 L 53 LAO 0 CAU
W = 1534 L = 256
IPL


Series: 4
CRANE^AVC THROMBOLYSE
Series: 9
CRANE^AVC THROMBOLYSE
Series: 3
Crane (IRM)
50 mm
50 mm
80 mm
*tseR2d1_10 2D
Echo: 1
TR: 4680.00
NEX: 2.00
%FOV 100.00
Flip: 150.00
*tir2d1rs29 2D
Echo: 1
TR: 9000.00
NEX: 1.00
%FOV 100.00
Flip: 150.00
2D
Echo: 1
TR: 3760.00
Coil: 8HRBRAIN
NEX: 2.00
%FOV 75.00
Flip: 90.00

# Sequent Medical:Technologie nouvelle Microbraid™ tresser un très grand nombre de brins de diamètres différents.

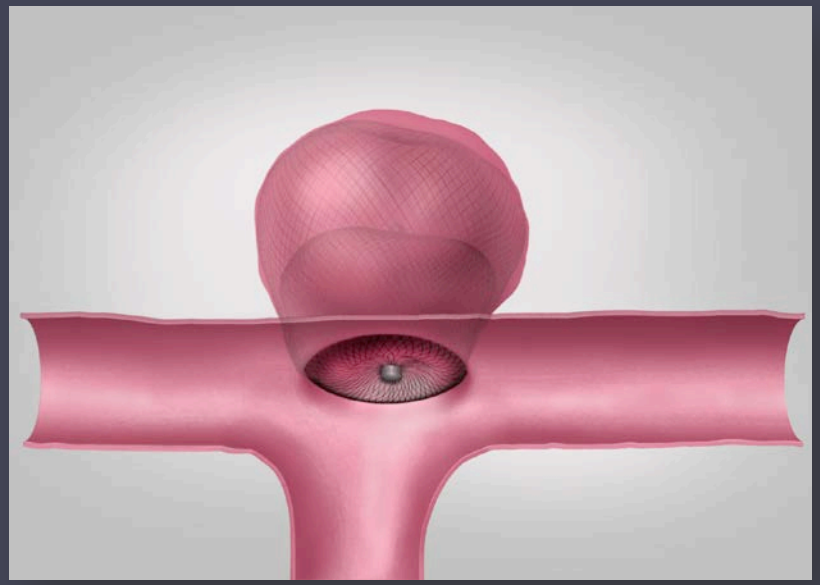
Pour exemple,
Pipeline 48 brins,
WEB actuel 144 brins,
Futur WEB single structure 288 brins



# Surface plus favorable à la cicatrisation

Le maillage dense du WEB tapisse le collet et fournit une surface plus  dense et régulière qu'un packing de coils et sera donc plus favorable à une éventuelle reconstruction de la paroi du vaisseau.

Coil-packed aneurysm



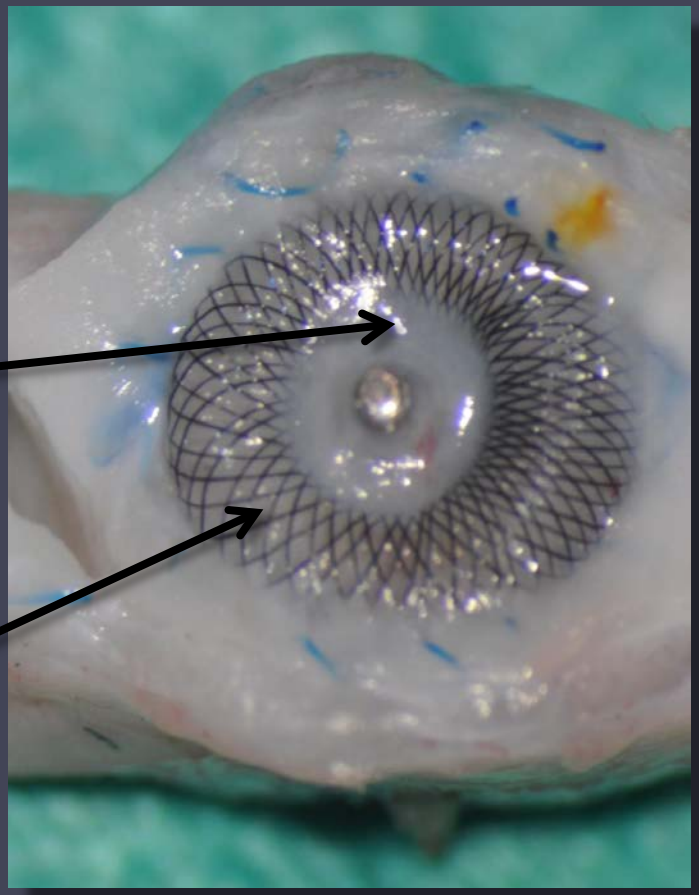
WEB

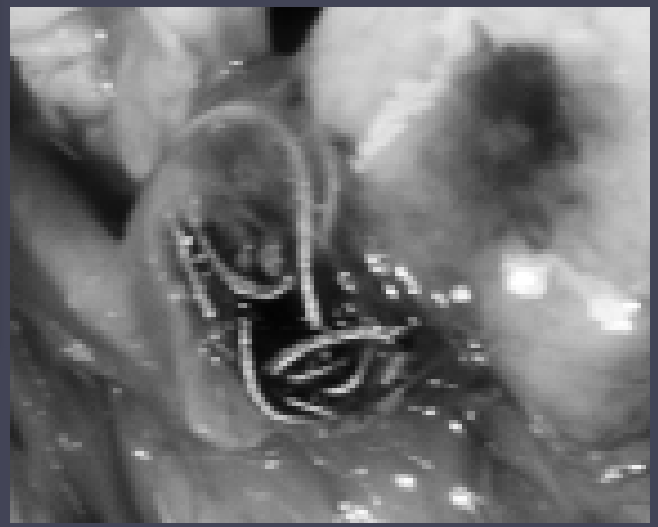
# Canine Data Shows Endothelial Growth on Microbraid™ Surface

- **2 month**

*Dense "Collagenous" Connective Tissue*

*Clear "Ground Substance" Connective Tissue*

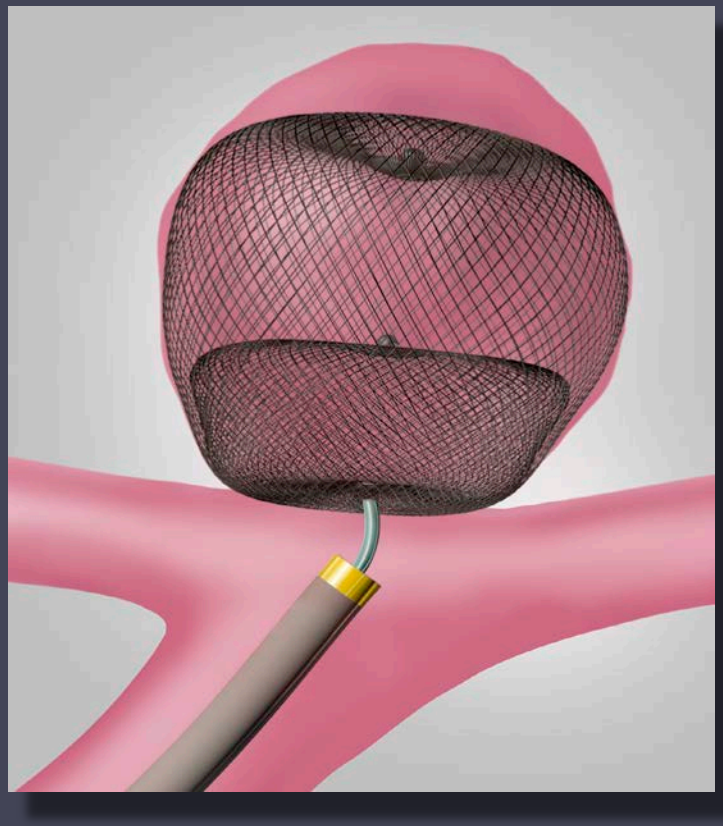


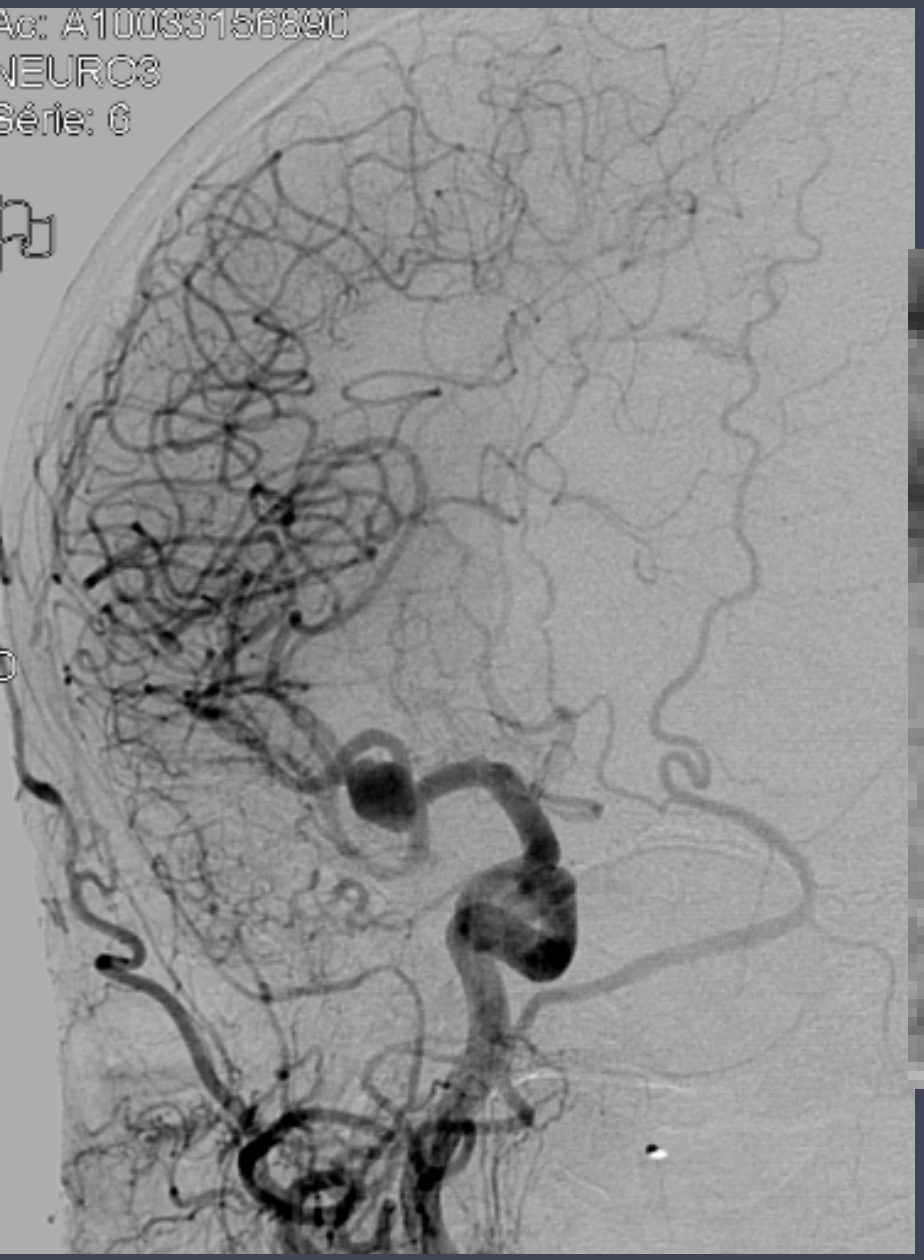


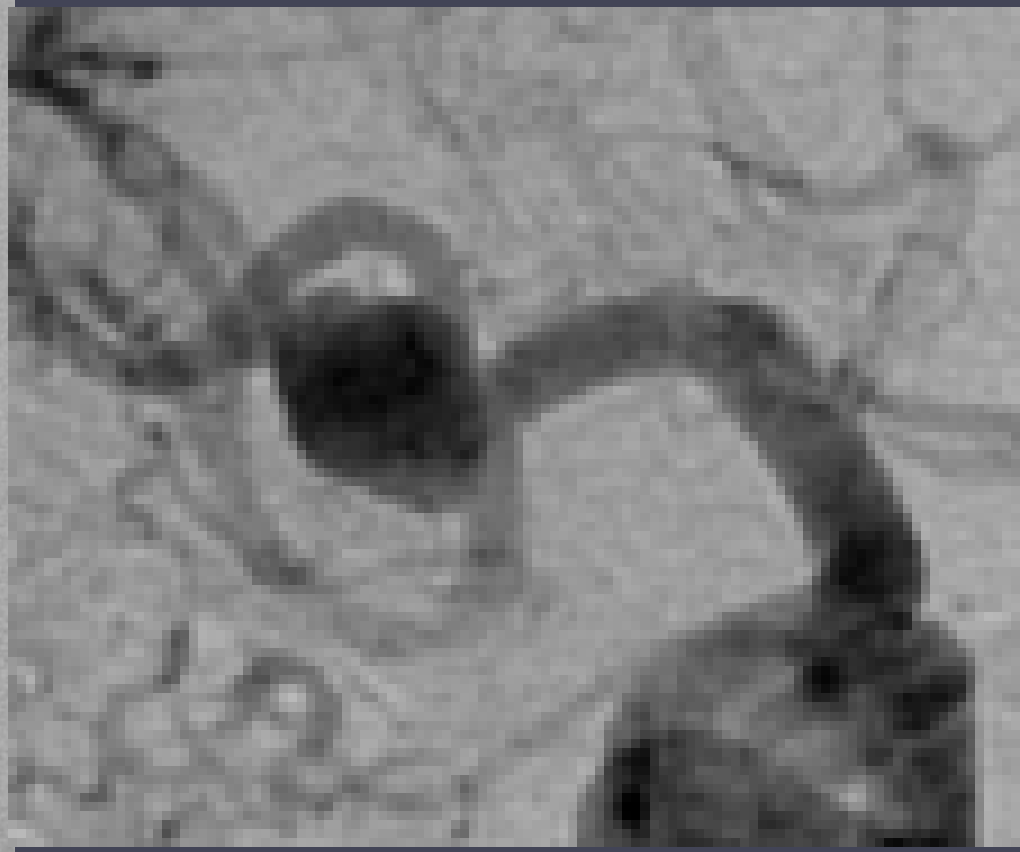
Traitement intrasacculaire, sans matériel dans l'artère

