ABC session "Anterior skull base and orbital area"

Anterior communicating aneurysms

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- Neurovascular Interventional Unit
- University Hospital Careggi
- Firenze
- Italia

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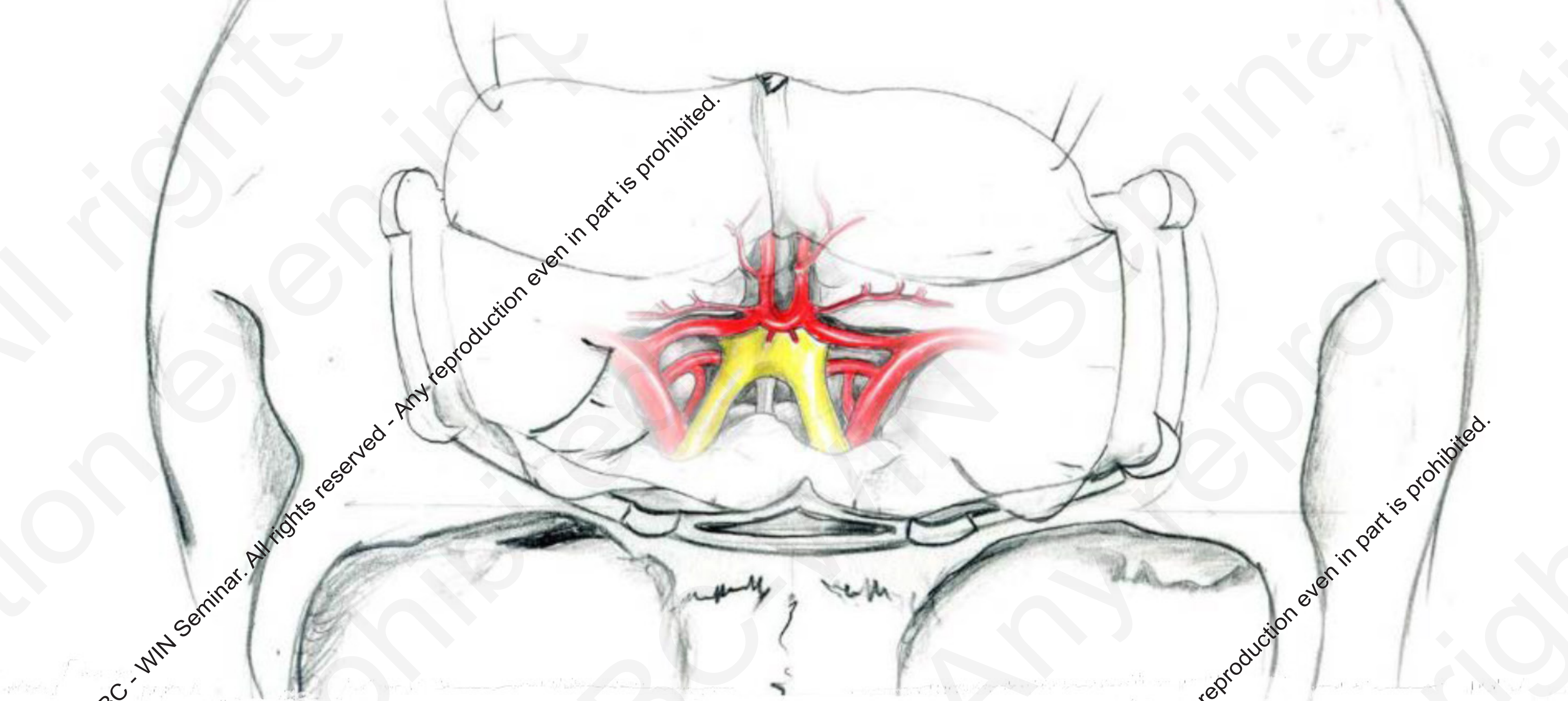
Anterior Communicating artery represents the communication between two ideally equal arterial systems (twins) placed in a condition of hemodynamic equilibrium

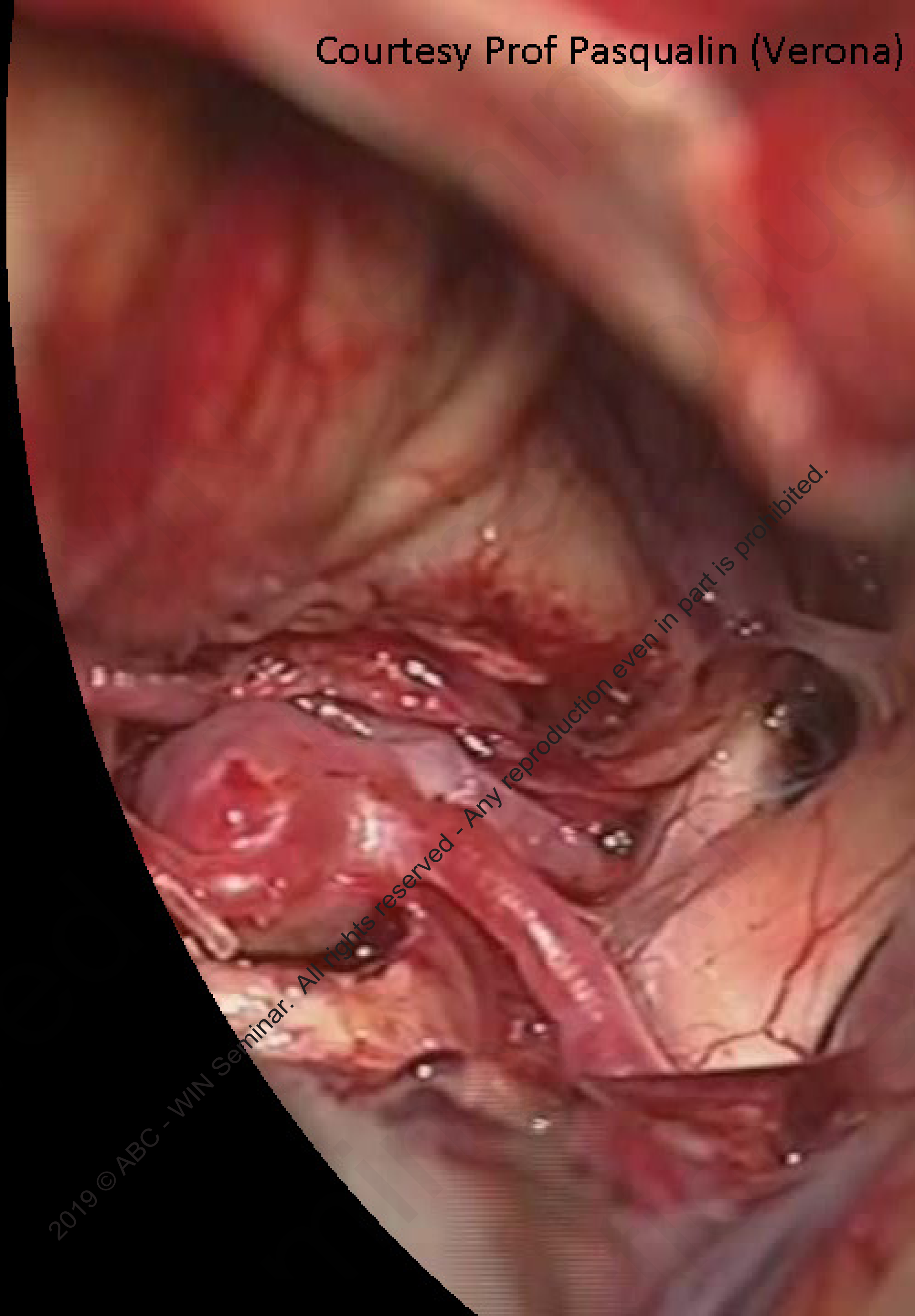
Functional anastomosis



- Acoa is the most common aneurysm site within anterior circultation
- ACoA Aneurysms are diagnosed in 22% to 40% of patients with subarachnoid hemorrhage (SAH)

- Midline location, anatomic variations, critical perforators and the variable geometry make these aneurysms challenging to treat

- Flow-related complex regional haemodynamics, may explain the high bleeding frequency even in small in size Acoa's aneurysms



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Lay out

- Midline location , **anatomic variations**, critical **perforators** and the **variable geometry** make these aneurysms challenging to treat
- The particular **hemodynamics** related to the complex regional flow may explain the AComA Aneurysms **propensity to bleed** even if they are small in size

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Development anomalies

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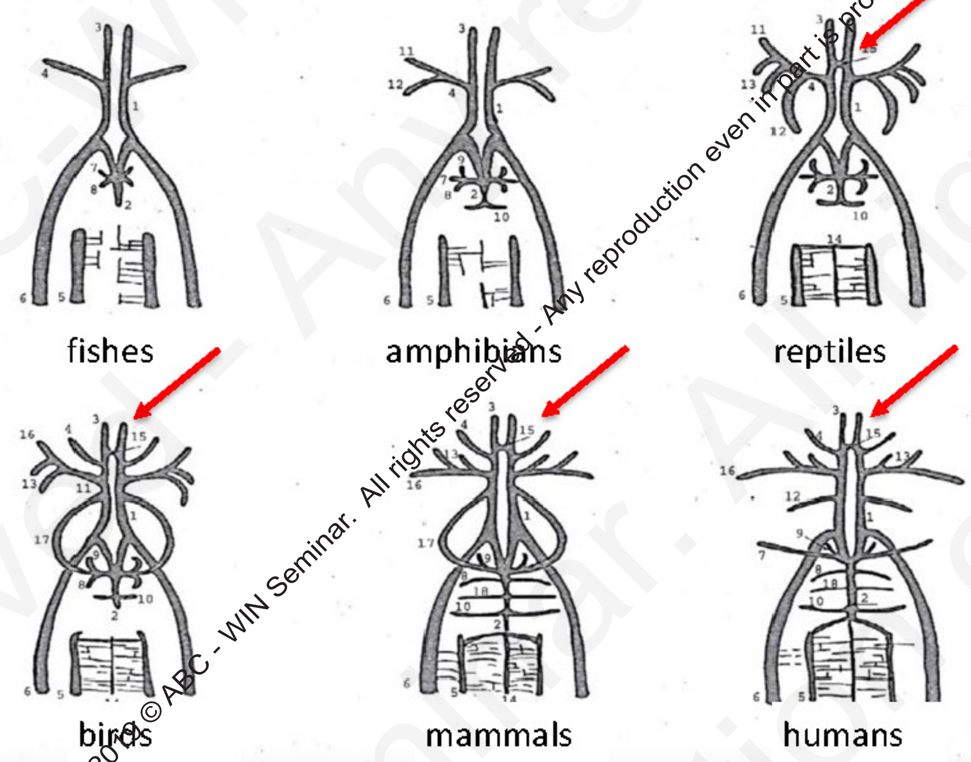
Phylogenesis

primitive anterior communicating artery

The first functional anastomosis between the right and left ACA is observed in **reptiles** as a short midline fusion of the olfactory arteries



Maryna A. Kornieieva et al. (2017). Int J clinical & case. 1:2, 33-40.

Lasjaunias P, Berenstein A, Brugge K. 2001. Surgical Neuroangiography. Berlin: Springer-Verlag Berlin and Heidelberg GmbH & Co.K.

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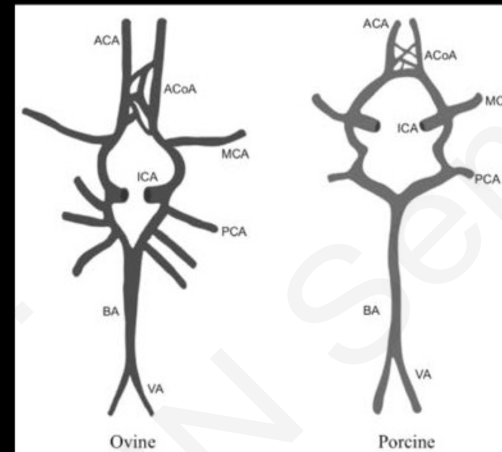
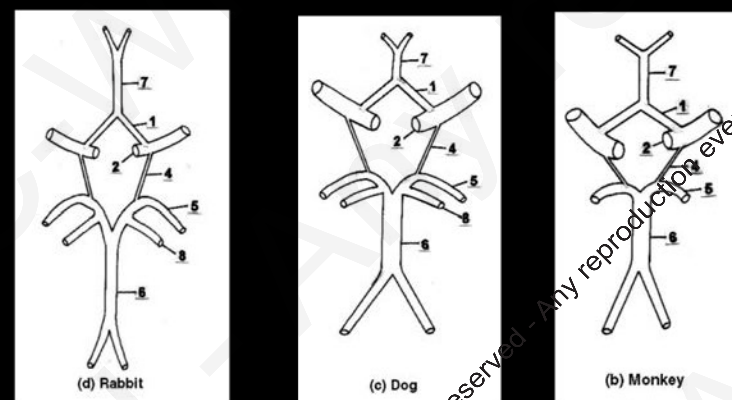
After reptiles, 3 successive evolutive models developed

- anastomotic net (pigs and sheep)
- short median fusion in a common trunk (monkey dog and rabbit)
- horizontal inter hemispherical connection (monkey)