Anévrismes rompus ou non
COLLET LARGE

« diversion de flux intrasac »
Clip endovasculaire



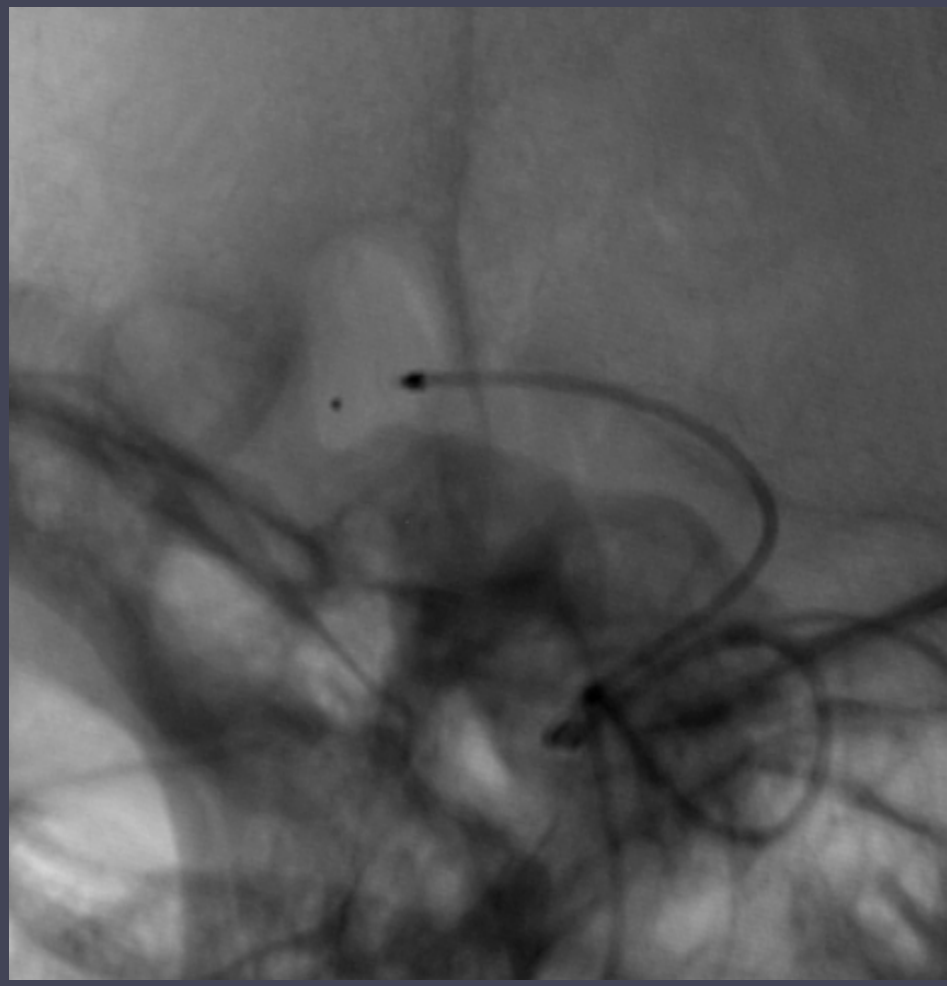


***Incidence de travail***

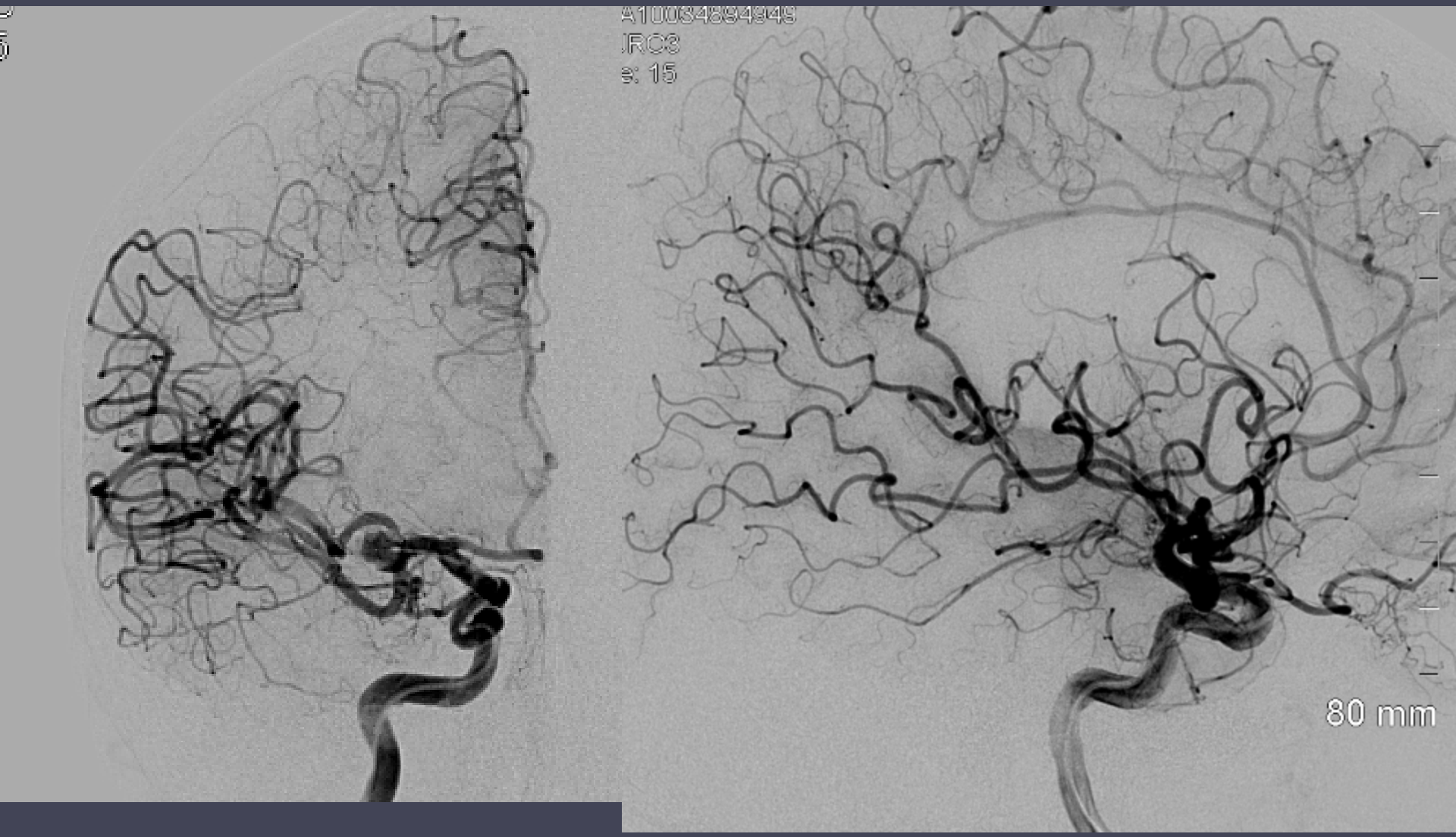
***Bilan***


*Incidence de travail*

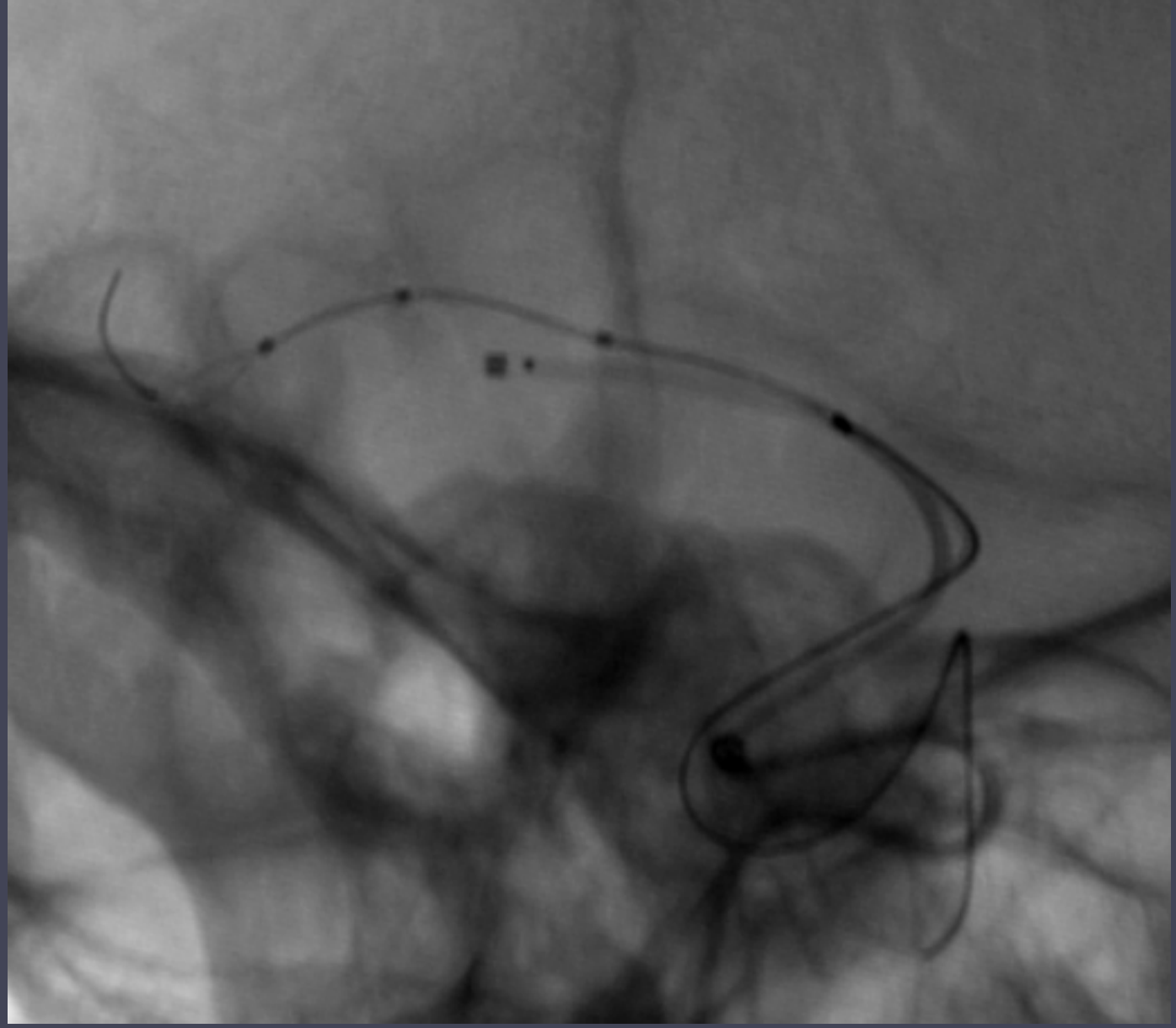


*1er déploiement du web Single layer 4mm/8mm (Dac 44 et Via 27)*

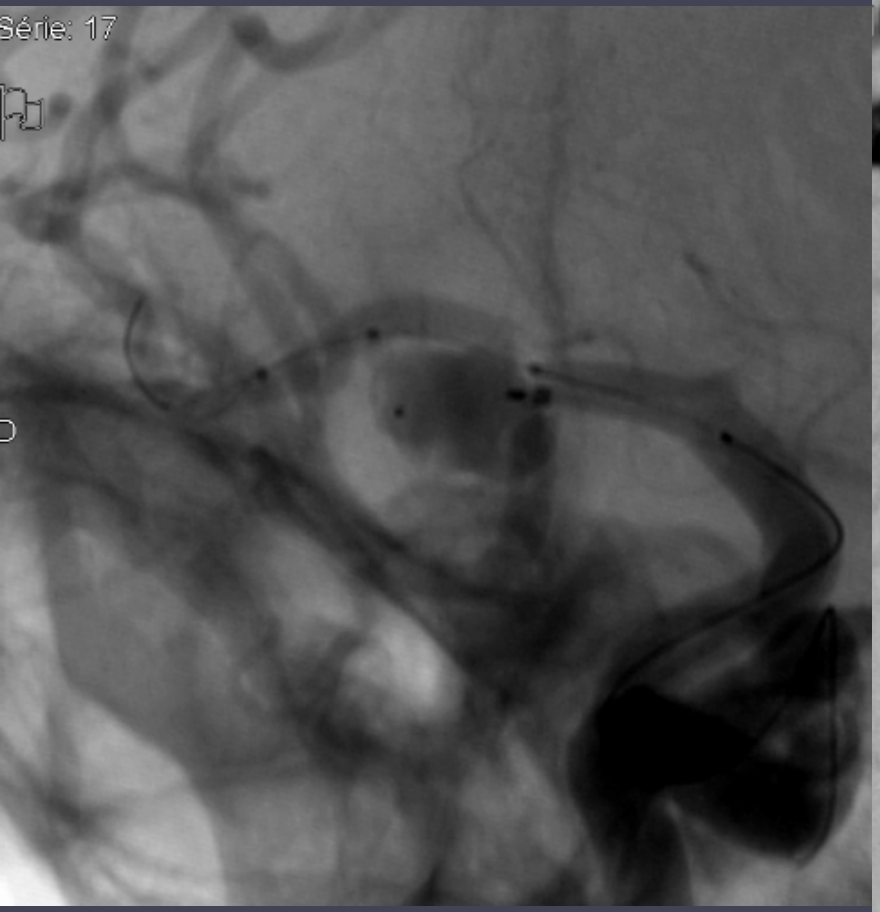

***10 minutes après la pose du web, sténose de la branche de division supérieure sylvienne droite et ….***

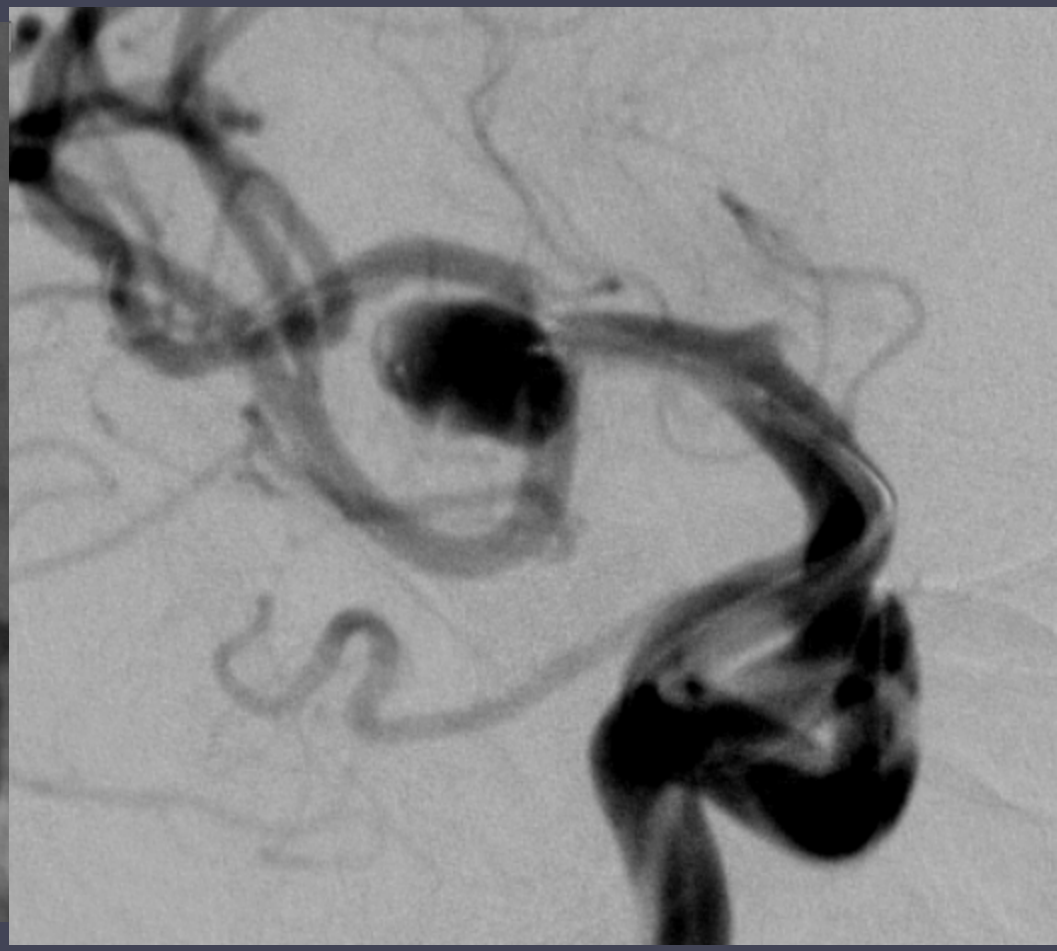



***Ralentissement circulatoire***

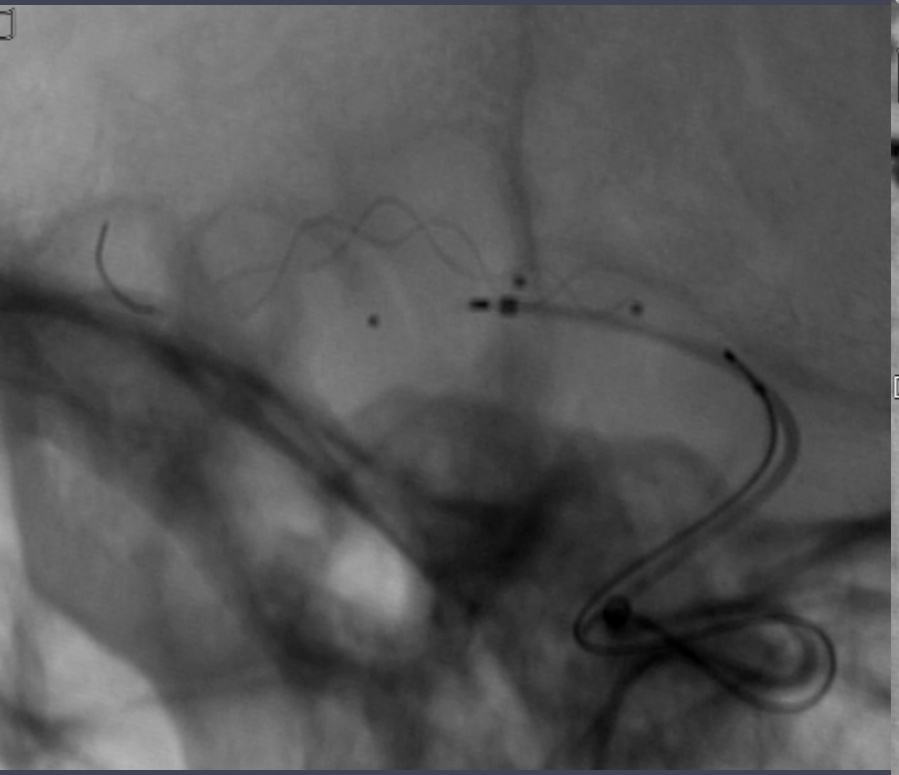


***Retrait du web***
***Cathétérisme de branche de division supérieure (scepter XC 4mmX11mm et terumo 16 double courbure)***

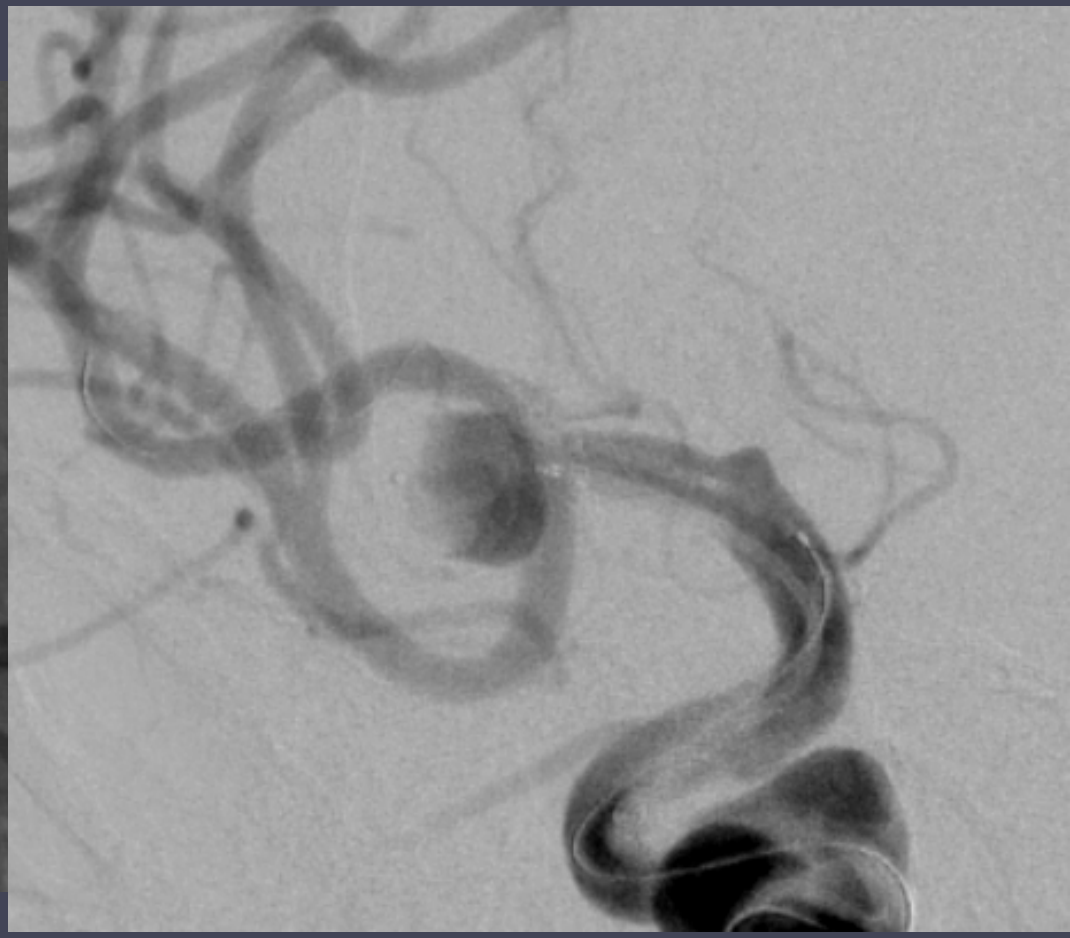


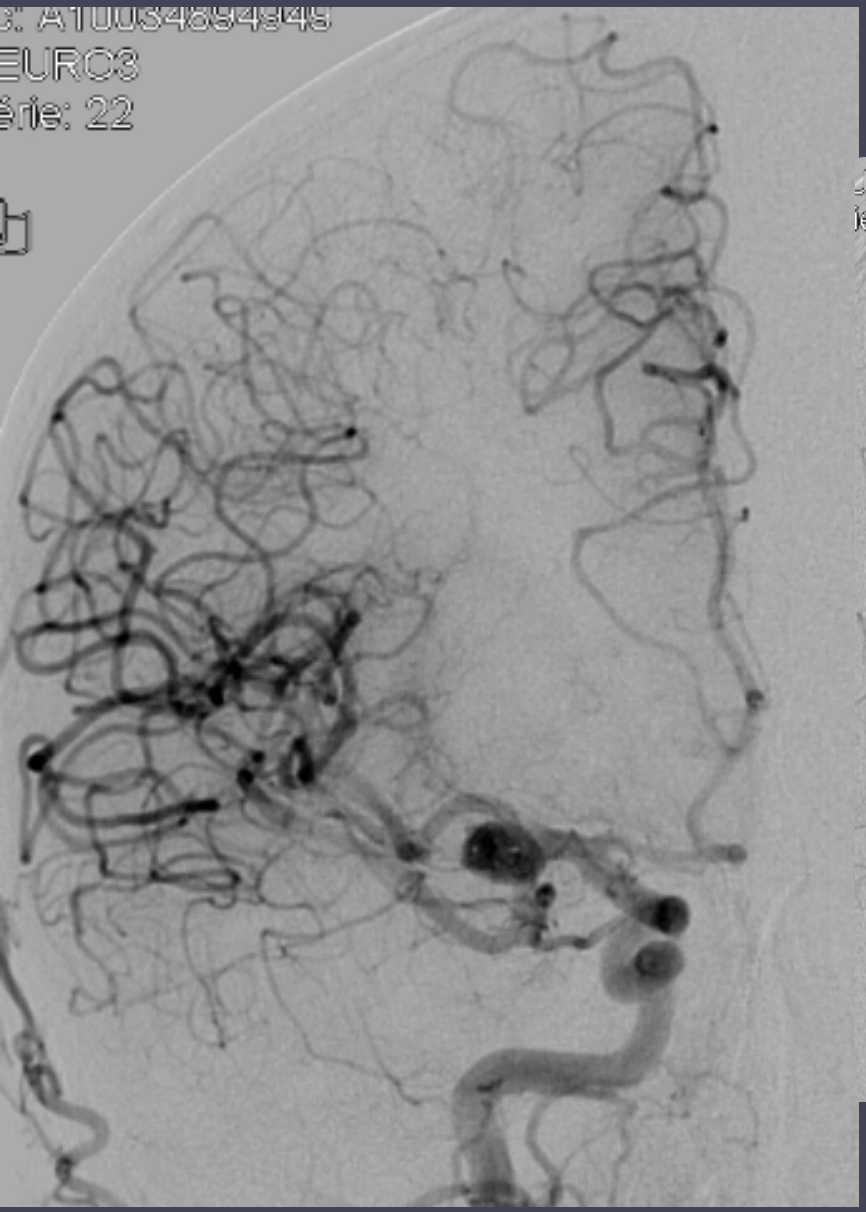
***Second déploiement du web***

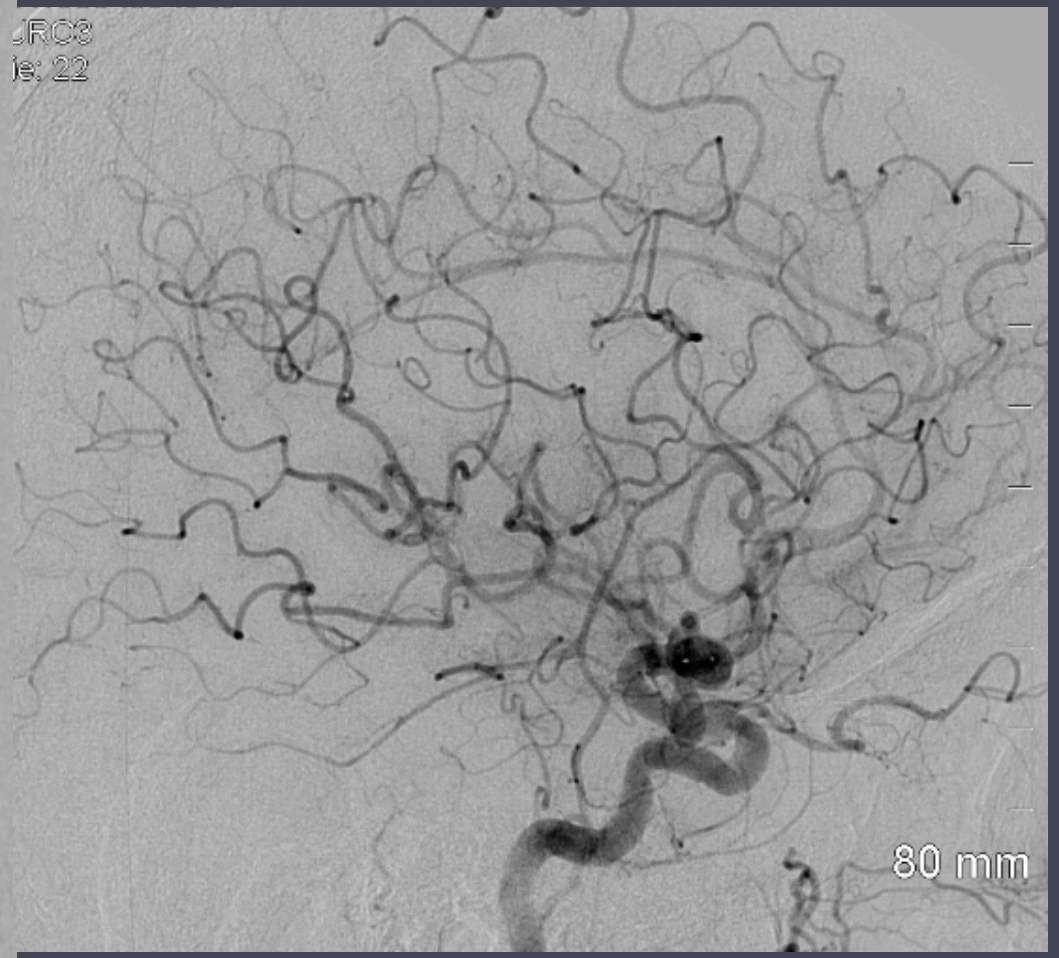



***Mise en place du stent Leo baby 2,5mmX 25 mm***



***Mise en place du stent Leo baby 2,5mmX 25 mm (seconde incidence)***






***Contrôle final***

# COMPLICATIONS Embo

- 20% d'imprévu
- 6% de complications

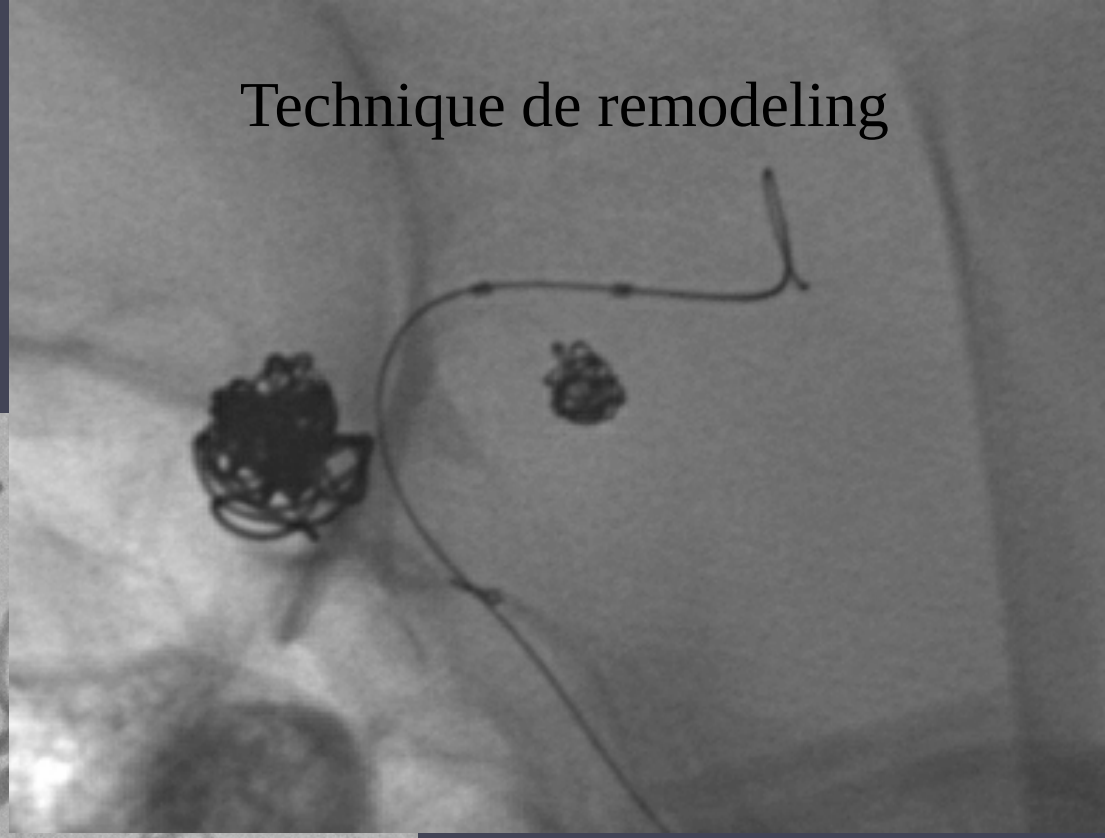
4% AVC ischémique

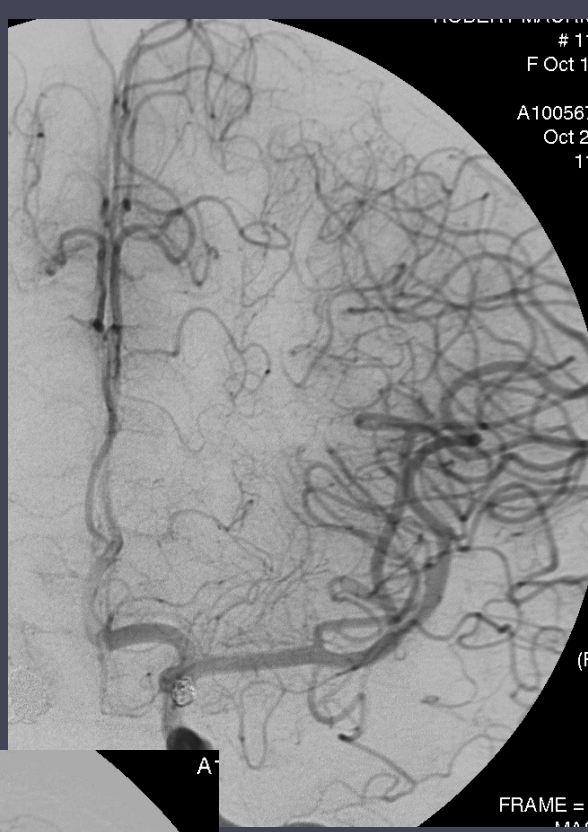
2% Décès (rupture++)

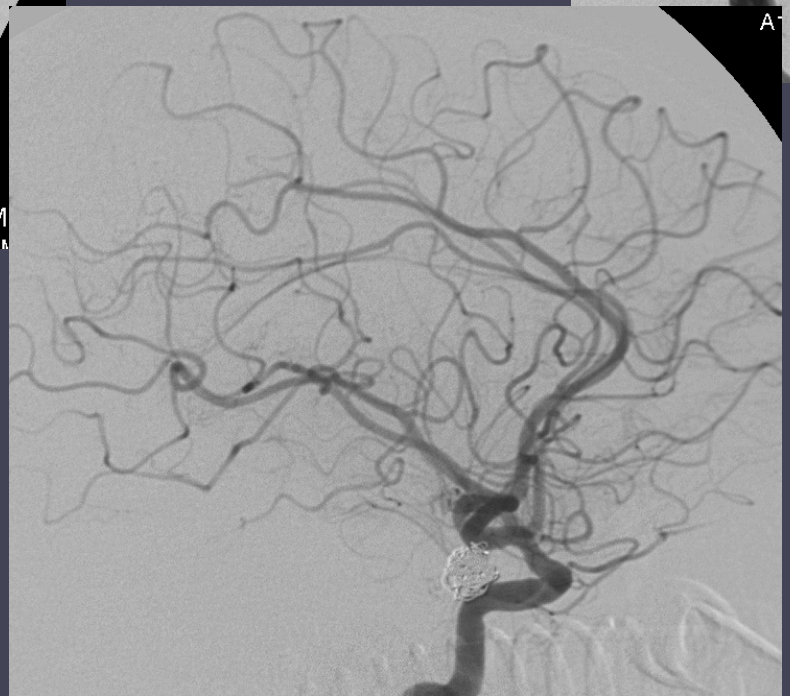
# TRAITEMENT D UN ANEVRISME RETROCAROTIDIEN GAUCHE ASYMPTOMATIQUE

Femme de 62 ans
ATCD d’ HSA 6 mois auparavant : bonne récupération
A été embolisée d ‘un anévrysme retro-carotidien droit