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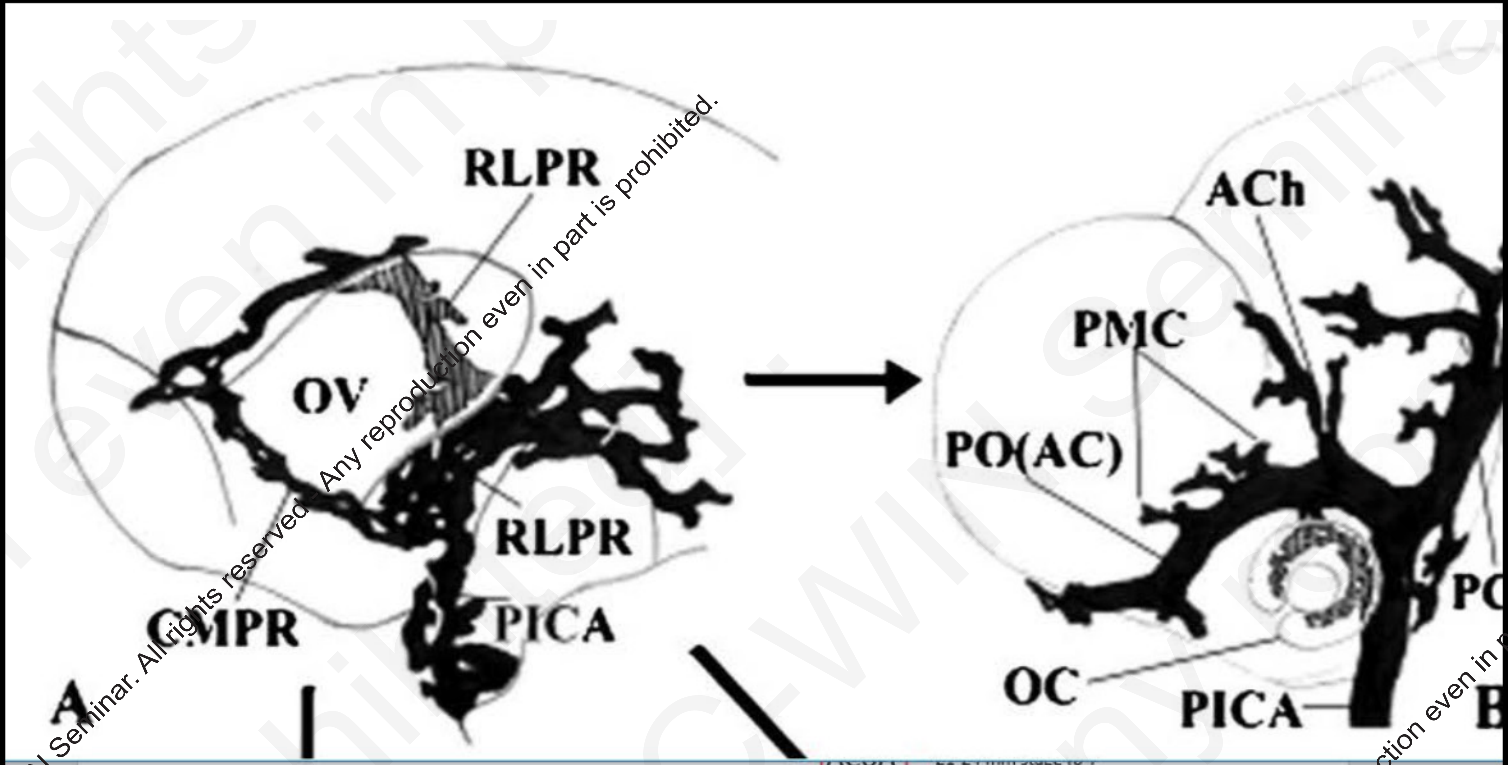
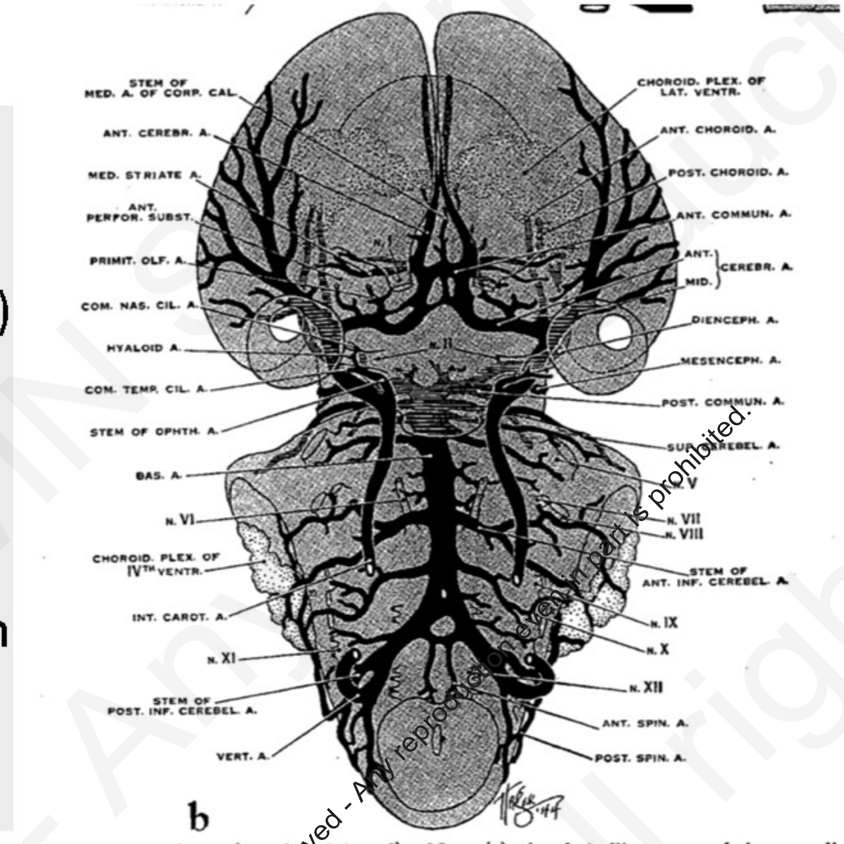


In Humans

- During the initial phase of cranial artery development, the arteries are plexiform before definite branches are formed

AcoA starts to develop after the complete formation of both ACAs during week 6-7 of embryological age (21-24 mm lenght embryo) from a **fusion in the arterial inter-communicating multi-channeled plexus**

AcoA becomes autonomous and patent when the embryo is around 40 mm long.



24 mm embryo, ventral view (Padget, 1947)

Padget, D.H. (1948) The development of the cranial arteries in the human embryo. Contribution to embryology. Carnegie Institution, 32, 205-261.
Menshawi K., Mohr J.P., Gutierrez J. (2015) A Functional Perspective on the Embryology and Anatomy of the Cerebral Blood Supply. J.Stroke; 17(2): 144-58.

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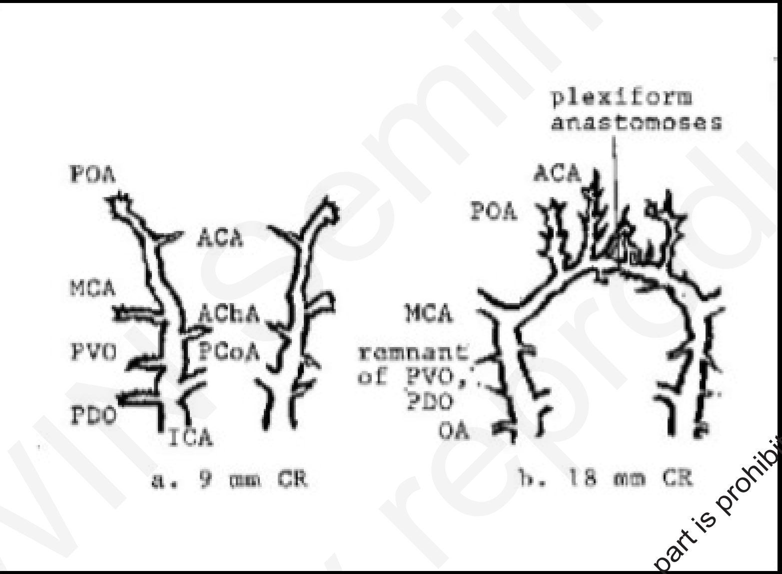
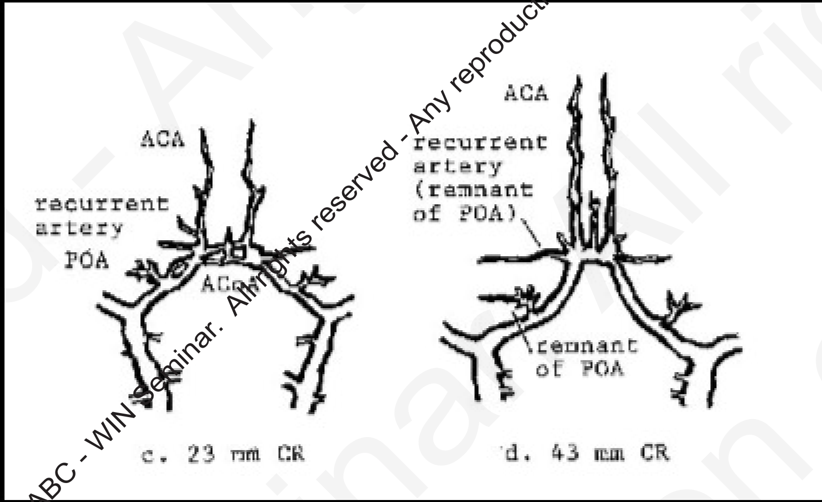
Final architecture of ACA is realized through different steps by progressive remodeling of the primitive arterial plexus



embryological steps

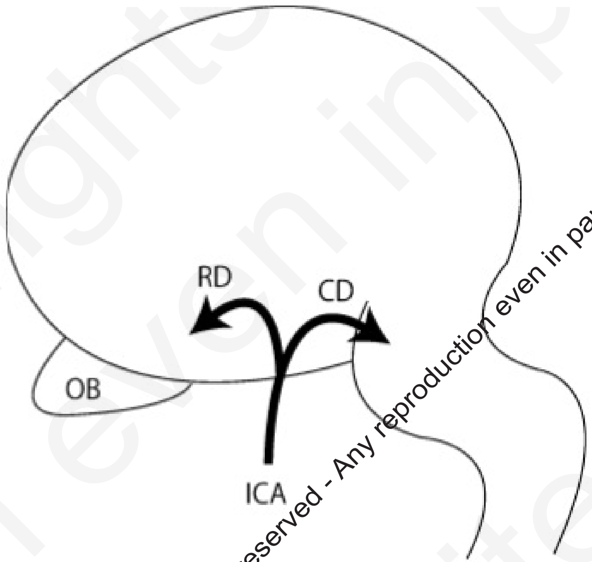
- Formation of primitive ICA
- Primitive Olfactory artery dominance
- ACA dominance
- A1 identification
- A2 identification
- **formation of the AComA**

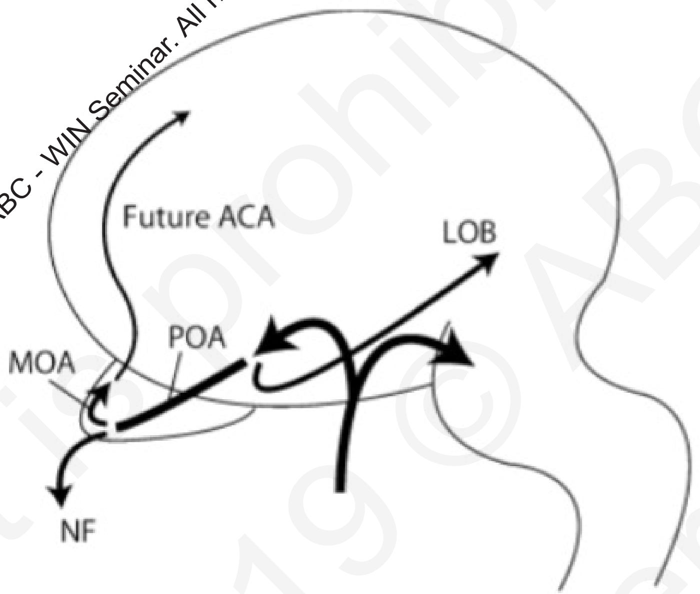


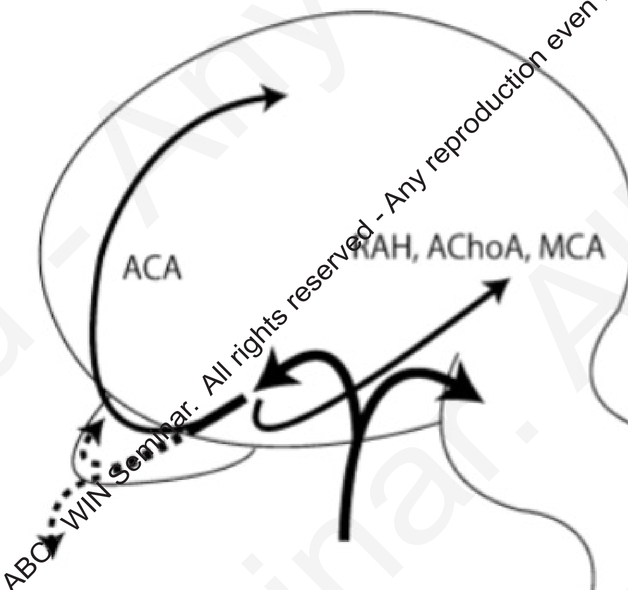
TAKEHISA TSUJI
J Neurosurg 83:138–140, 1995

Primitive internal carotid artery (ICA)
Rostral division (RD)
Caudal division (CD).
OB olfactory bulb
primitive olfactory artery (POA)
nasal fossa (NF).
medial olfactory artery (MOA) embryological forerunner of the ACA.

Lateral olfactory branch (LOB) gives RAH, AChoA,MCA)







M. Komiyama
Surg Radiol Anat (2012) 34:97–98

After regression of the terminal portion of the POA, the MOA constitutes the ACA proper.