# Technique de remodeling



Axium : echec du 4:8 helix

3-6 3D

2-2 helix

2-1 helix

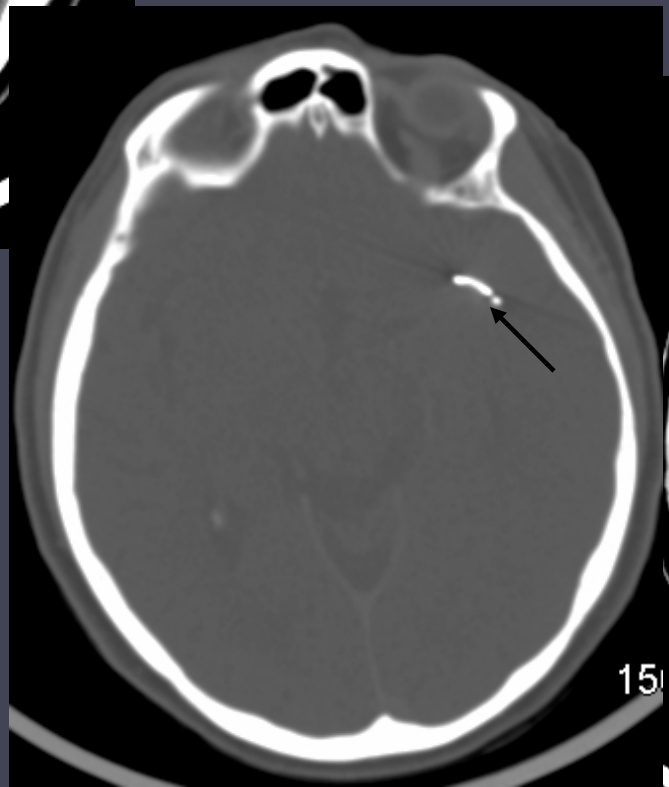
Contrôle final

1 heure plus tard
Après le réveil,
hémiparésie droite  brutale et confusion

scanner

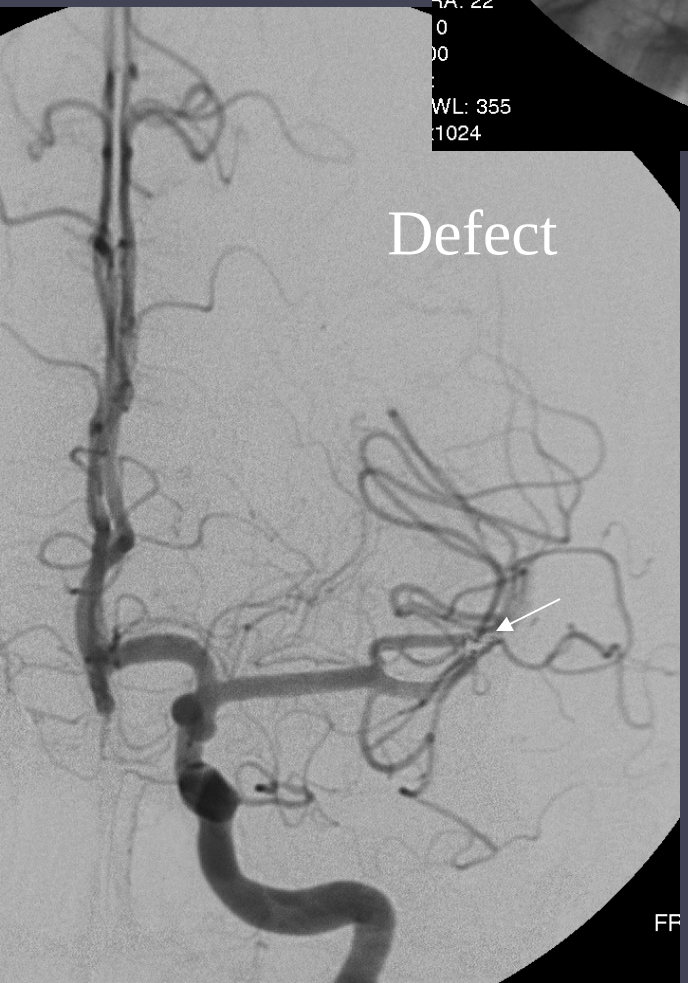

Migration coils

Pas de retentissement parenchymateux



# Nouvelle artériographie


Defect



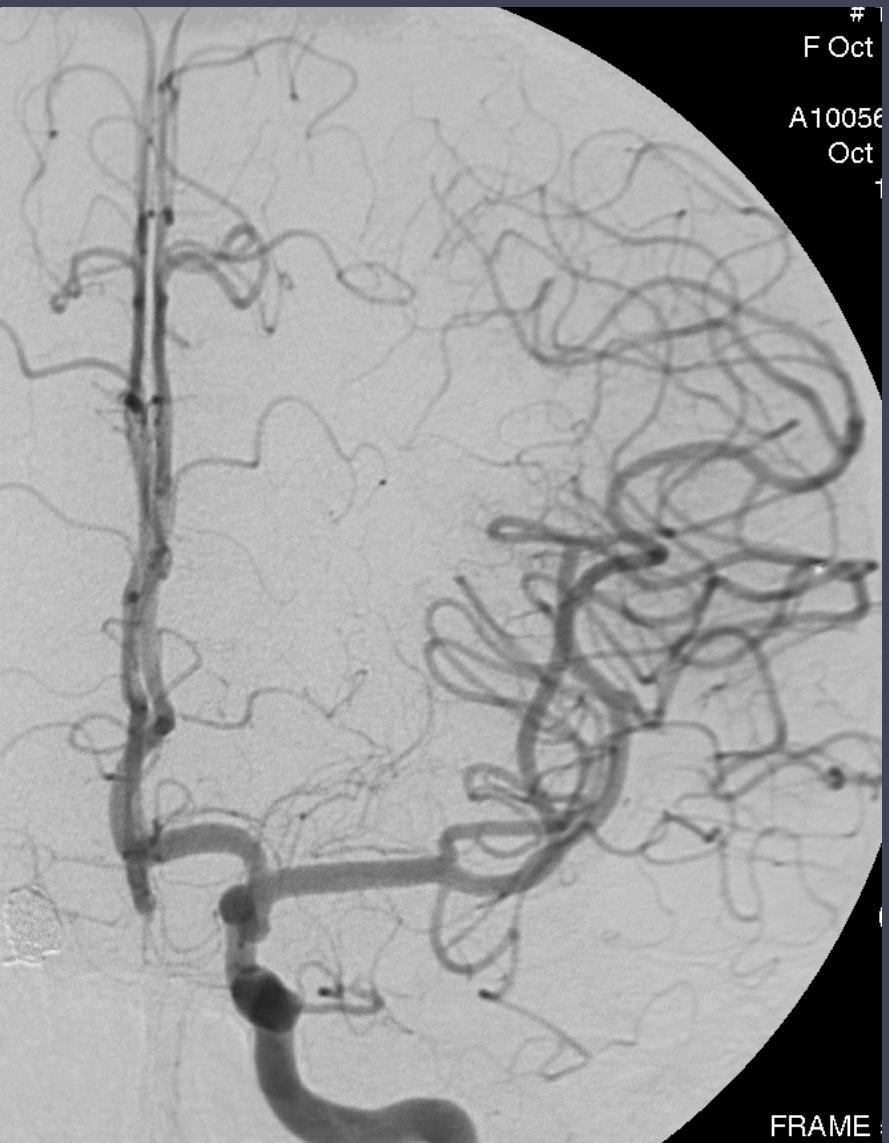
# Extraction du matériel en 1 heure

# Que faire?

Il reste un coil de 2-1 distalement

1 ou 2 AAG pendant 3 à 6 mois ?

Anévrysme fragilisé par le TTT?
Nouvelle embolisation?



Recupération de la vascularisation distale sylvienne

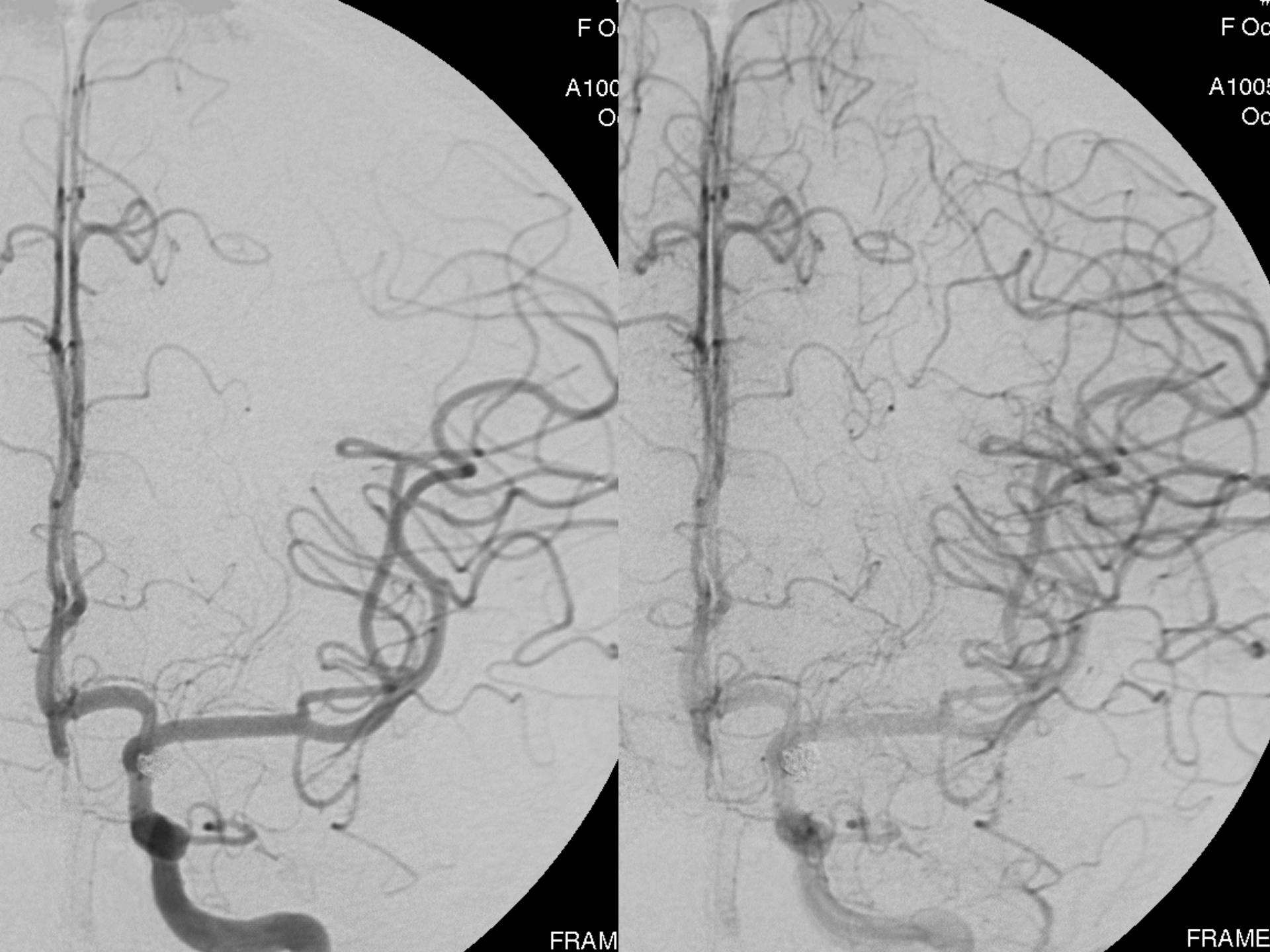
saignementt

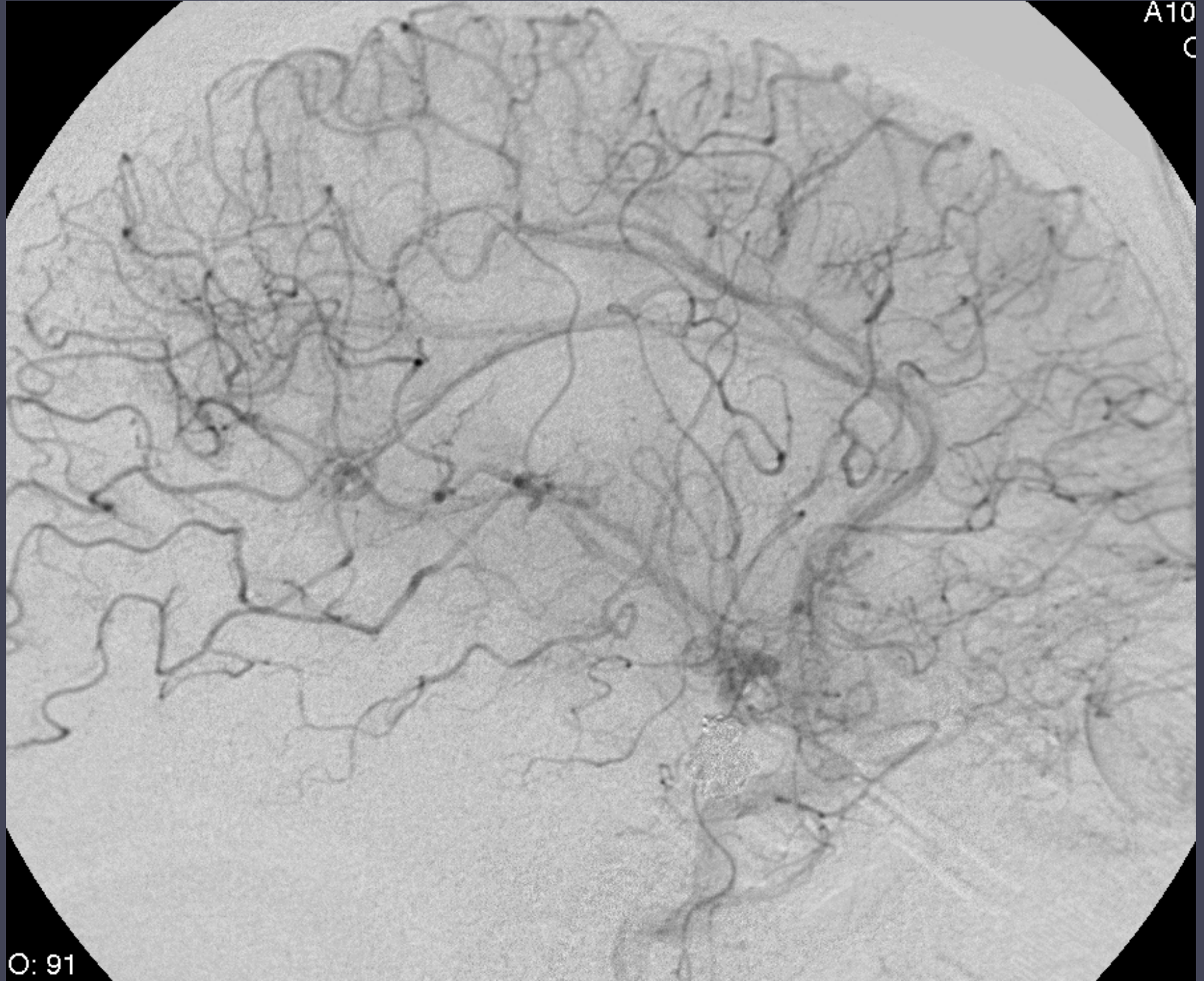
Après « compression » par le ballon

1er contrôle

2ème contrôle

Contrôle final




A10
C
O: 91

# AVC Ischémique

# Conclusion: L’AVENIR 1992 Embolisation…Revascularisation

- Hémostase
- Tumeur
- Angiome profond superficiel
- Temporaire
- Définitif
- Particule
- Liquide
- Implant

# Occlusion Artérielle Aigue
# Recanalisation endovasculaire

## “STROKE”

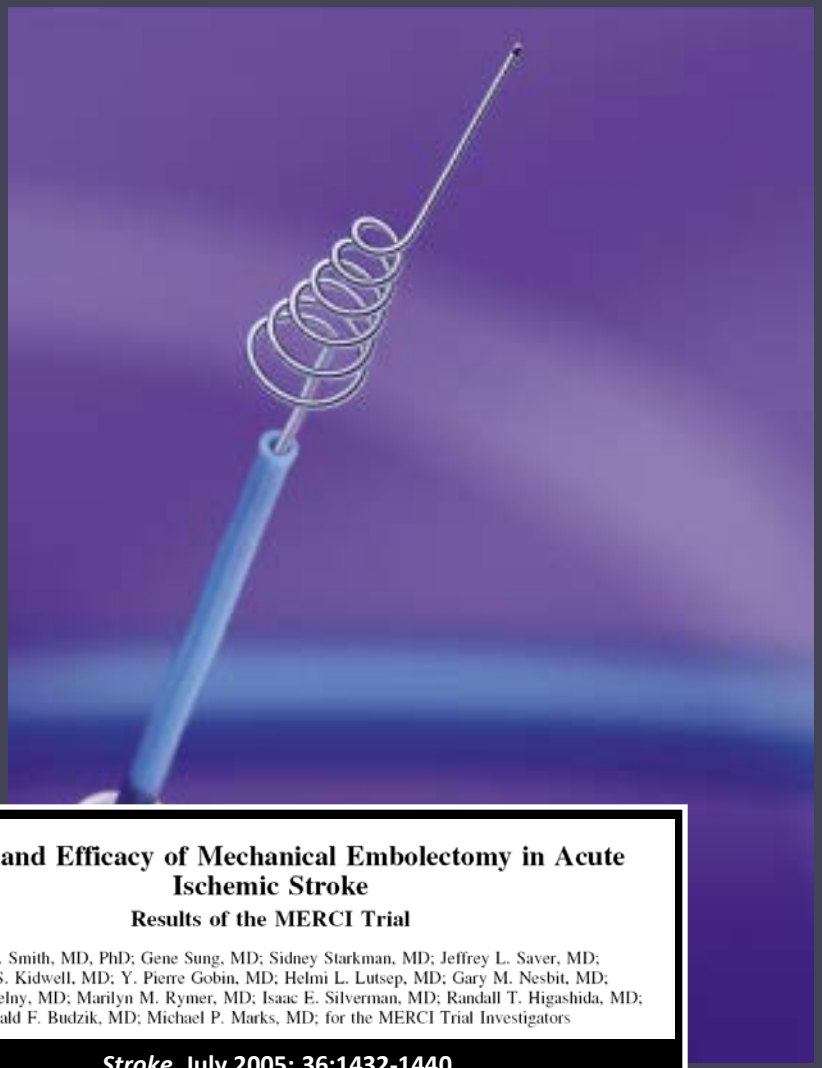
- la troisième cause de décès

- la première cause de morbidité et de handicap

- 100 -200 nouveaux AVC / 100.000 hab/an

- 150 000/an …

# endovascular treatment

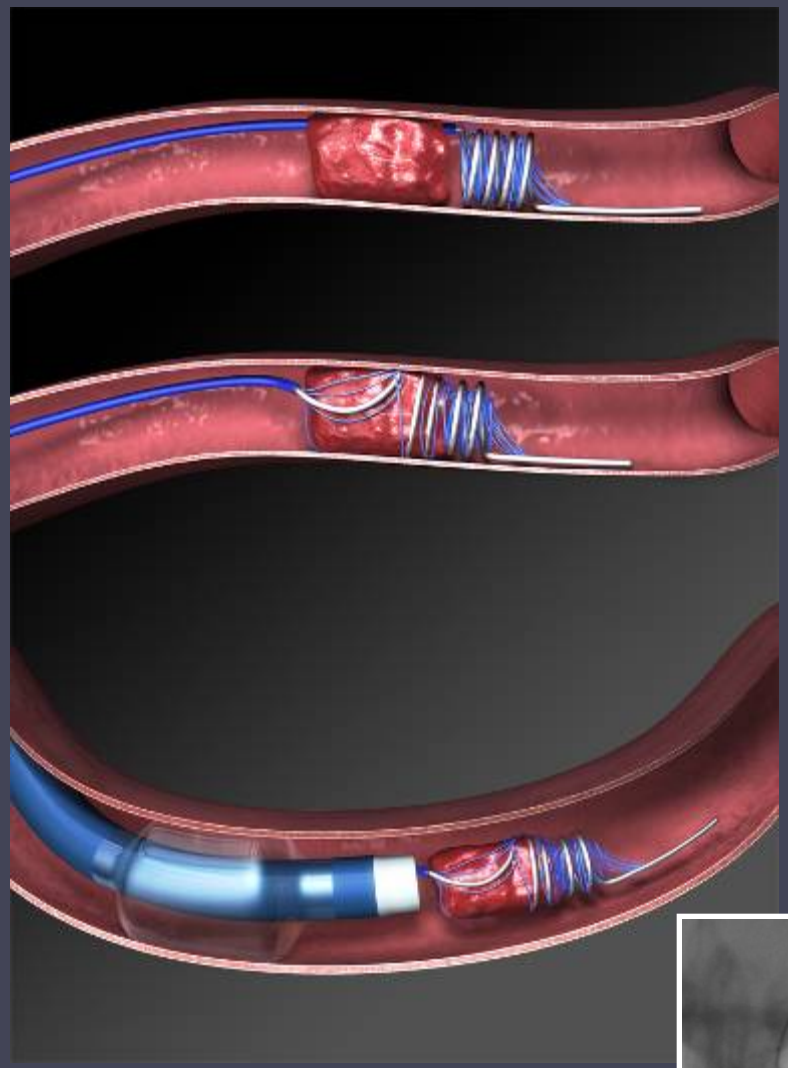


**Safety and Efficacy of Mechanical Embolectomy in Acute Ischemic Stroke**

**Results of the MERCI Trial**

Wade S. Smith, MD, PhD; Gene Sung, MD; Sidney Starkman, MD; Jeffrey L. Saver, MD; Chelsea S. Kidwell, MD; Y. Pierre Gobin, MD; Helmi L. Lutsep, MD; Gary M. Nesbit, MD; Thomas Grobelny, MD; Marilyn M. Rymer, MD; Isaac E. Silverman, MD; Randall T. Higashida, MD; Ronald F. Budzik, MD; Michael P. Marks, MD; for the MERCI Trial Investigators

***Stroke*, July 2005; 36:1432-1440**



# X6/X5

**FDA Cleared for Thrombus Removal in Stroke in August 2004**
**Based on MERCI trial**

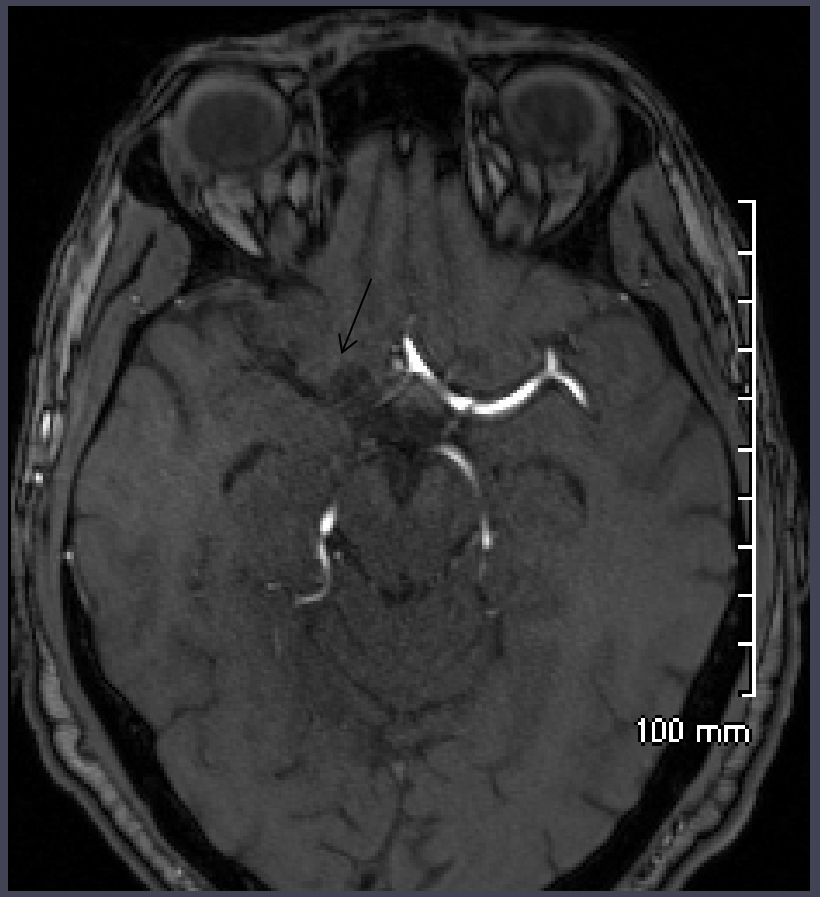
# L5*

**Being Investigated for Thrombus Removal in Multi MERCI trial**

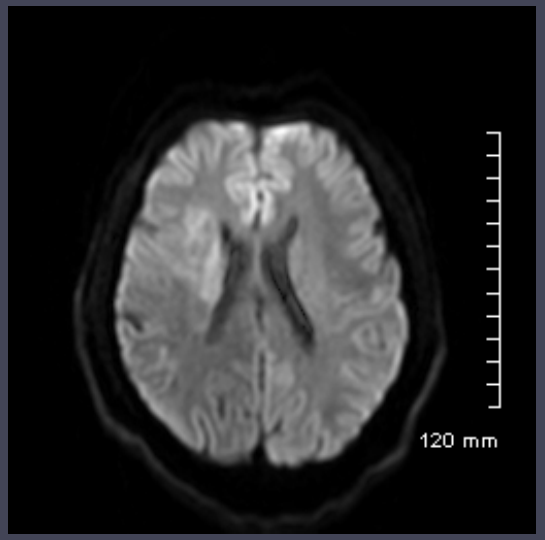
***CAUTION: Investigational device. Limited by federal (U.S.) law to investigational use only.**

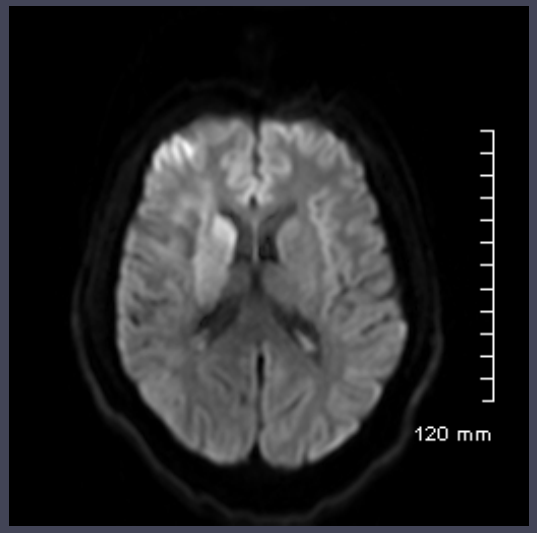
# Multi pass with the system « Reloading »