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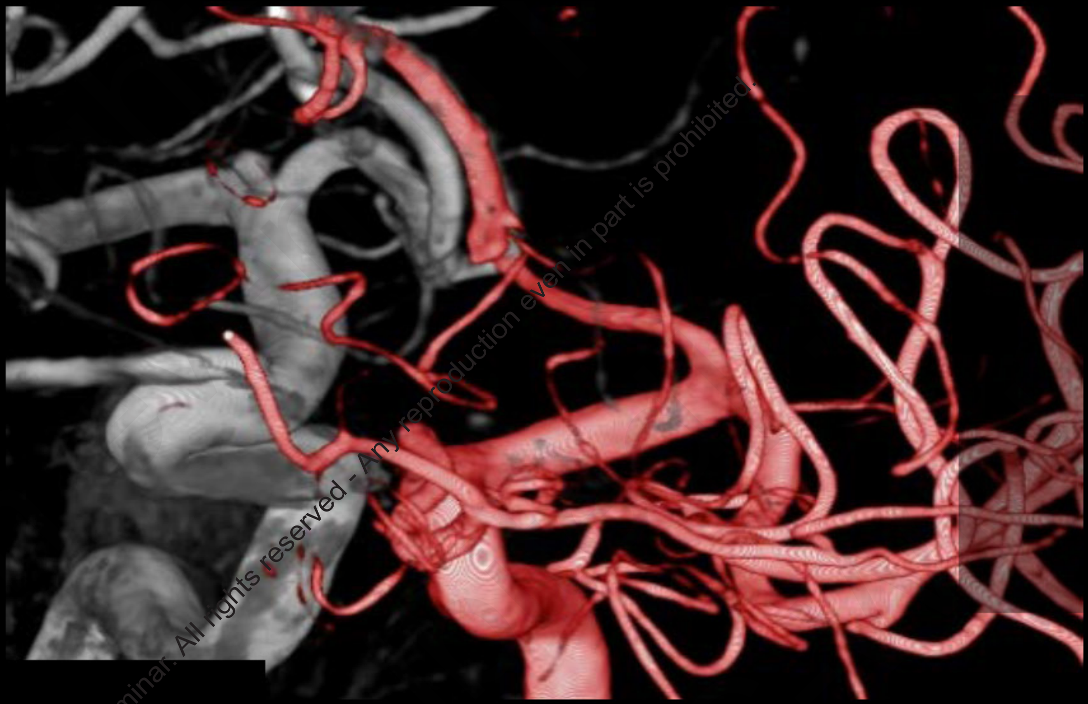
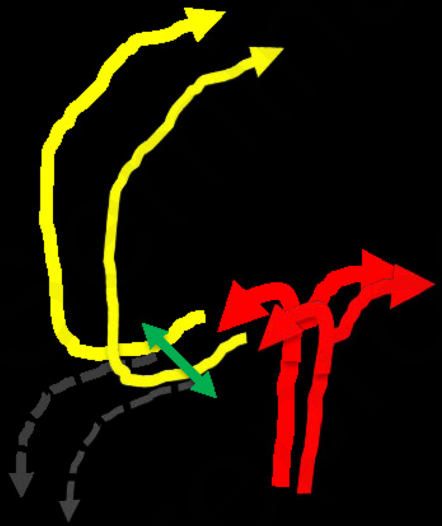


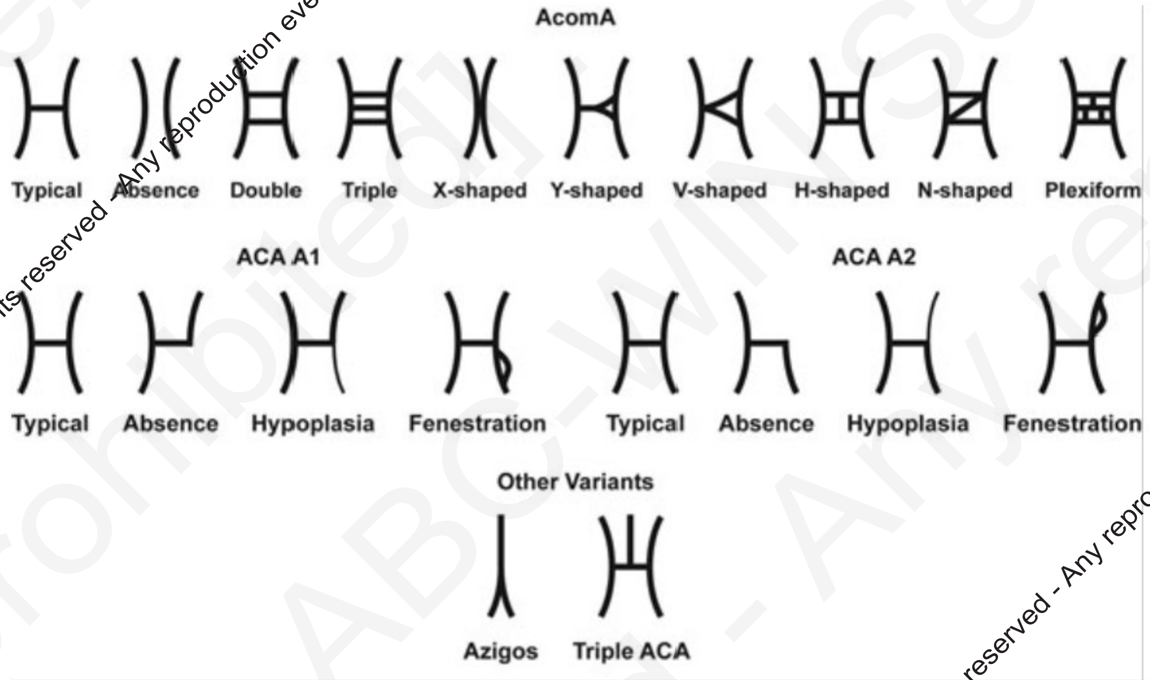


AcomA develops where is the deflection of the ACA towards the Interhemispheric fissure (future A1 A2 angle) secondary to the POA regression

AcomA area marks the point of the regression of the Primitive Olfactory Artery

For these reasons the AcomA area may be considered the **pivot of embryogenetic and phylogenetic events** determining the mature configuration of the anterior part of the CoW and the passage from an olfactory world to an emotional (limbic) one

-ACoA inaugurates the phylogenetic establishment of the Willis circle
-Acoa marks the final realization of the adult CoW during embryogenesis



Partial fusion and concurrence of different phylogenetic models may explain the numerous anatomical variants of AcomA

Development anomalies

Persistence of the Primitive Olfactory artery (PPOA)

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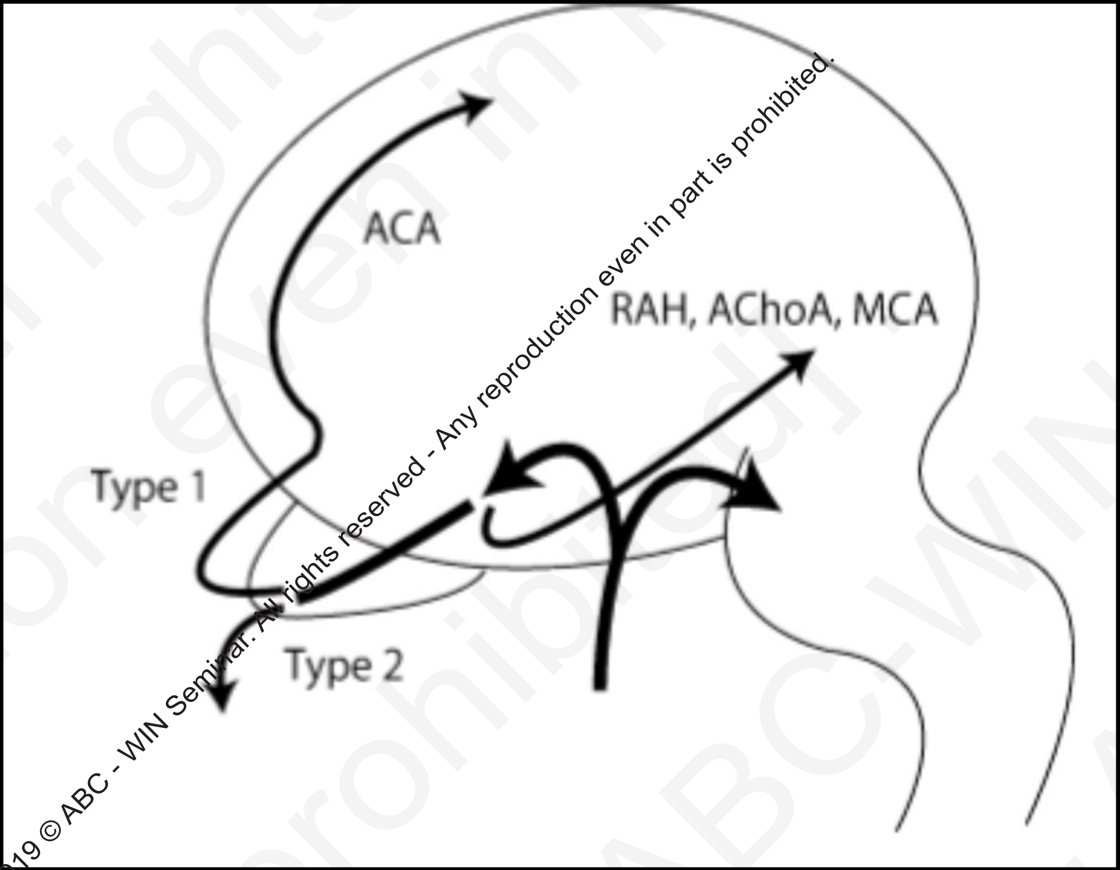
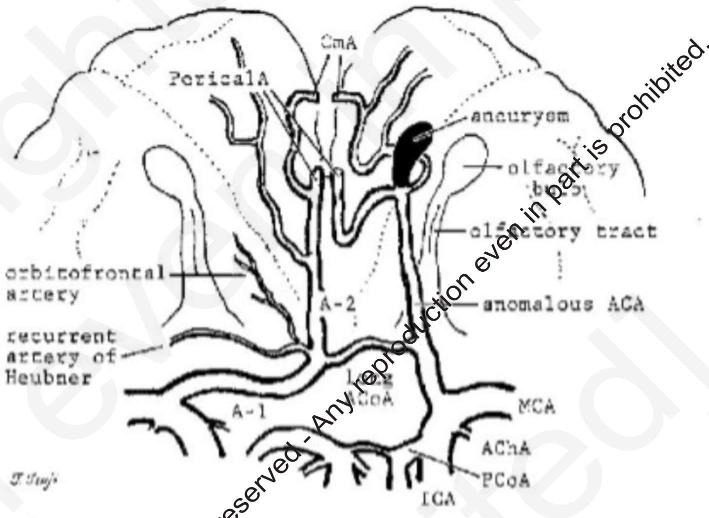


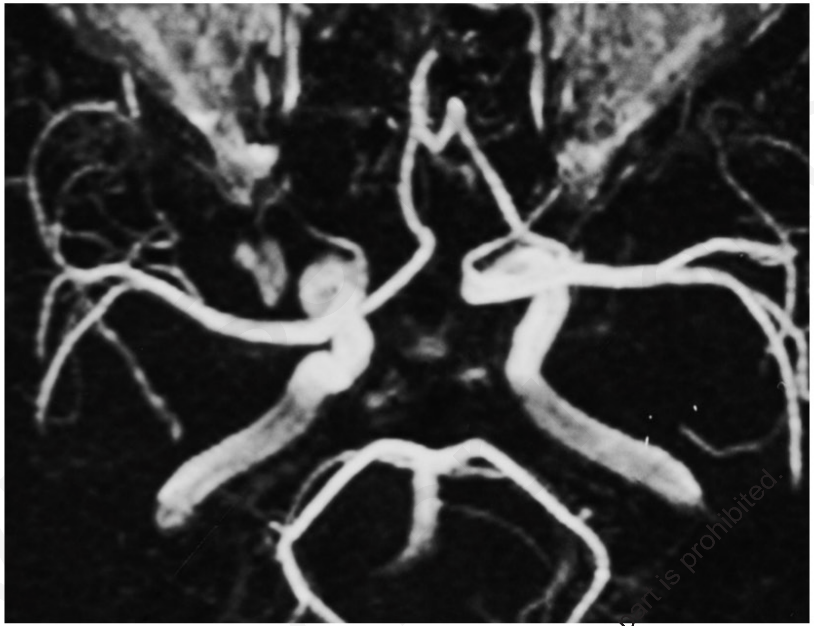
- If the normal regression of the proximal primitive olfactory artery does not occur, the **ACA or some of the ACA branches** (fronto polar and orbito frontal , superior internal frontal) **may arise from this persistent embryonic vessel.**

- **POA**
- **Two directions**
  - **medial olfactory** artery becomes the ACA proper
  - **Lateral olfactory artery**

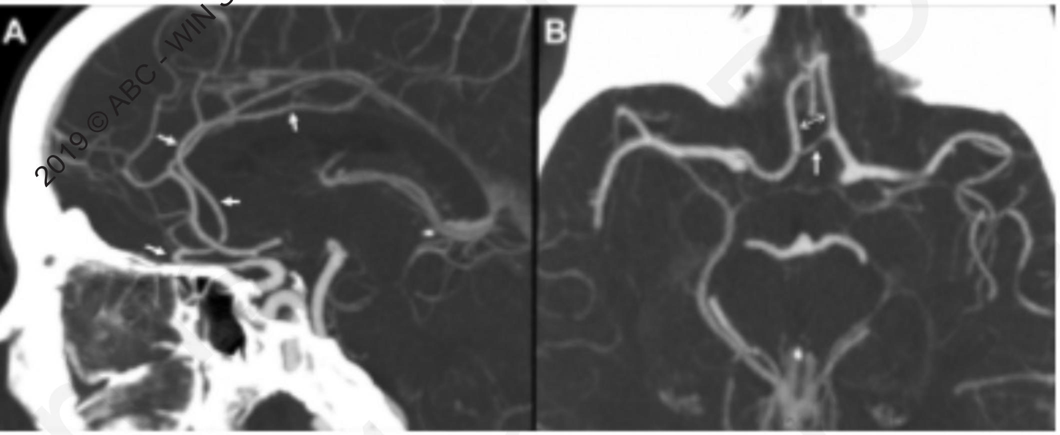
    include the
    - recurrent artery of Heubner,
    - anterior choroidal artery,
    - lateral striate artery,
    - the lateral MCA