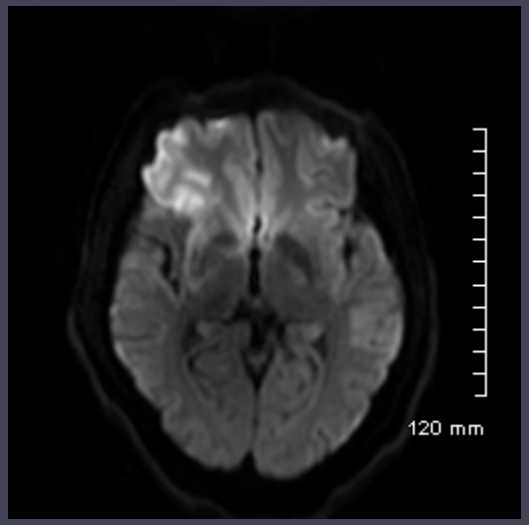
# H, 33ans,hémiplégie, h3, 2° AVC

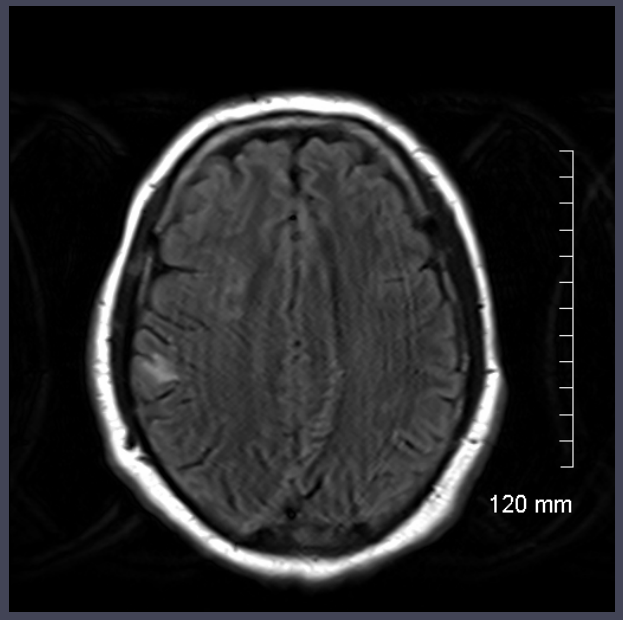



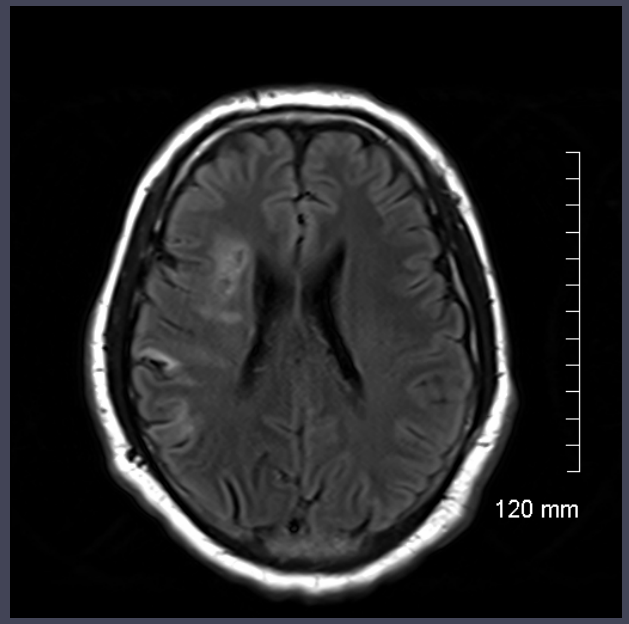
# hémiplégie gauche

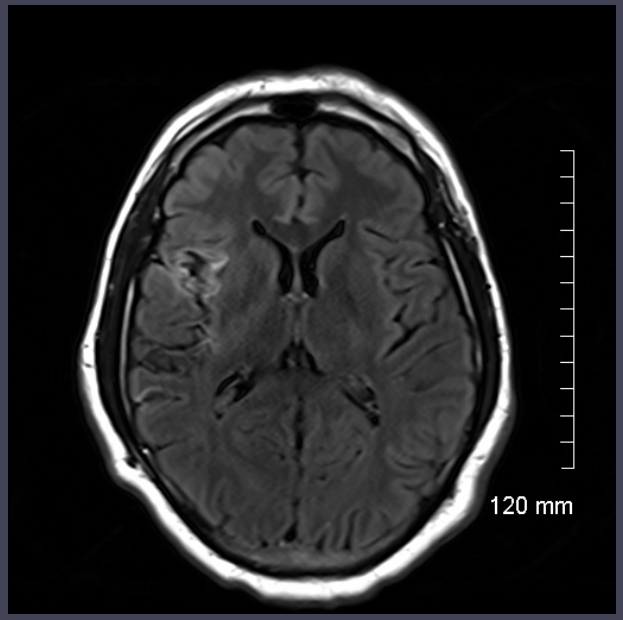


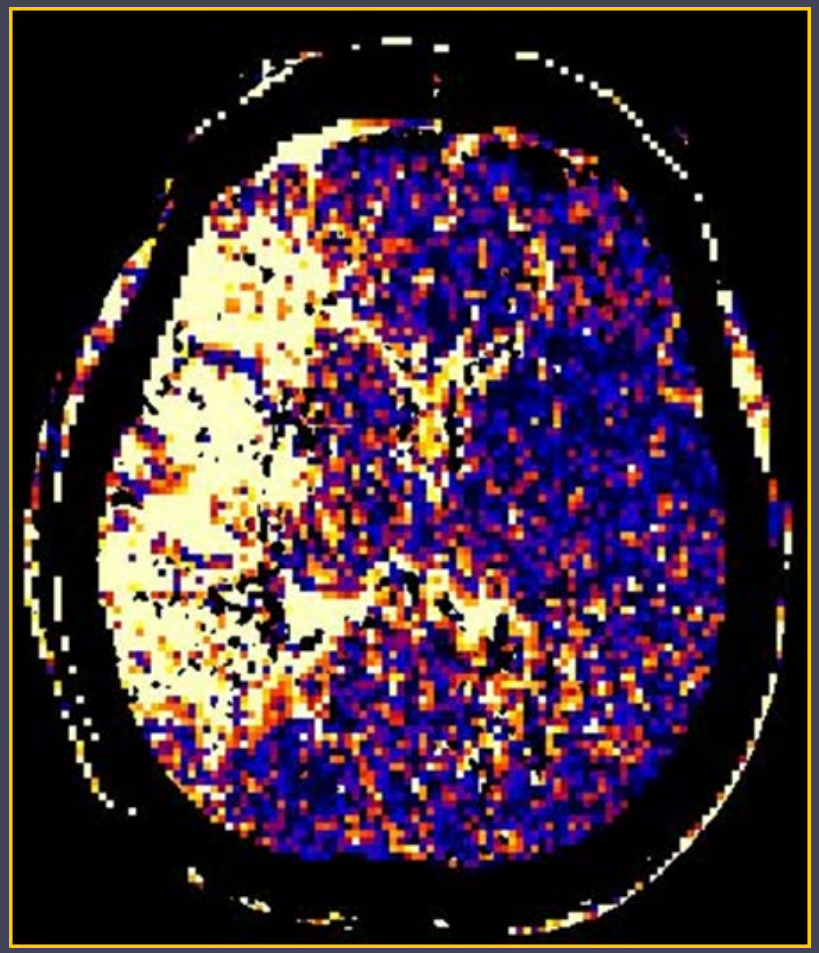



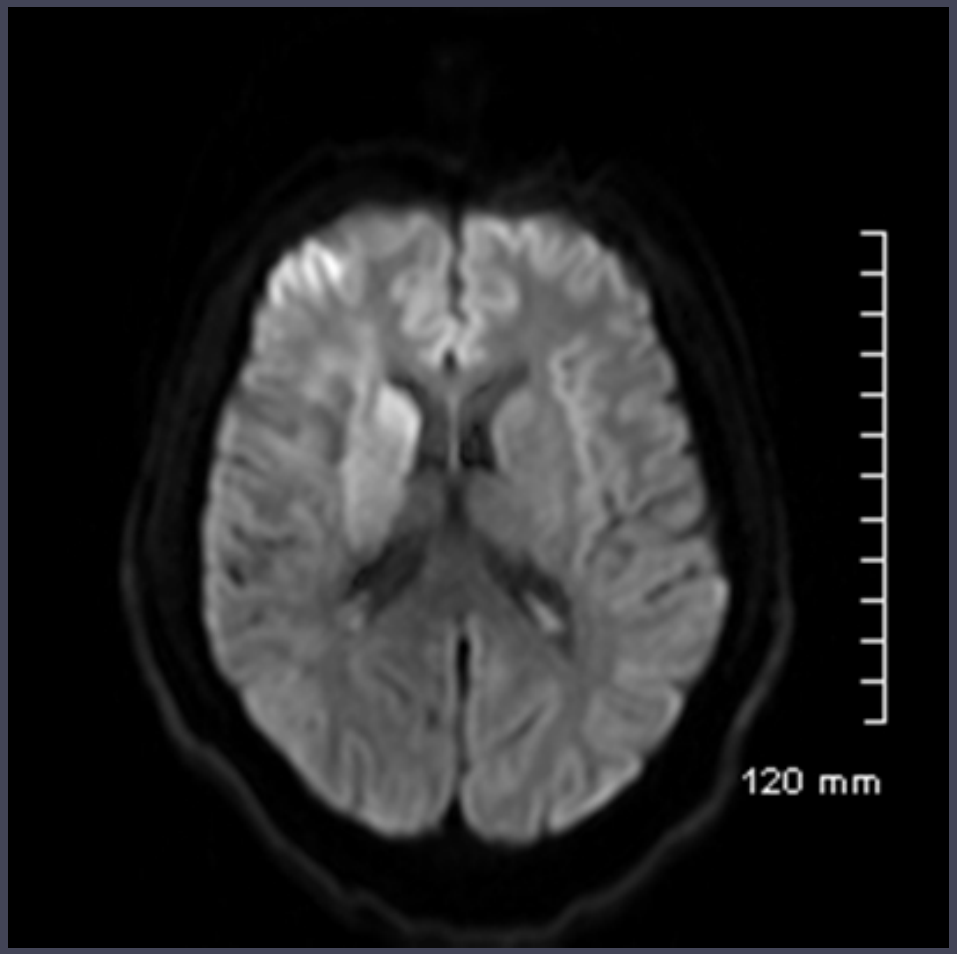



# Miss Match

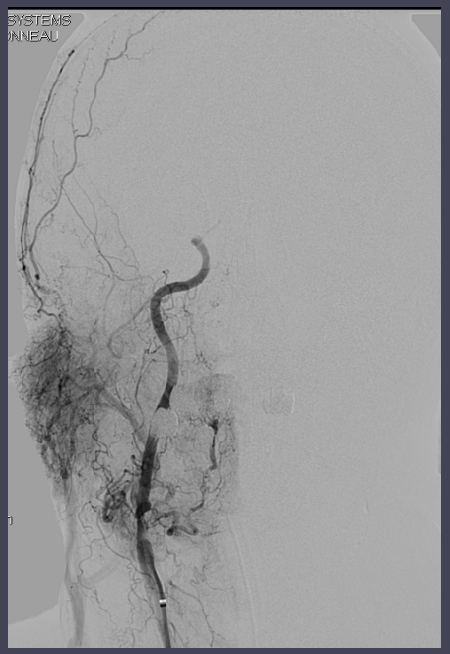
Perfusion

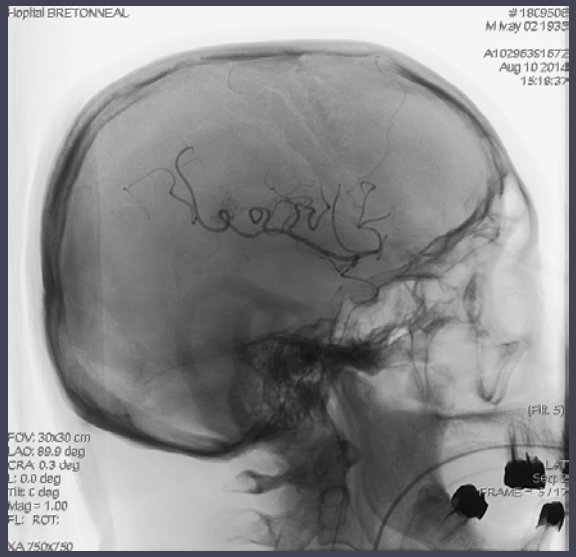


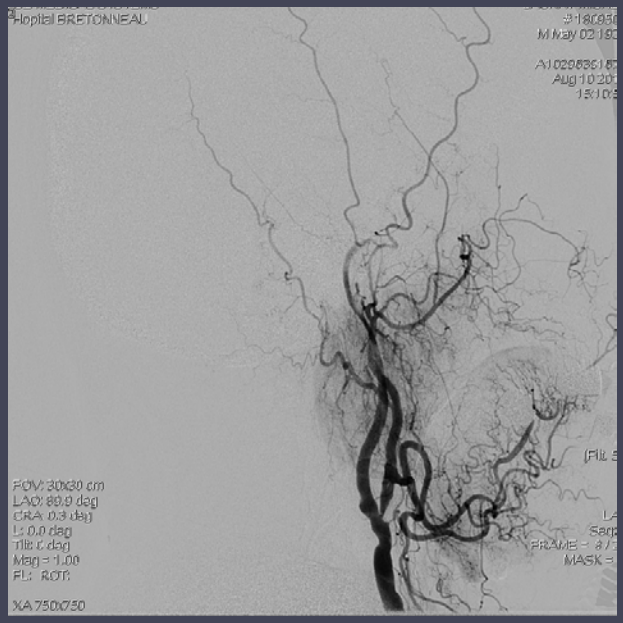
diffusion



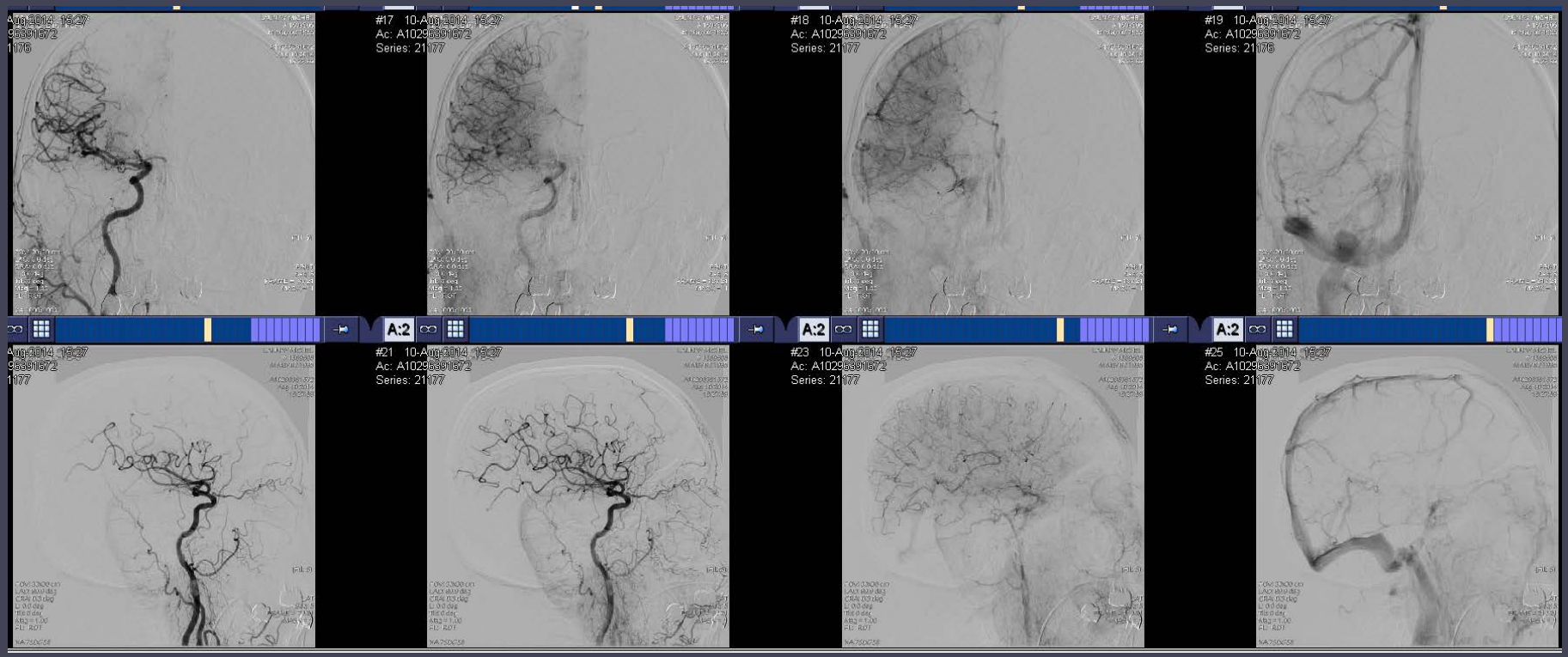
# thrombectomie

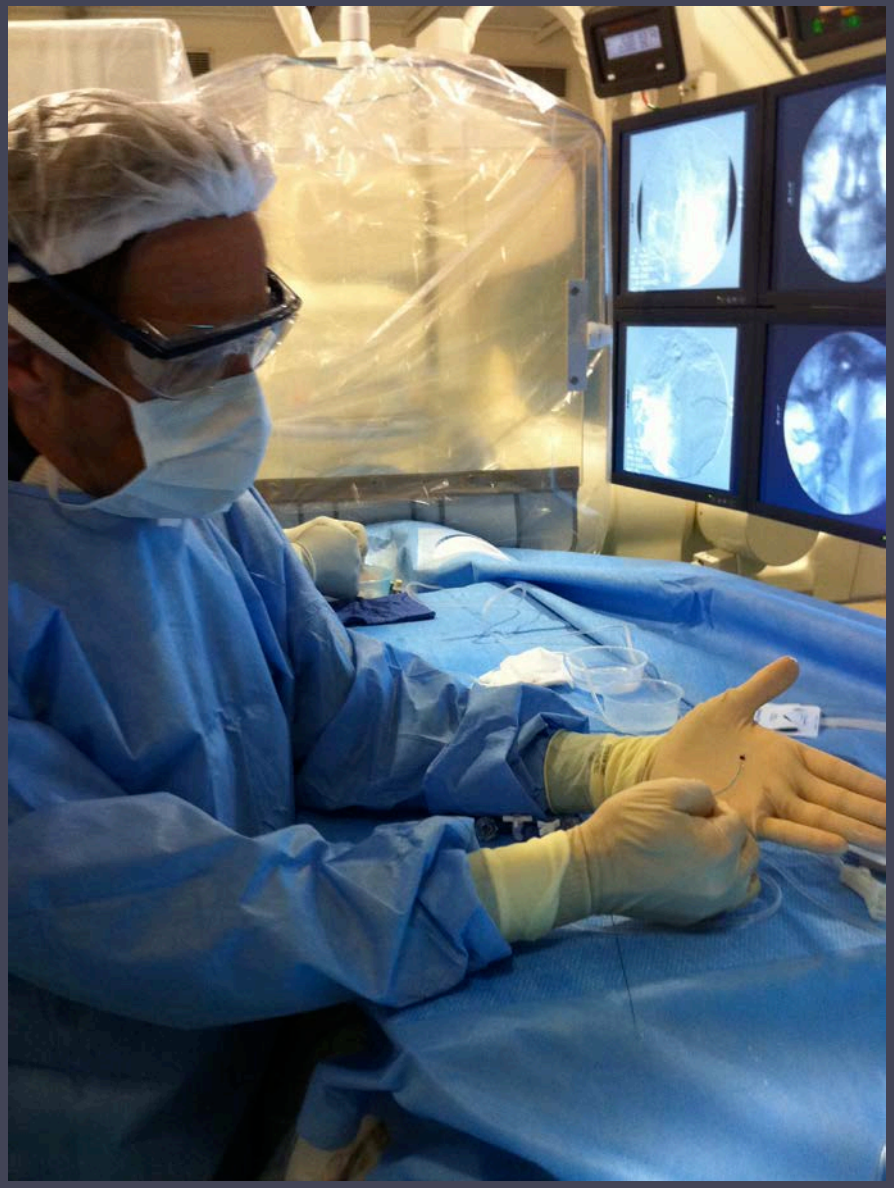


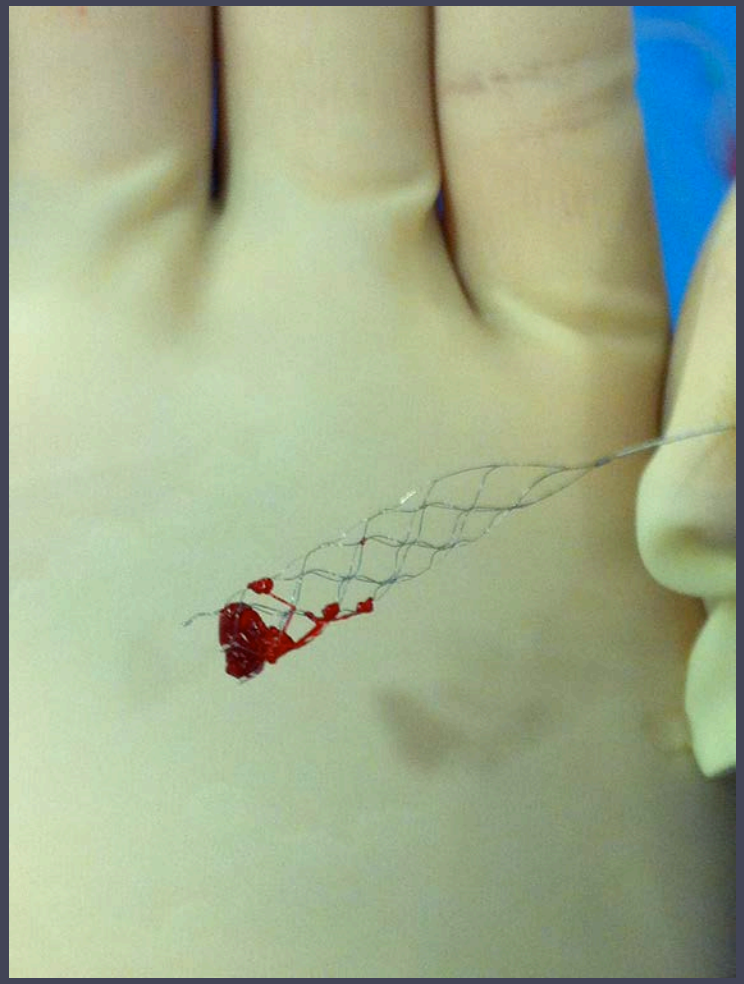