TAKEHISA TSUJI
J Neurosurg 83:138–140, 1995



A. Uchino J Cinical Imag 25 (2001) :258 -261



Hosur B, et al. BMJ Case Rep 2018;11:e227782

characteristics of the PPOA

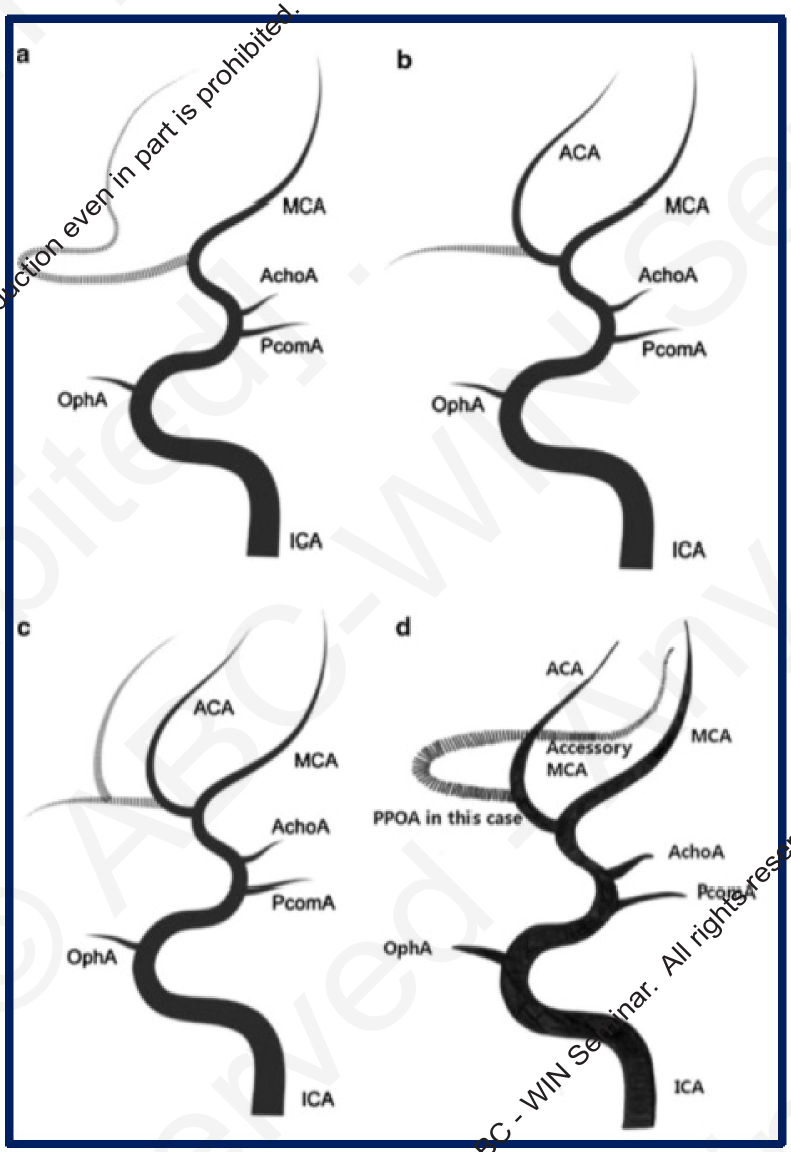
- anomalous course along olfactory tract
- hairpin deflection in correspondence of olfactory bulb
- association with the long ACoA,
- absence of the recurrent artery of Heubner on the anomalous side
- Cortical distribution in calloso marginal territory

<u>Type 1 (med olfact. br)</u>

the anomalous artery **arises** **<u>from the ICA,</u>** runs along the olfactory tract, and makes an hairpin bend to supply the territory of the distal ACA

<u>Type 3 (med olact br)</u>

PPOA <u>arises **from ACA**</u> has 2 branches: the <u>*superior one*</u> forming the callosomarginal branch of the ACA, and the <u>*anterior one*</u> extending toward the cribriform plate with an anastomosis with the ethmoidal arteries



<u>Type 2,(med. olfact br.)</u>

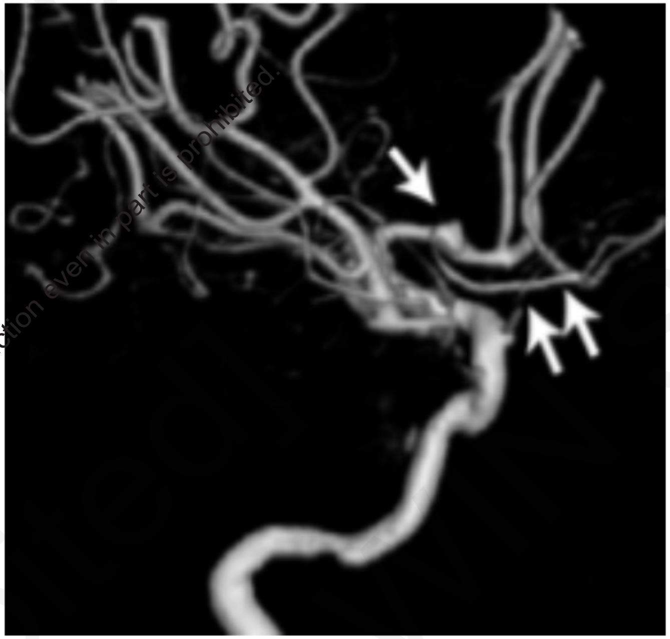
the <u>artery arises **from the ACA**</u> and passes through the cribriform plate to supply the nasal cavity as the ethmoidal artery.

<u>Type 4 (lat olfact br)</u>

PPOA **arise from carotid bifurcation or <u>origin</u>** <u>M1</u> ,connects to the accessory middle cerebral artery (MCA)

Nobutaka Horie J Neurosurg 117:26–28, 2012

Myoung Soo KimSurg Radiol Anat (2013) 35:849–852



TYPE1

Anomalous artery originating from the left internal carotid artery at the bifurcation, running anteroinferiorly and making an hairpin turn posterior to the crista galli

TAKEHISA TSUJI J Neurosurg 83:138–140, 1995

TYPE3

two branches: the superior branch forming the callosomarginal branch of the ACA, and the anterior branch extending toward the cribriform plate, with an anastomosis with the ethmoidal artery.

Nobutaka Horie J Neurosurg 117:26–28, 2012

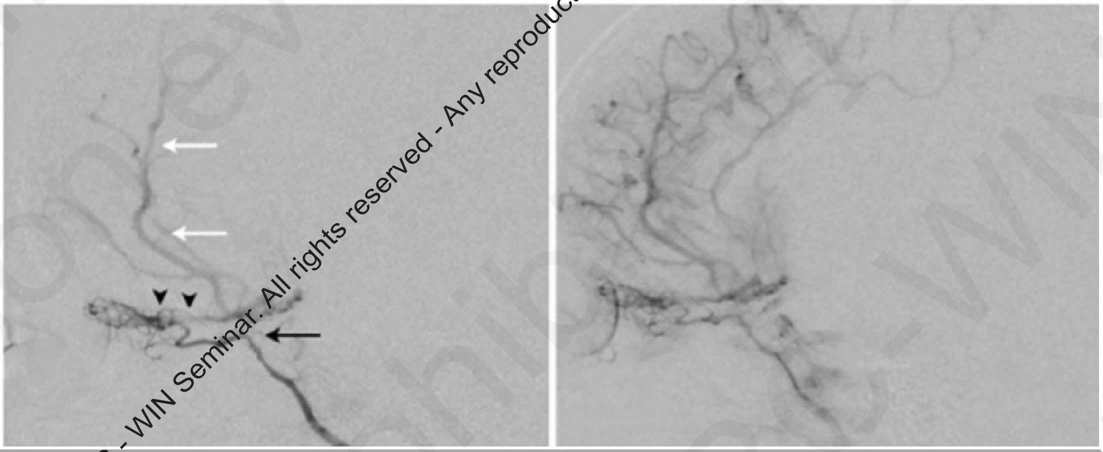
TYPE 4

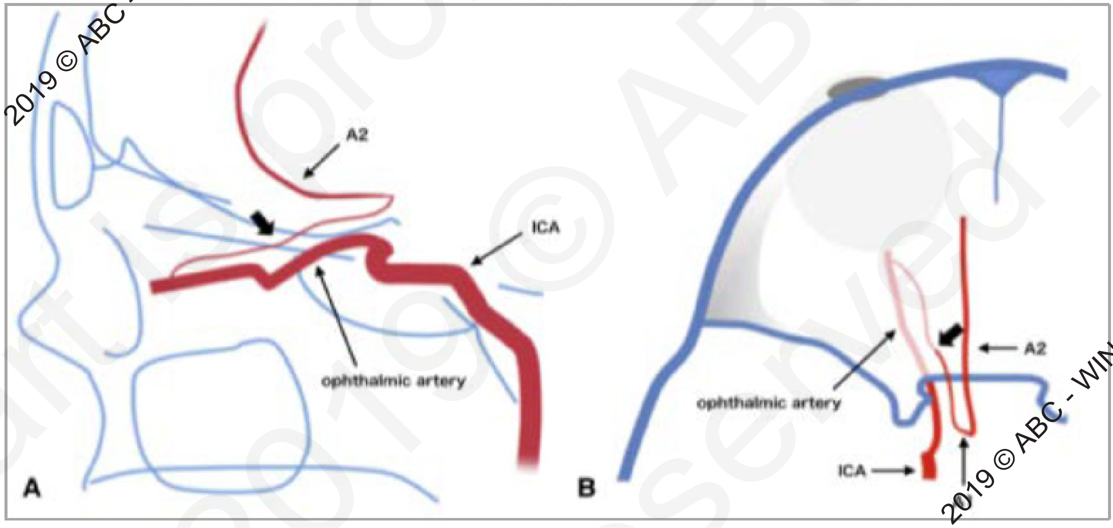
normal A1, from which the PPOA is originated along the olfactory tract. The distal portion of the PPOA then made an abrupt acute angle and ran into the Sylvian fissure. This PPOA supplied the distal MCA territory

Myoung Soo Kim
Surg Radiol Anat (2013) 35:849–852

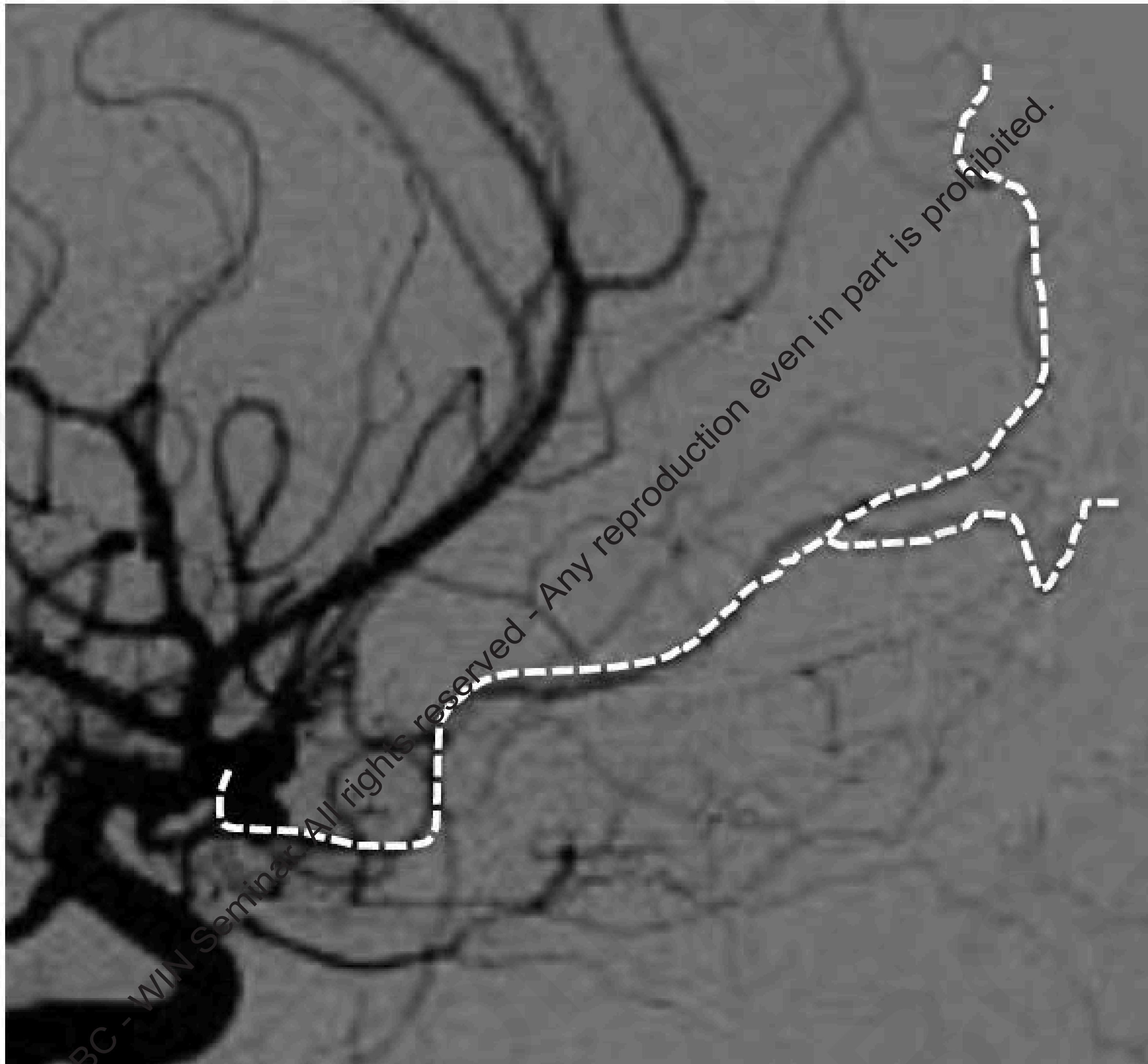
Persistent Primitive Olfactory Artery as Novel Collateral Channel to the Anterior Cerebral Artery in Moyamoya Disease

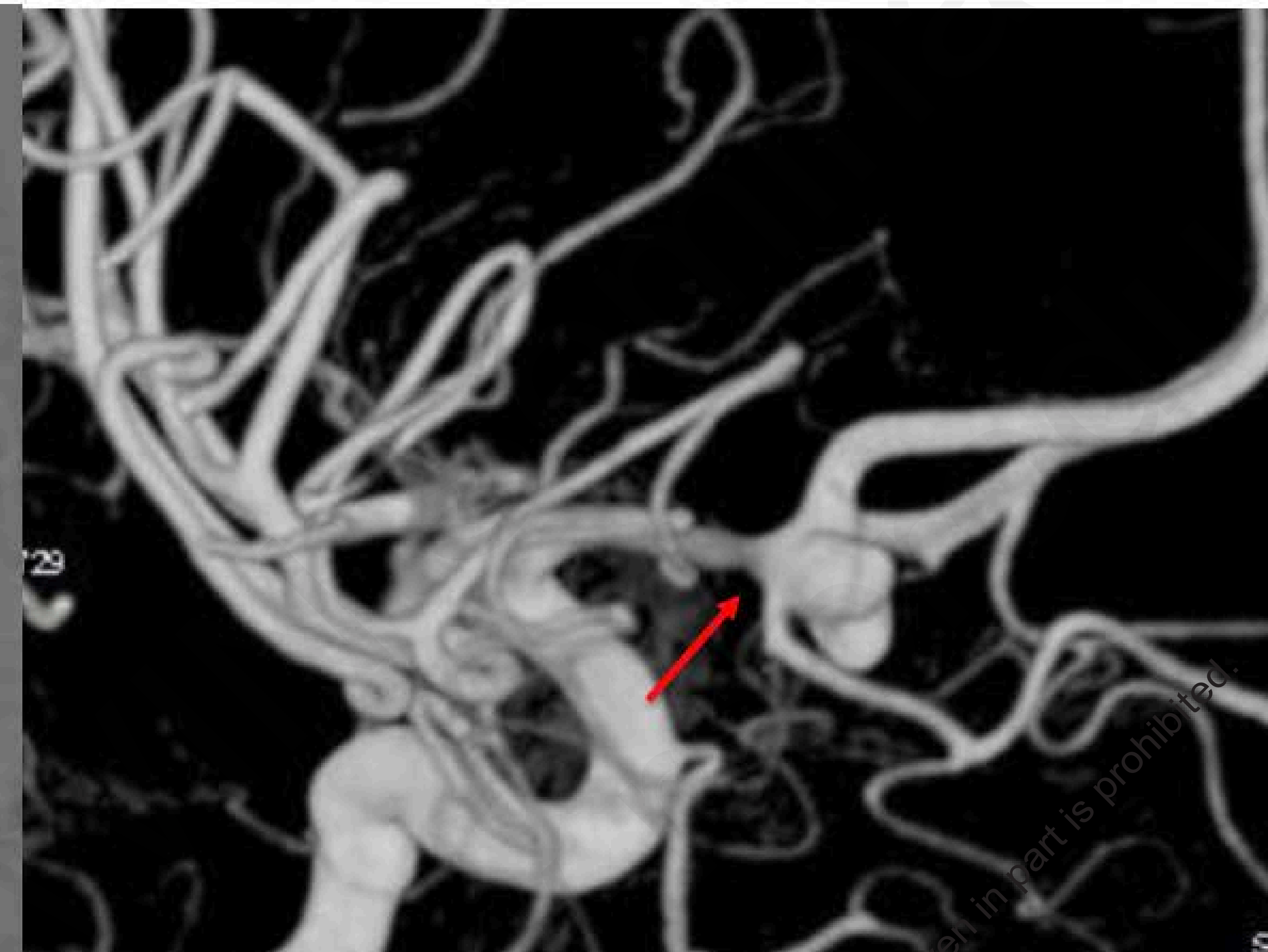
Tetsuhiro Kamo, MD, Haruto Uchino, MD, PhD, Hisayasu Saito, MD, PhD,
Daina Kashiwazaki, MD, PhD, Naoki Akioka, MD,
Naoya Kuwayama, MD, PhD, and Satoshi Kuroda, MD, PhD





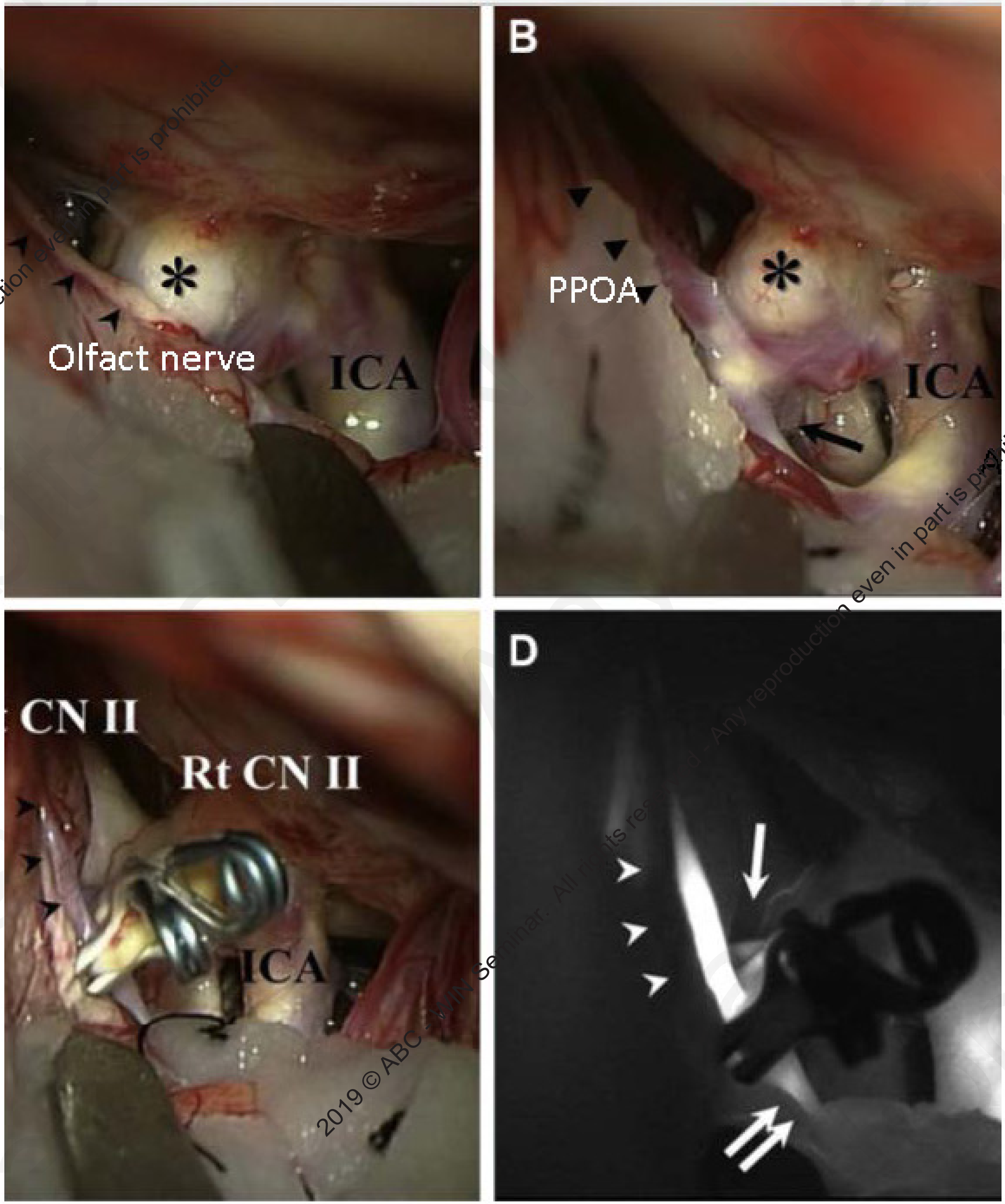
4,8% of patient with Moya Moya disease (stage V) have basal anastomosis between ethmoidal arteries from ophthalmic artery and PPAO





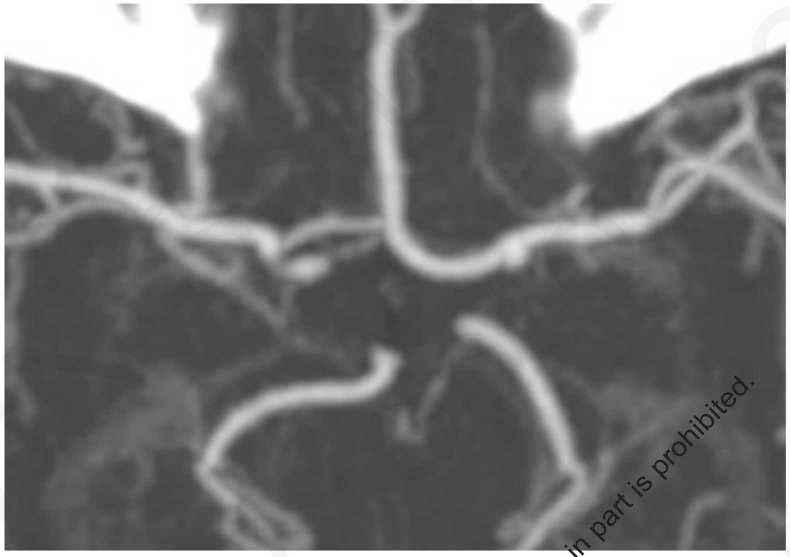
- common trunk for fornto polaris and orbito-frontal areteries takes in charge also the frontal internal artery of the calloso marginal territoty . For its origin form A1 colse to the AcomaA and its cortical distribution it may be considered as the cortical remnant of the primitive olfactory artery

PPOA arises from A1
Just beyond ipsilateral
Olfactory nerve and
Above ipsilateral optic nerve
Aneurysm may have
adherence with I and II cn



Yuiko Sato
WORLD NEUROSURGERY 84 (6):
2079.e7-2079.e9, DECEMBER 2015

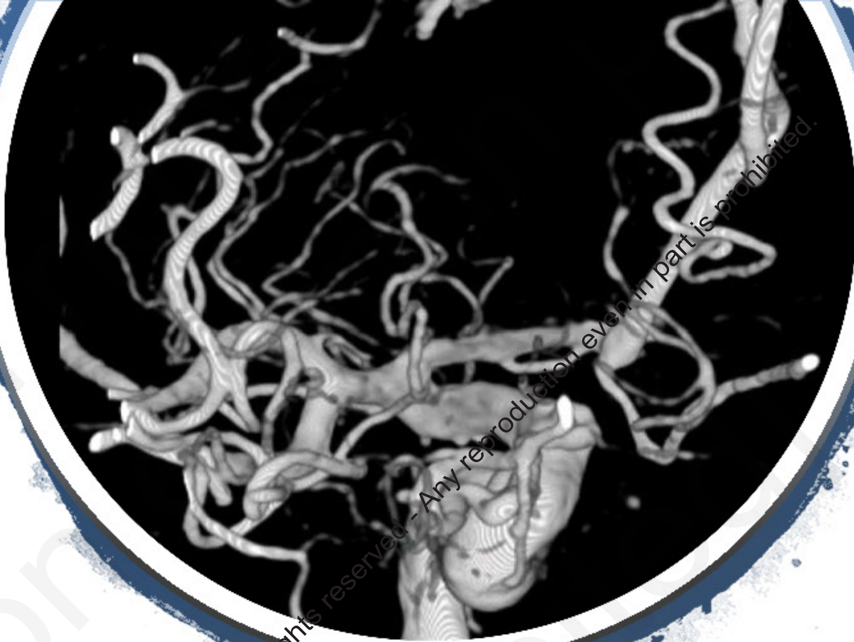
Development anomalies
A1 segment



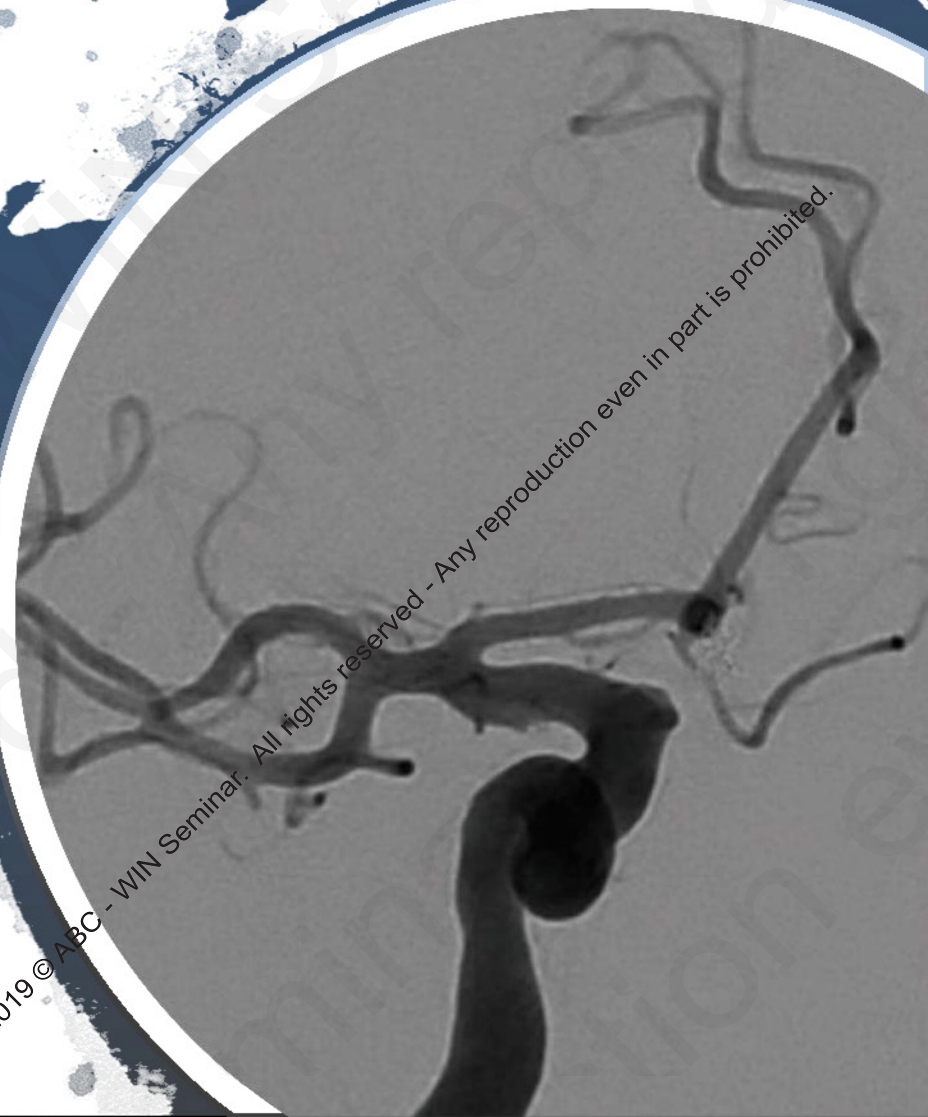
A1 Segment Fenestration

Fenestrations of the A1 segment are rare, with an estimated prevalence of 0 to 4% in anatomic studies and less than 0.1% in angiographic studies These fenestrations may be caused by the **optic nerve** coursing **through the fenestration (first type infra-optic A1)**

St Wong Acta Neurochir (2008)