# Récupération parenchymographie

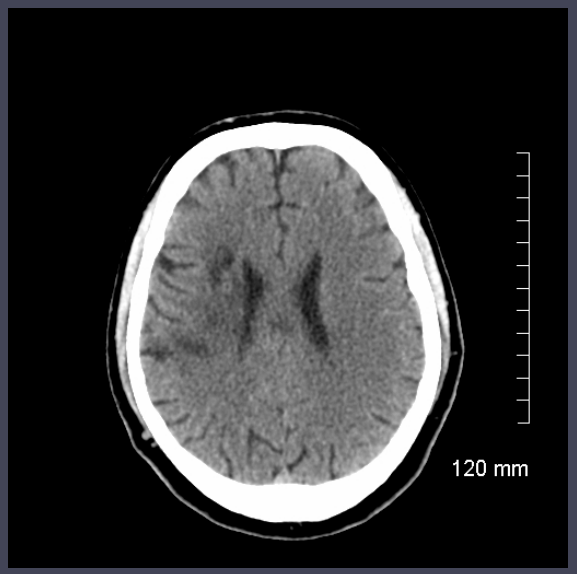




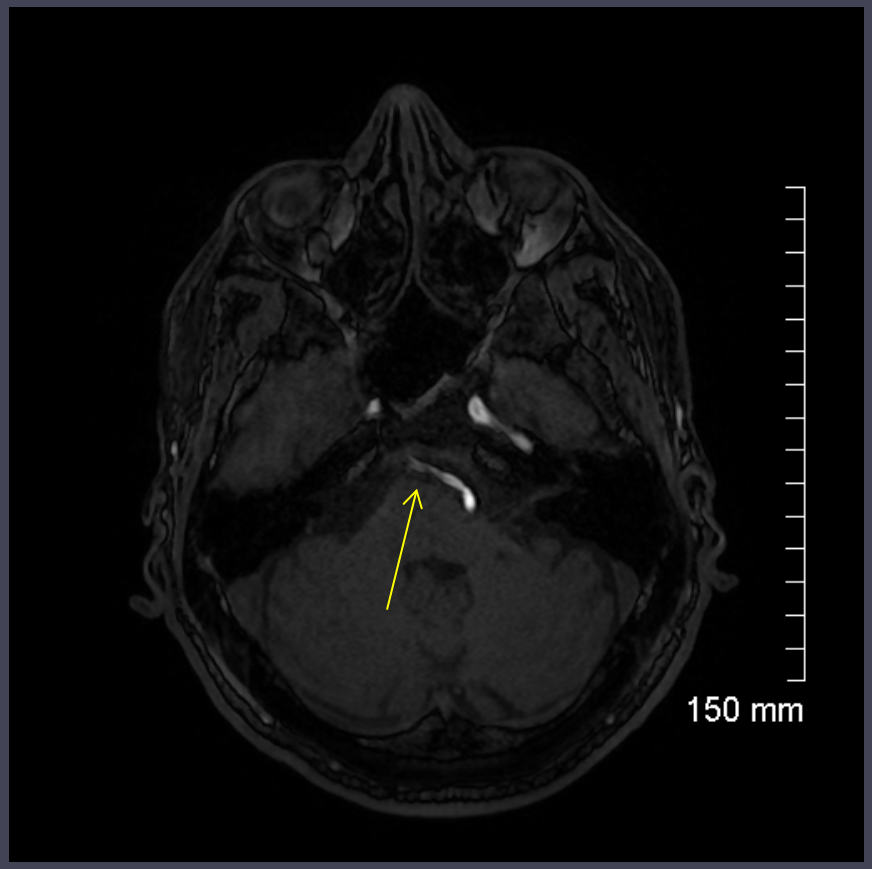


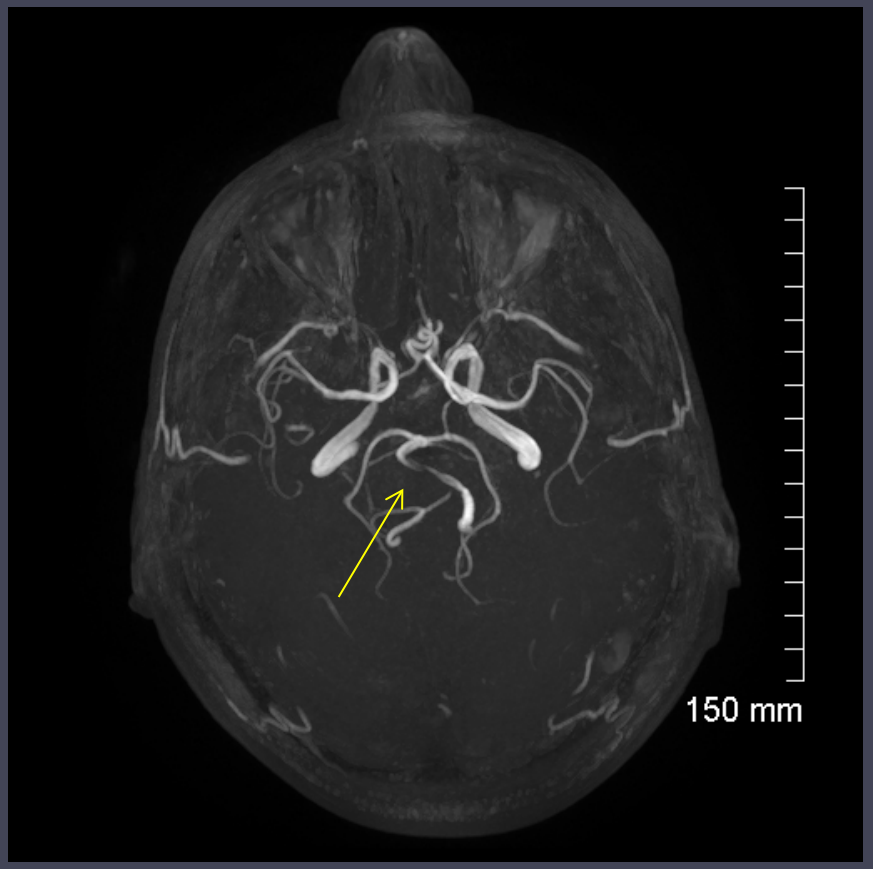
# TDM à distance



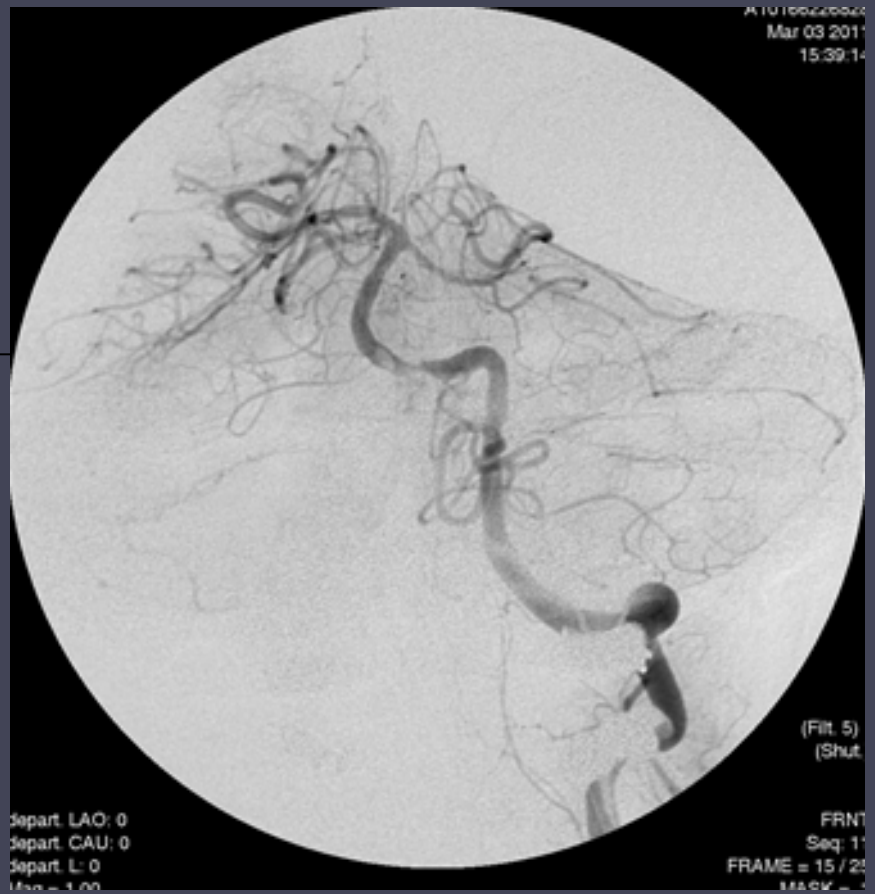


# 4 épisodes régréssifs d’hémiparésie
# IRM =Pas de signe d`avc ischémique

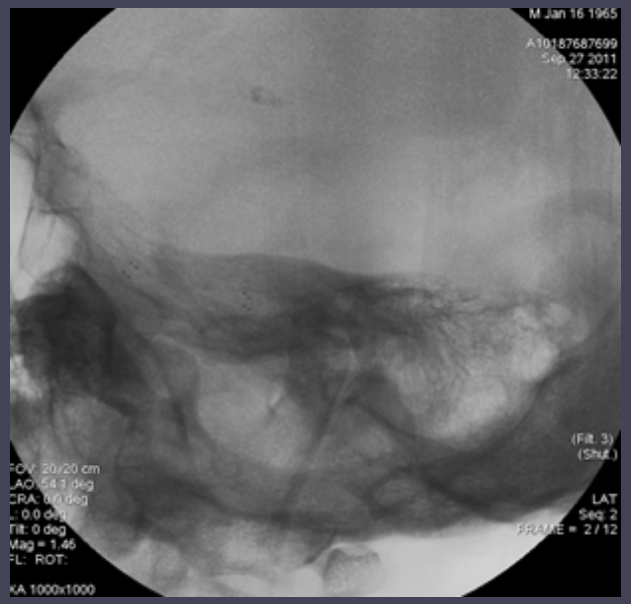


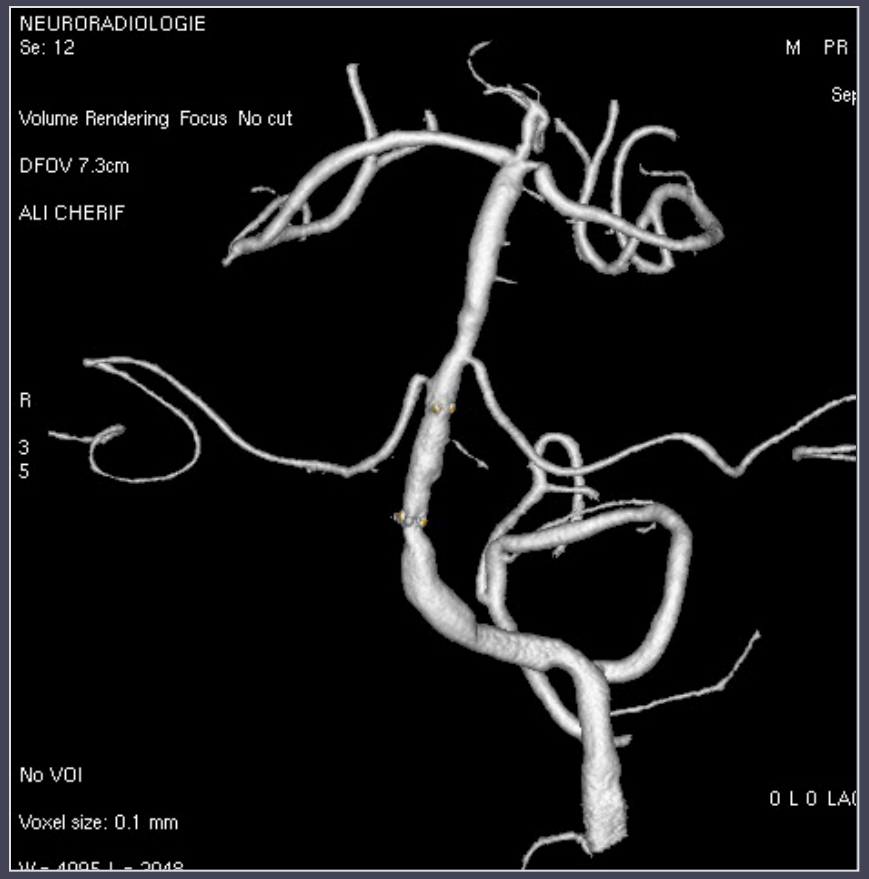
solitaire FR


Stent wingspan

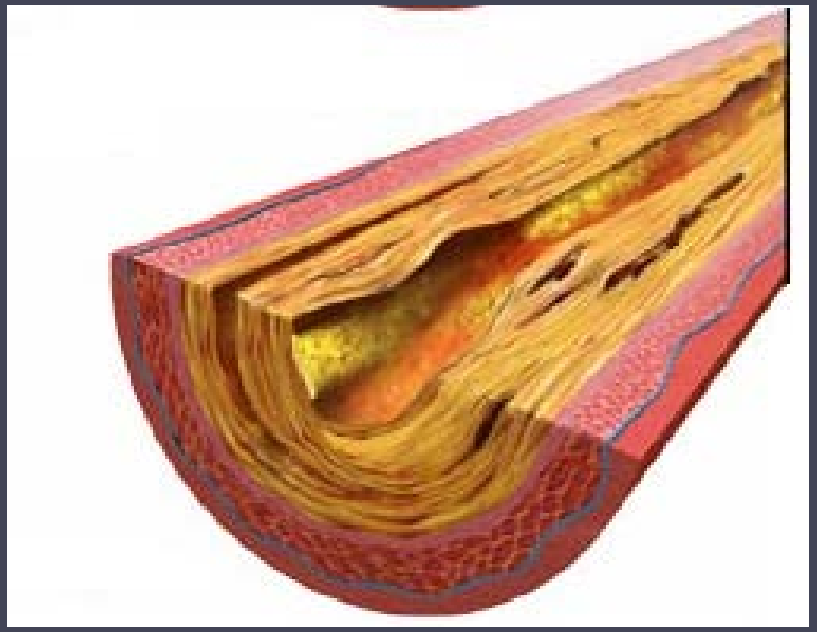
# Récupération après stenting

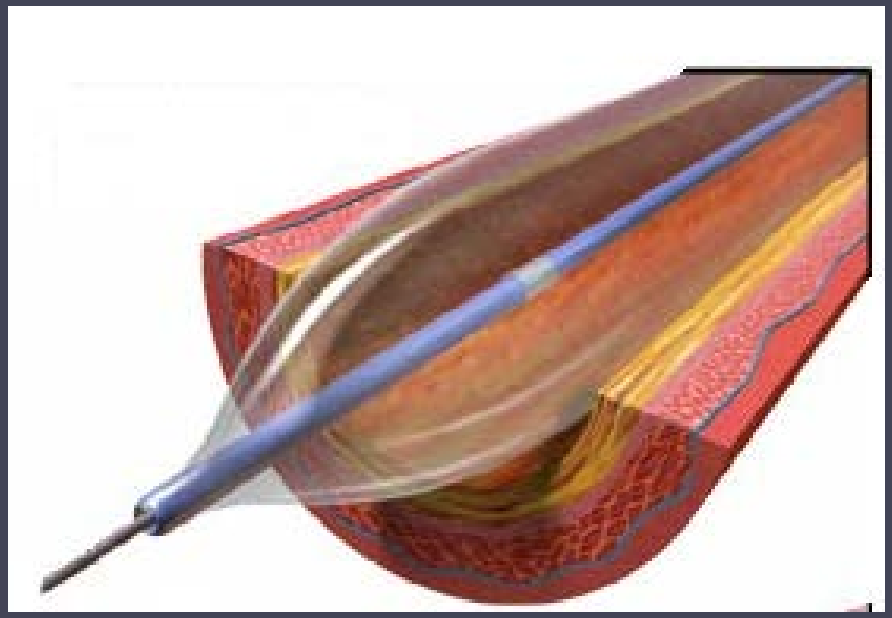


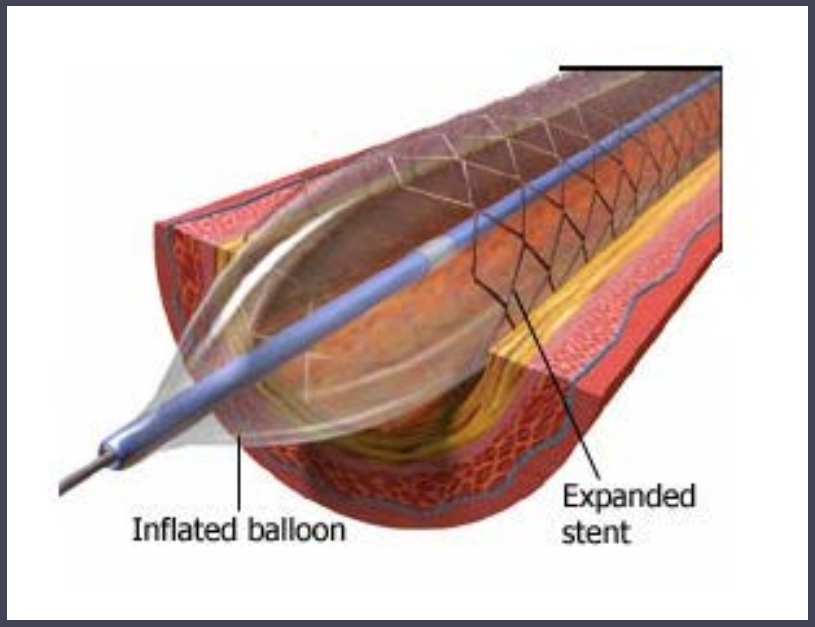
# Les Stents:

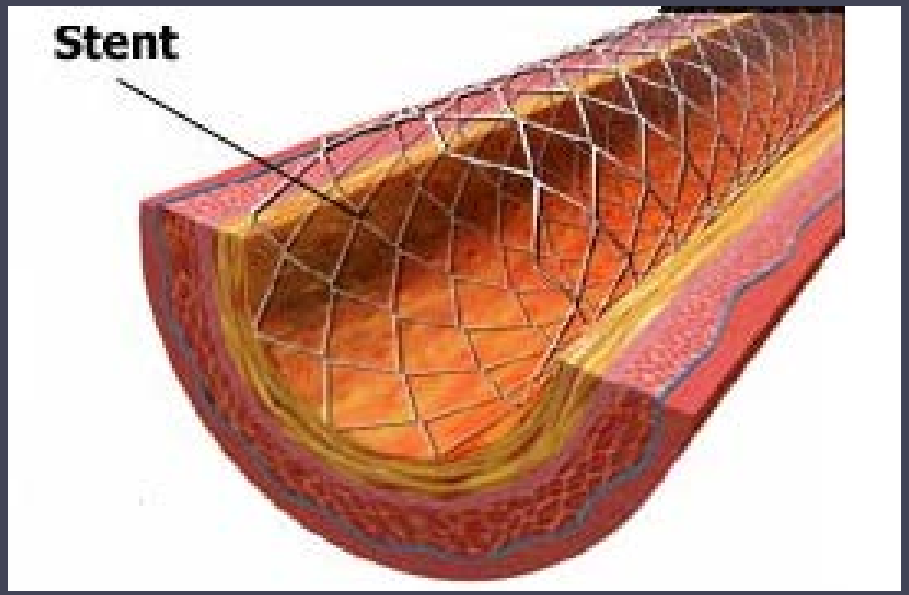
carotidiens . . .