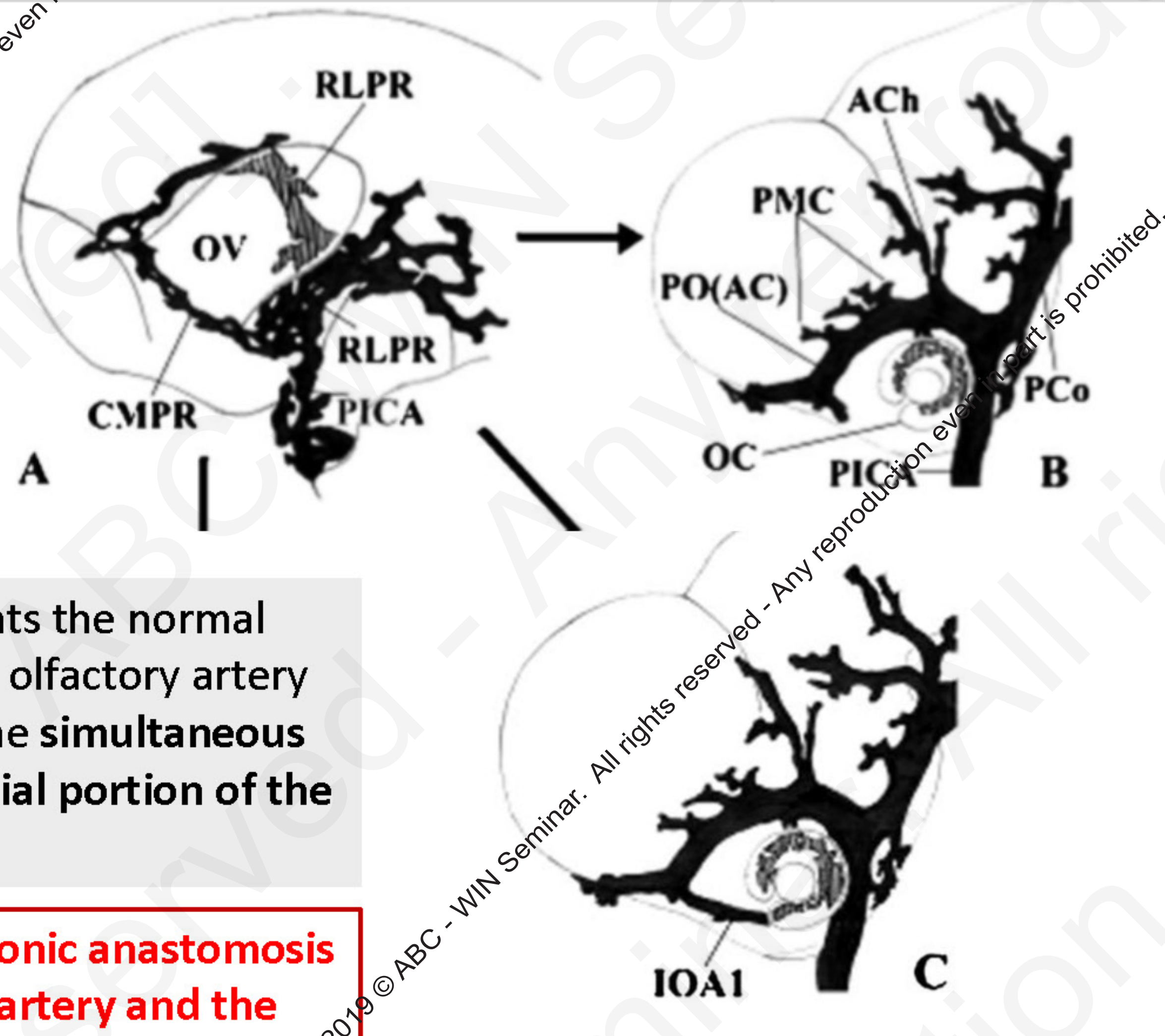


Courtesy Dr Arturo Consoli



Development

Normal
embryogenesis



type I configuration represents the normal development of the primitive olfactory artery and its derivatives but with the **simultaneous persistence of the caudomedial portion of the peri-optic arterial ring**

the **persistence of the embryonic anastomosis between primitive maxillary artery and the anterior cerebral artery**

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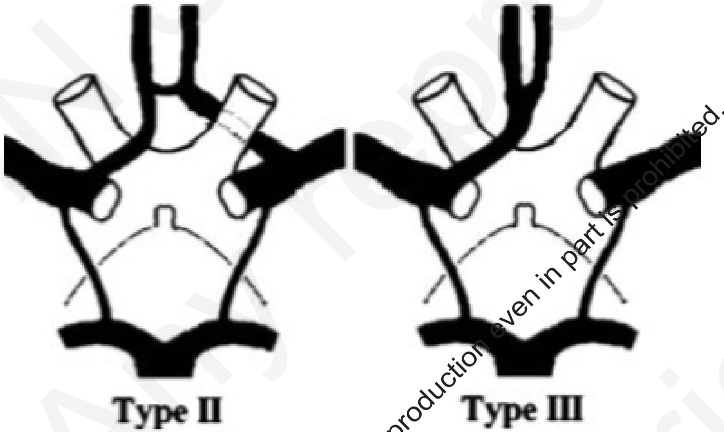
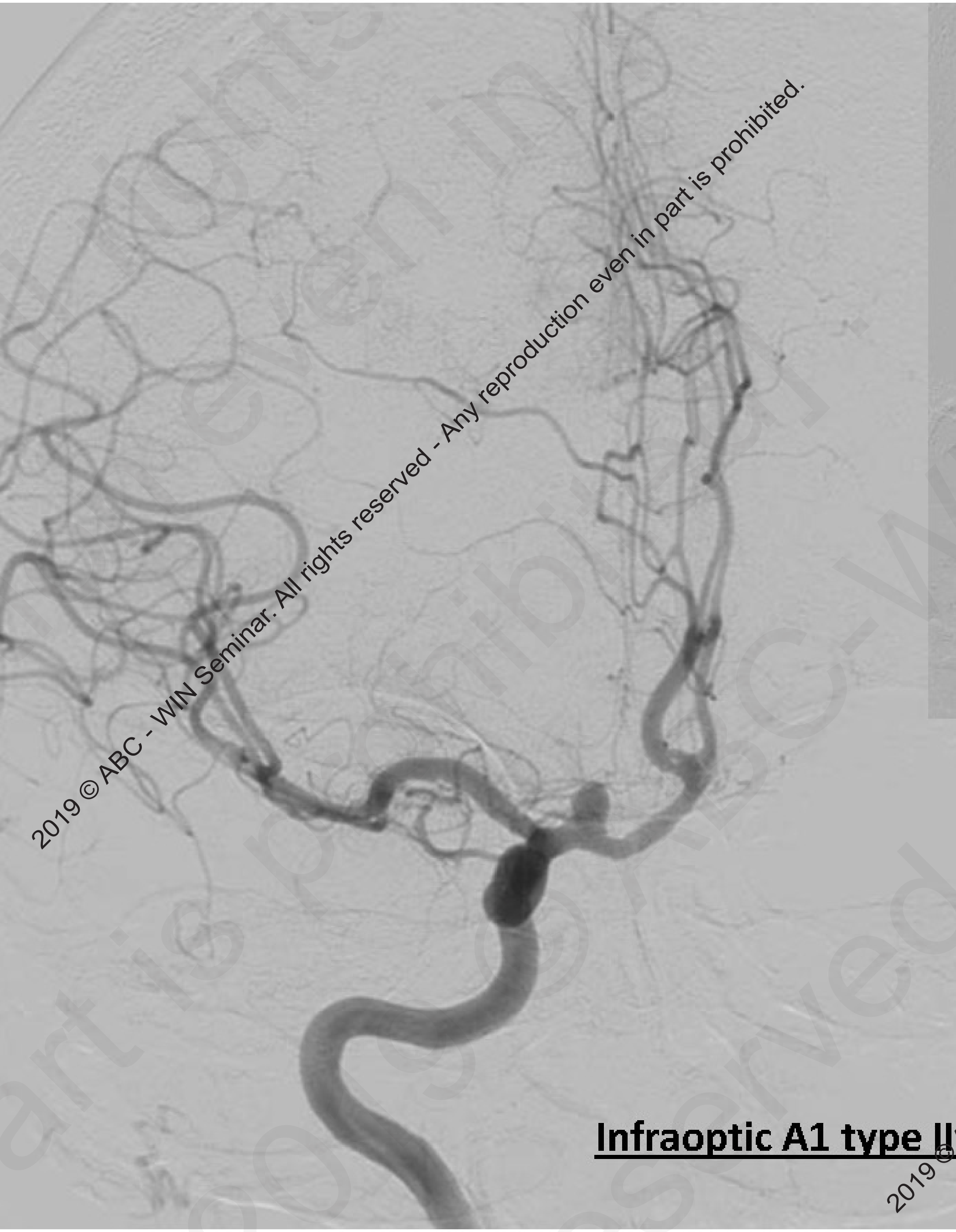
Infraoptic A1 type II, internal carotid artery bifurcates at ophthalmic artery level, forming an infraoptic but no sovraoptic segment.

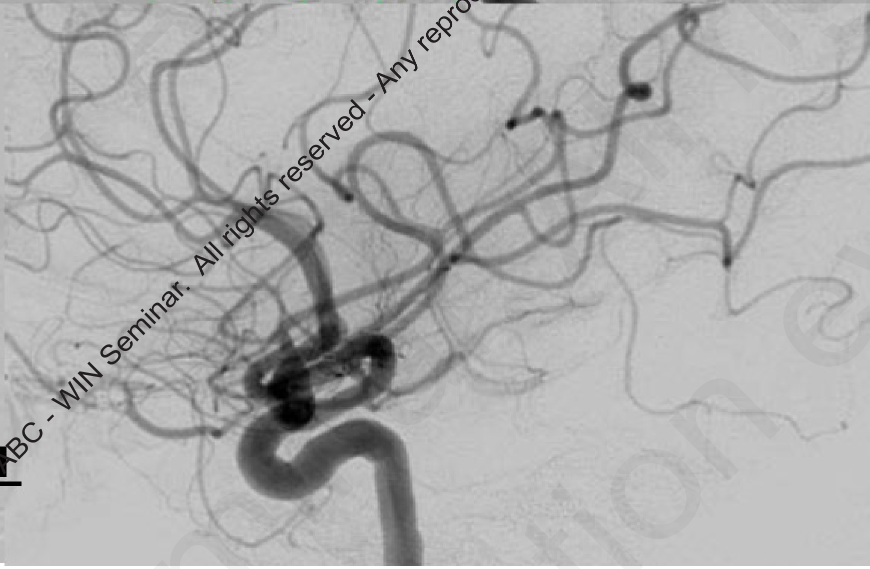
Infraoptic A1 type III is similar to type II with no contralateral A1.

In both type II and III variants, infraoptic A1 represents the only supply to distal anterior cerebral artery (carotid-anterior cerebral anastomosis)



St Wong Acta Neurochir (2008)





Infraoptic A1 type III

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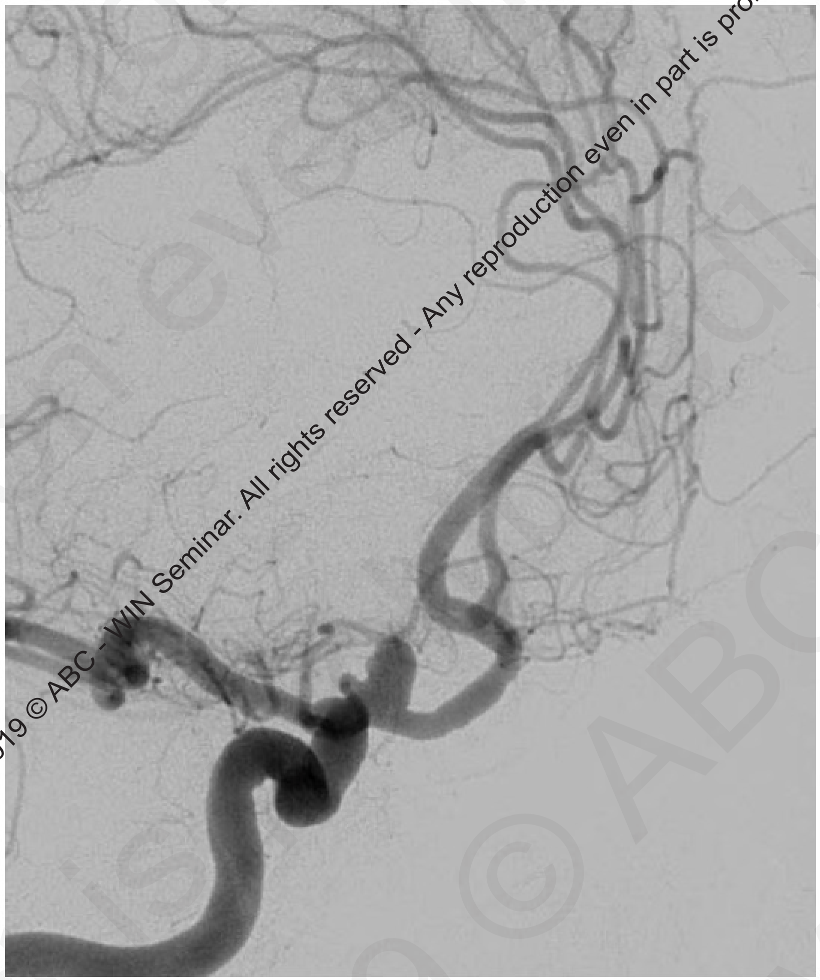
infra-optic segment of A1



four features

- the anomalous artery branches off from the internal carotid artery at the level of the ophthalmic artery
- the anomalous artery runs below and then medial to the ipsilateral optic nerve;
- anastomosis with the normal supraoptic A1 (carotid-ACA anastomosis) nearby the anterior communicating artery
- the anomalous artery supplies the vascular territory of a normal anterior cerebral

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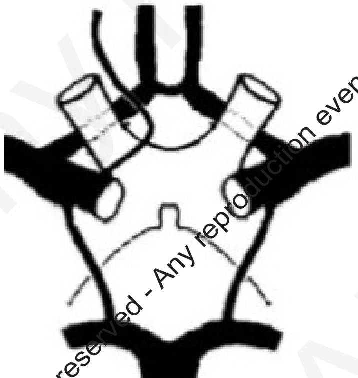
Infraoptic A1 type IV

accessory anterior cerebral artery variant

- infraoptic accessory anterior cerebral artery give rise to the ipsilateral orbitofrontal artery and frontopolar artery

- No anastomosis between infraoptic accessory anterior cerebral artery and ipsilateral supraoptic A1 segment.