et les autres






Inflated balloon
Expanded stent


Stent

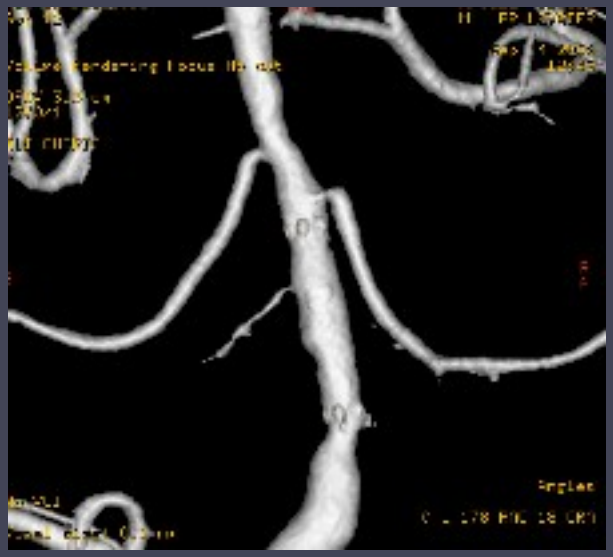
avant

Post stenting

avant

Post stenting

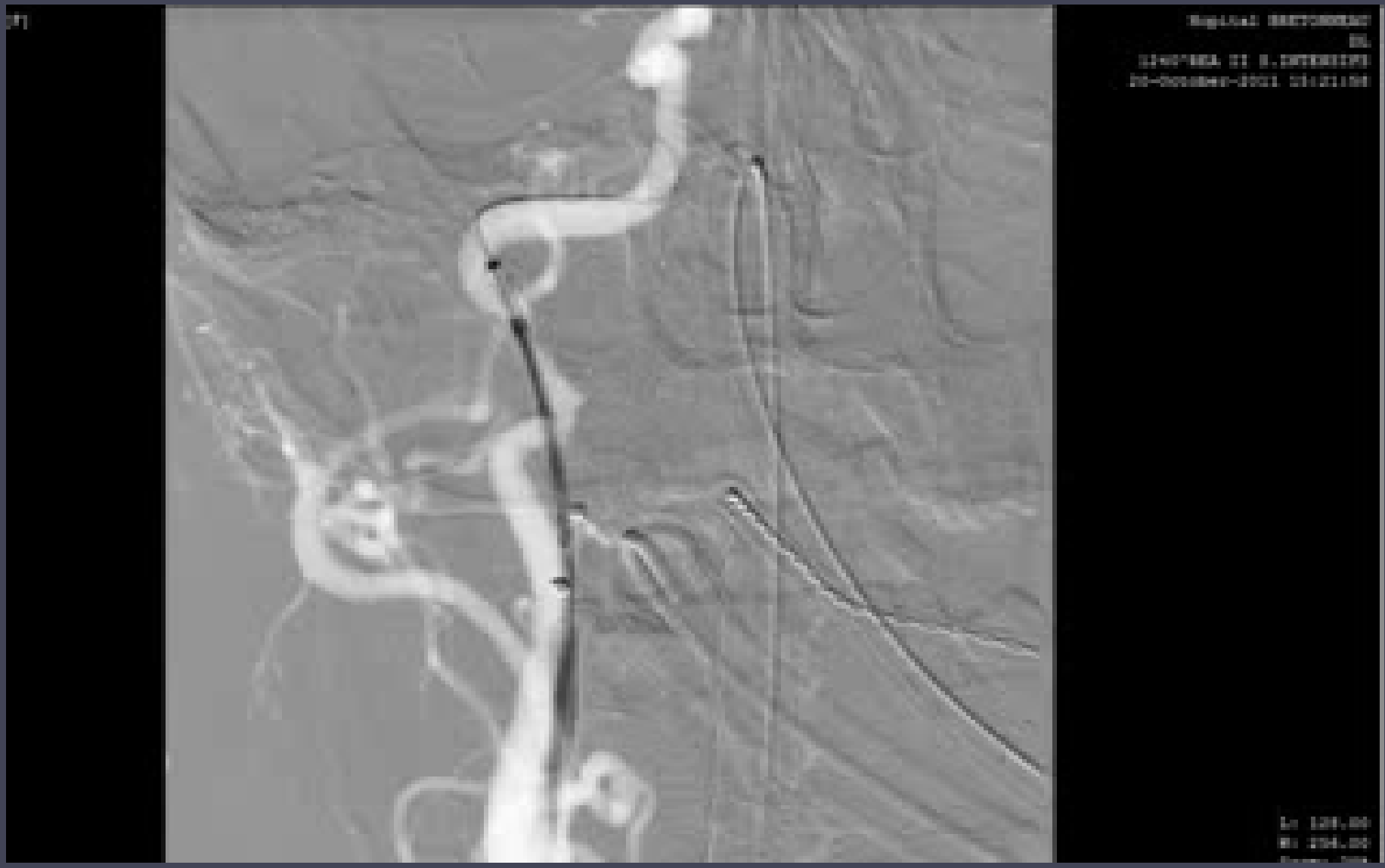
# Sténose athéromateuse intra crânienne Angioplastie-Stentin



# Diagnostic ?

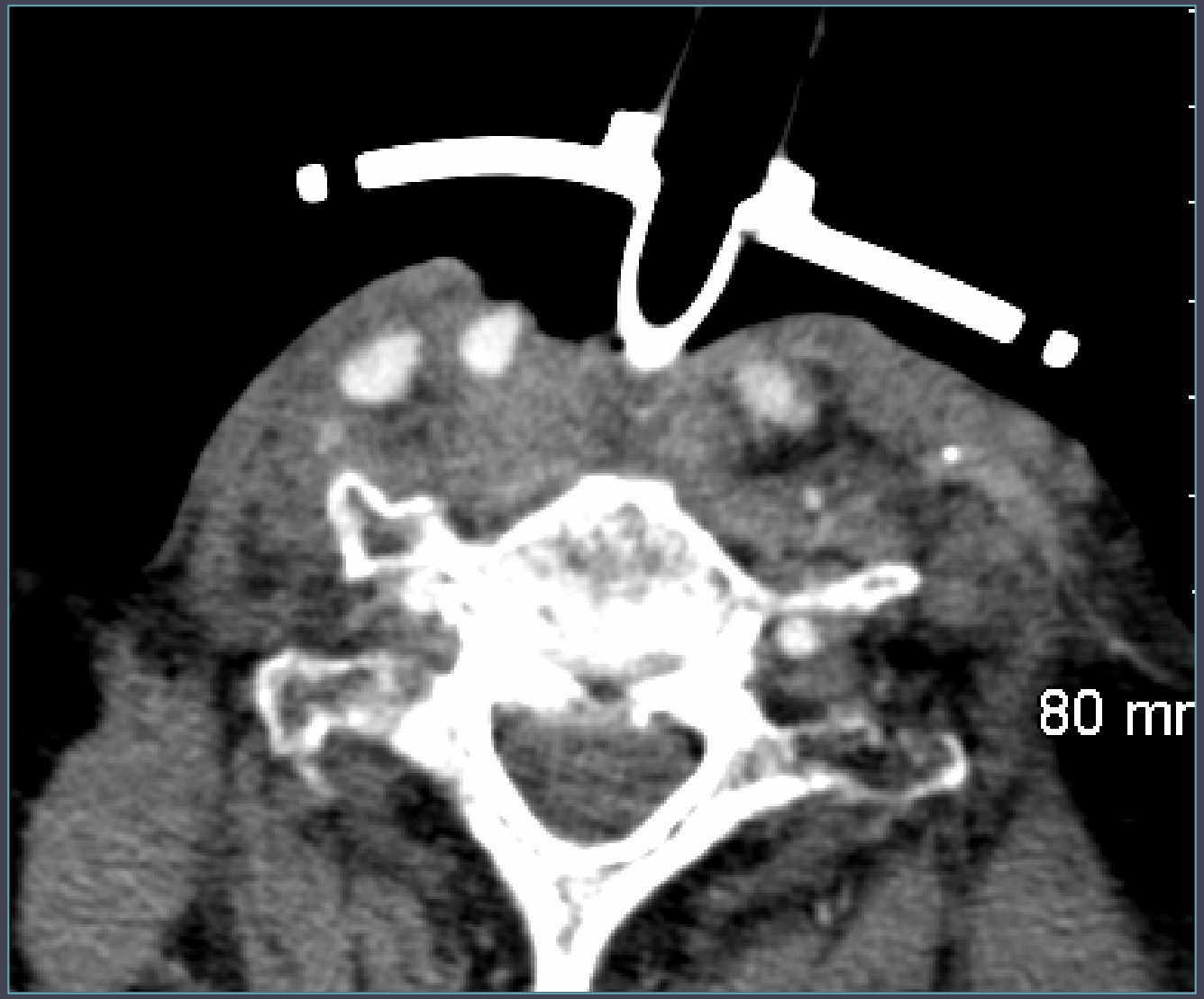

R PAPAGIANNAKI
F Apr 09
OV: 20/20 cm
AO: 0.0 deg
RA: 0.0 deg
0.0 deg
0 deg
FRAME = 8
MASK


20 cm
deg
deg




E MEDICAL SYSTEMS
pital BRETONNEAU
R PAPAGIANNAKI
CV: 12x12 cm
AO: 90.0 deg
RA: 0.0 deg
0.0 deg
it: 0 deg
ag = 1.00
: ROT:

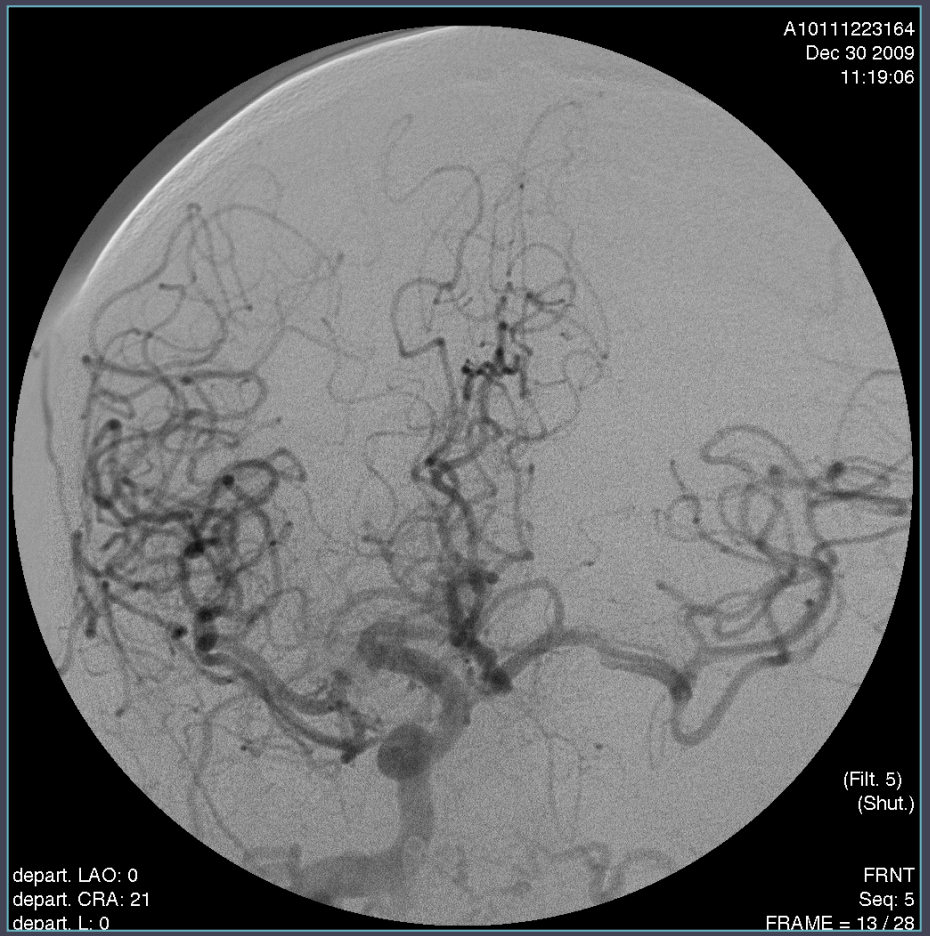
# 53 ans,trachéotomie (10 ans), hémorragie

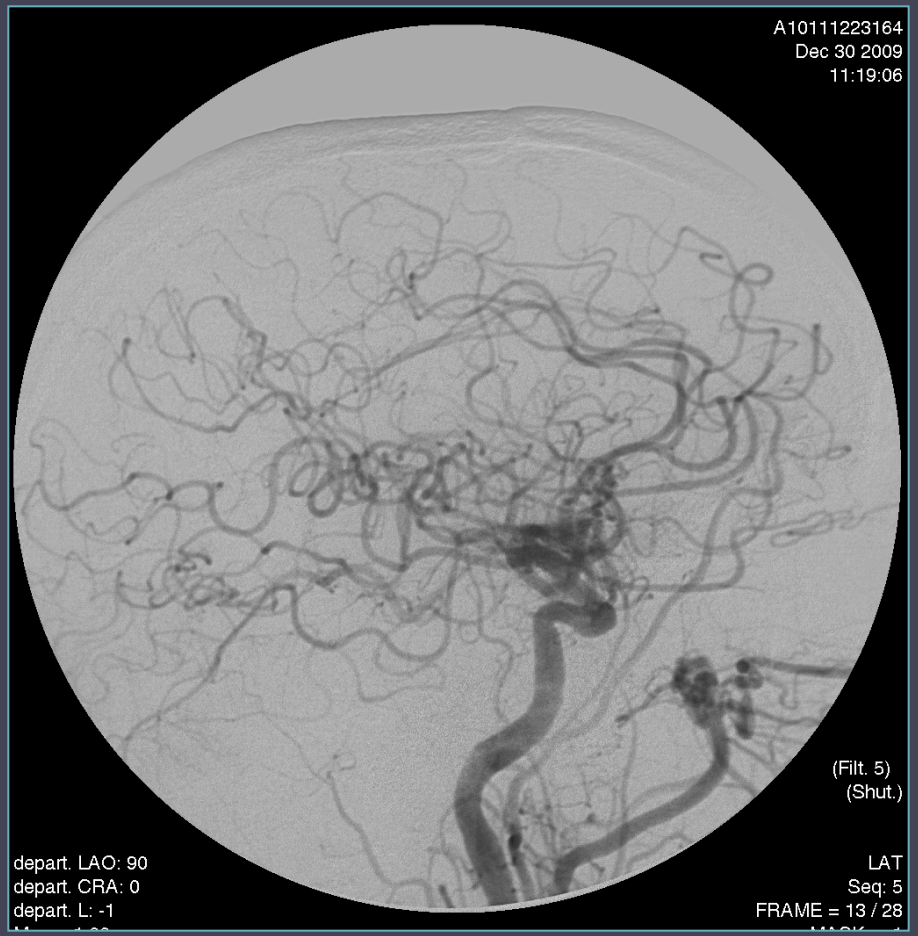



HERBRETEAU DENIS
M Dec 24 1927
A10111223164
Dec 30 2009
10:49:32
LESION
(Filt. 5)
(Shut.)
depart. LAO: 0
depart. CAU: 0
FRNT
Seq: 2

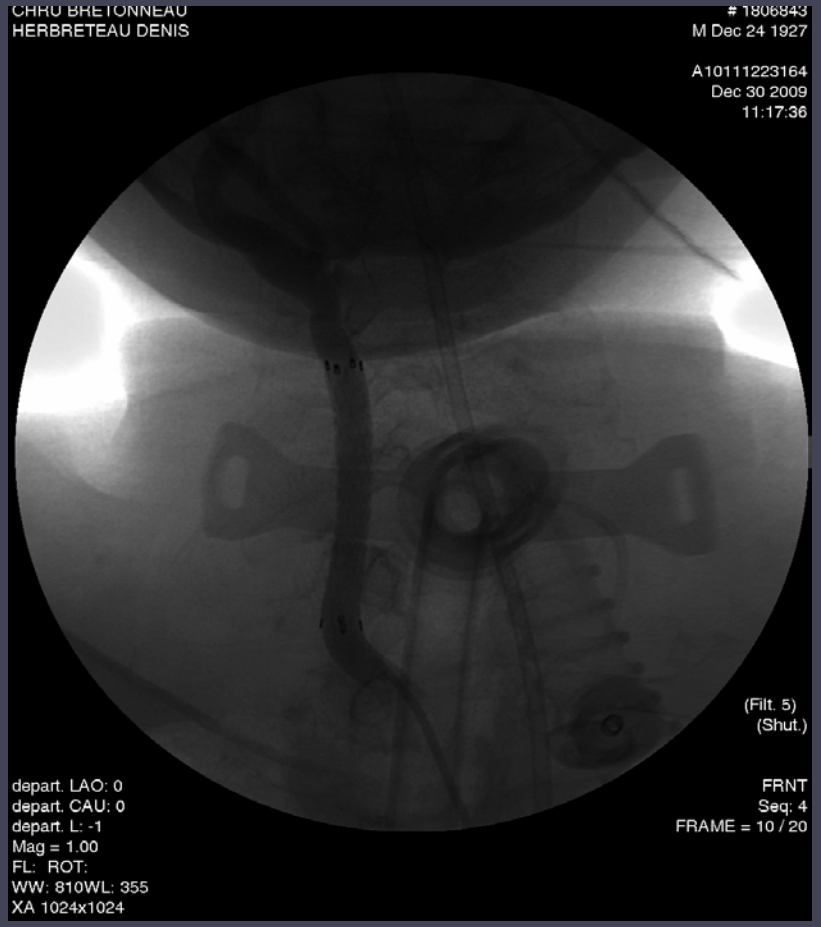

DoB: Dec 24 1927
Dec 30 2009
10:54
MIP No cut
DFOV 5.3cm
HERBRETEAU DENIS
4.2 mm (2D)
5.4 mm (2D)
R
P
L
A
Angles
No VOI
0 L 45 RAO 0 CRA
Voxel size: 0.3 mm
W = 3757 L = 2056
I 49

# L’autre carotide est thrombosée



# Fluency 9/40mm

# EN CONCLUSION

- PASSION !!!
- PATIENCE ++
- PAS PRISONNIER D’ UNE TECHNIQUE
- PHARMACIEN : BONNE COLLABORATION