It may be considered as an infraoptic origin of orbito frontal-fronto polar artery



Type IV

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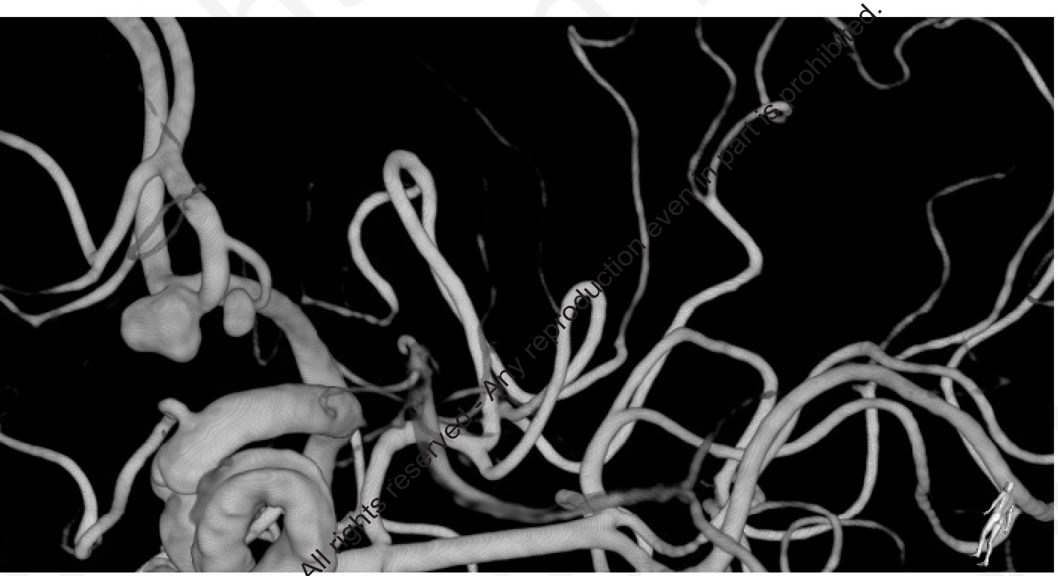
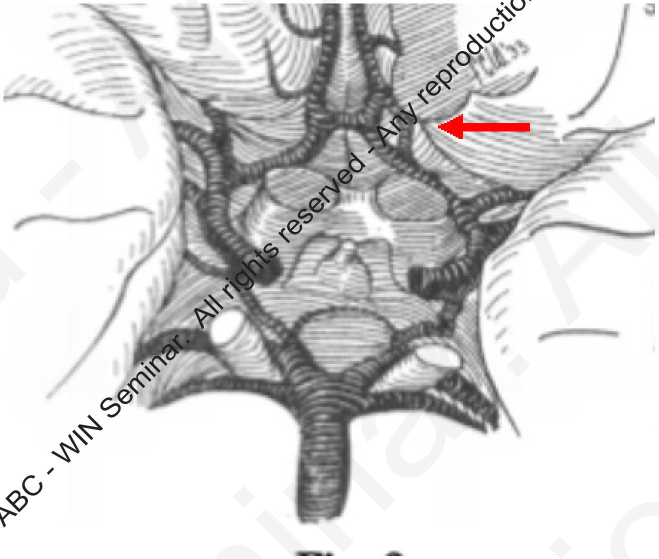


Fenestration at A1-A2 angle may be considered as the residual origin of primitive olfactory artery

Phylogenetic model

Orang-utan. The two anterior cerebral arteries run parallel to each other and are joined together by a thick anterior communicating artery. In addition, a *loop is present in the left anterior cerebral artery,*

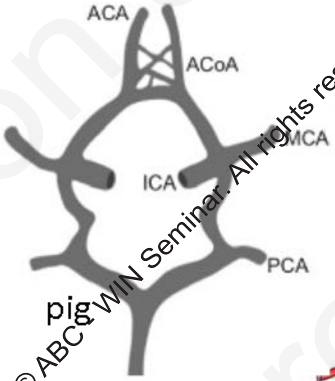


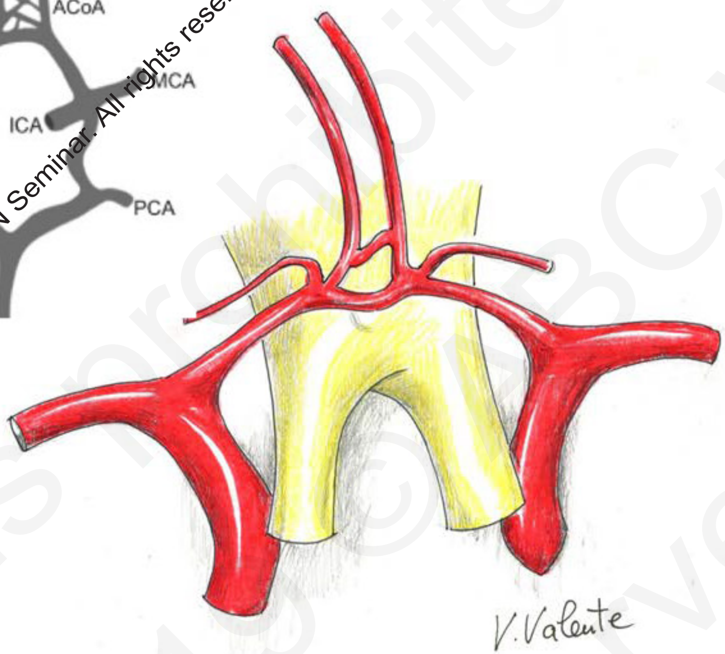
Ophthalmic artery arising from A1

Deriving from PVOA (primitive Ventral ophthalmic artery) , arising from the future anterior cerebral a.

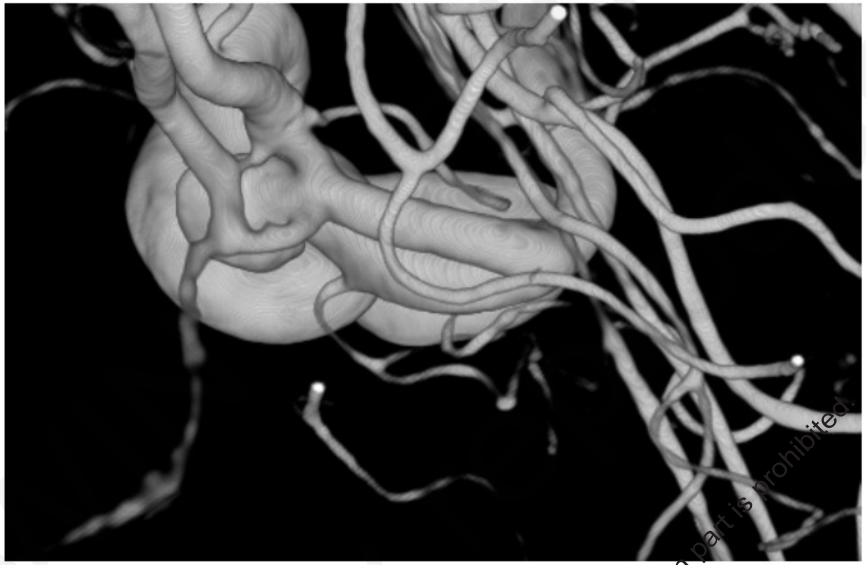
Development anomalies
AcomA

<u>Duplication or triplication</u> **of the AcomA (one third of patients, one tenth of patients respectively)follow the embryological model of inter-communicating multichannel plexus**



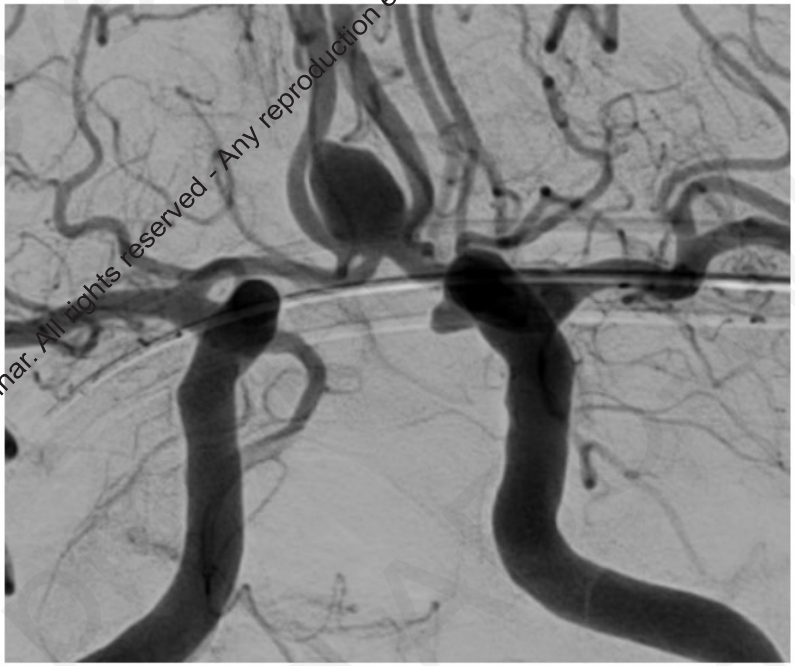


AcomA Duplication



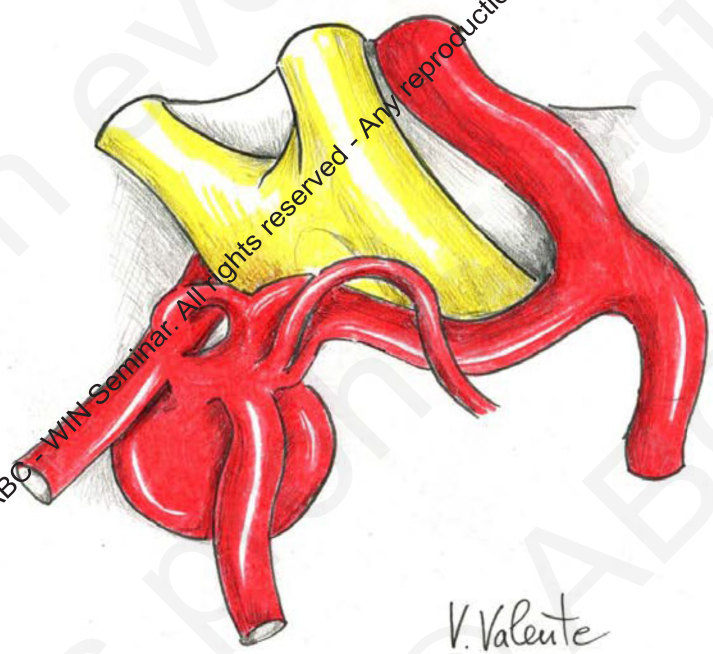
AcomA fenestration

incomplete fusion of the arterial intercommunicating plexus.
This process is responsible for a wide variety of anomalies.

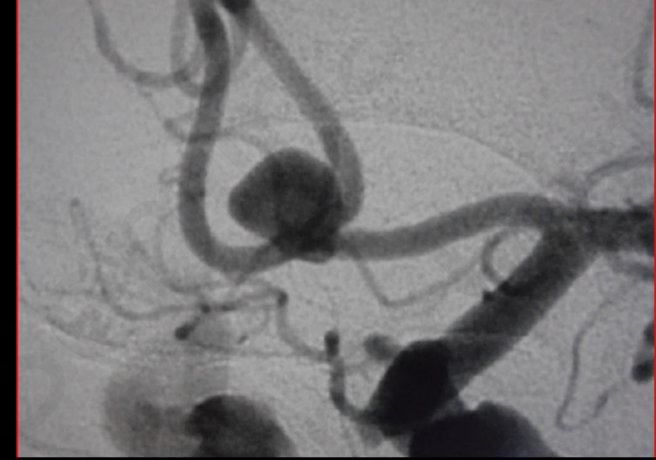
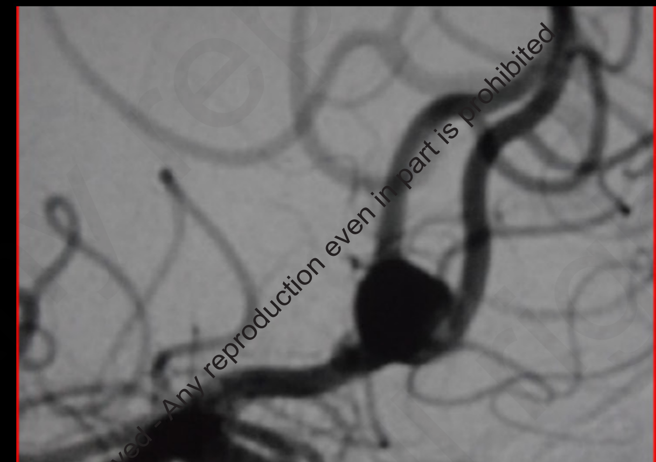


single, double, or even triple fenestrations of the AComA in up to 40% of specimens.

3D rotational angiography is the gold standard for their diagnosis



The presence of Fenestrations and duplications in the anterior communicating artery must be carefully recognized due to their difficut surgical treatment and increased operatory risk during endovascular procedures (perforation during endovascular navigation and stenting)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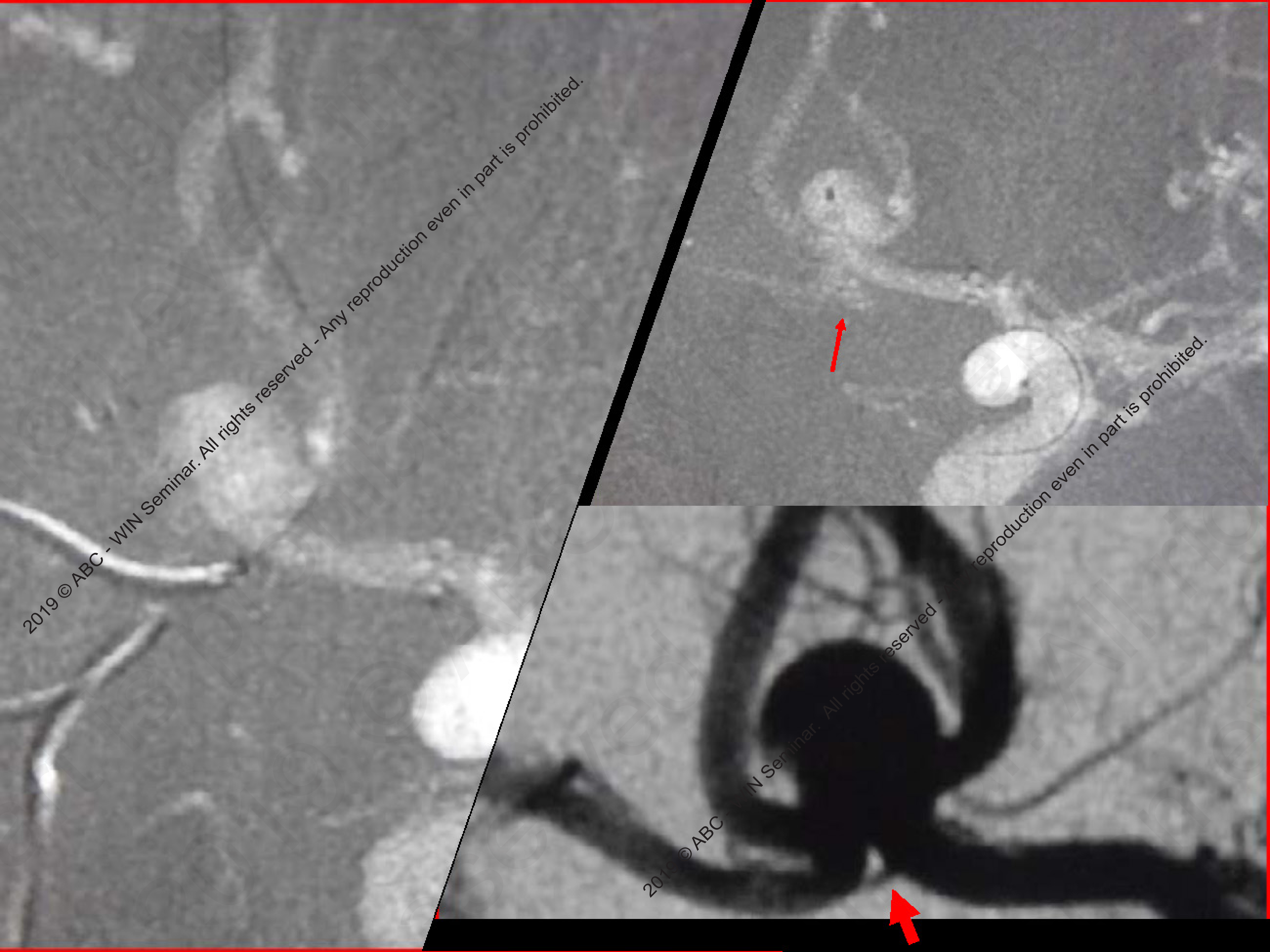

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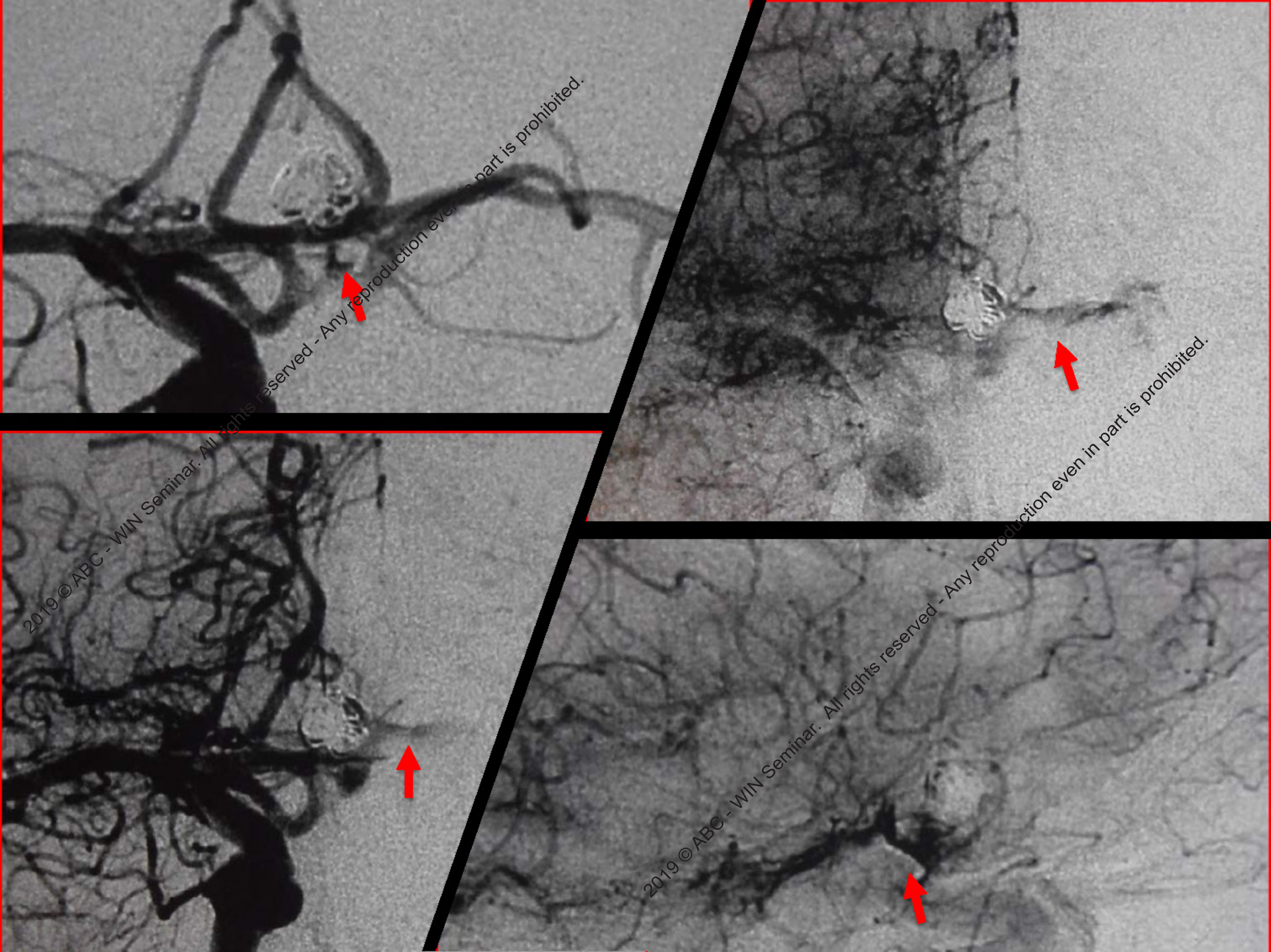
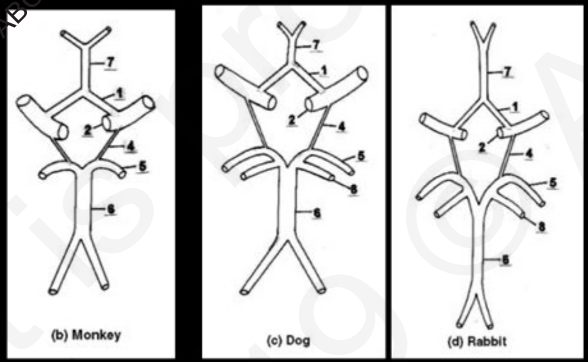


Development anomalies
A2 segments

The midline fusion is on of the possible phylogenetic models of

intercommunication between A1 tracts

- Azygos artery



A2 anomalies may present in different morphological **variants**, which may origin during **different phases of embryological development**

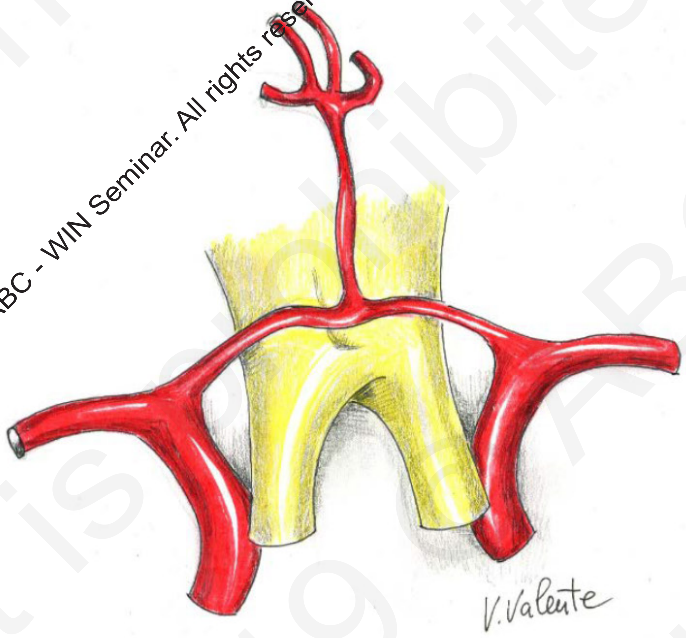
- **midline fusion of A2 segments**, originating from the medial branch of the olfactory artery at the 16-mm stage of embryogenesis
- **persistence of the median artery in the corpus callosum** (20–24-mm stage)

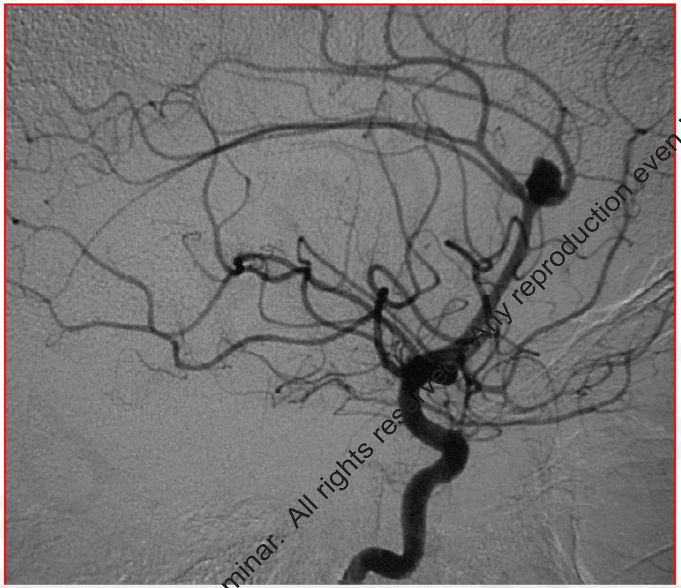
Azygos Type 1

a single unpaired ACA,

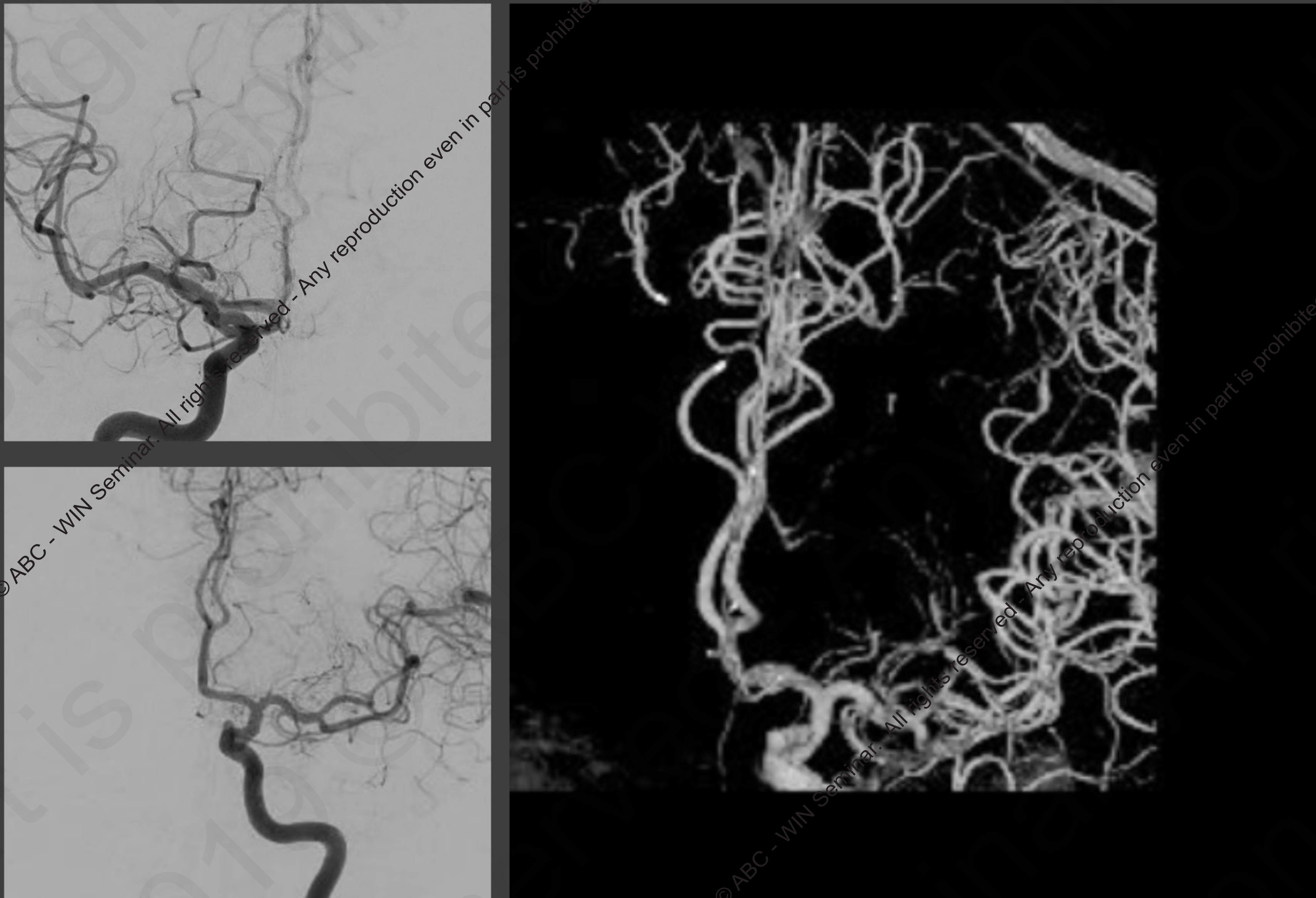
Both A1 segment give origin to an unpaired single median artery

That supplies bilateral cortical anterior cerebral vascular territories





- fusion of the A2 segments,



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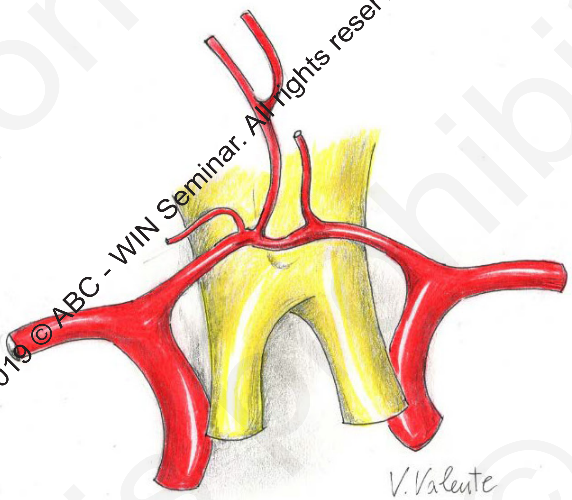
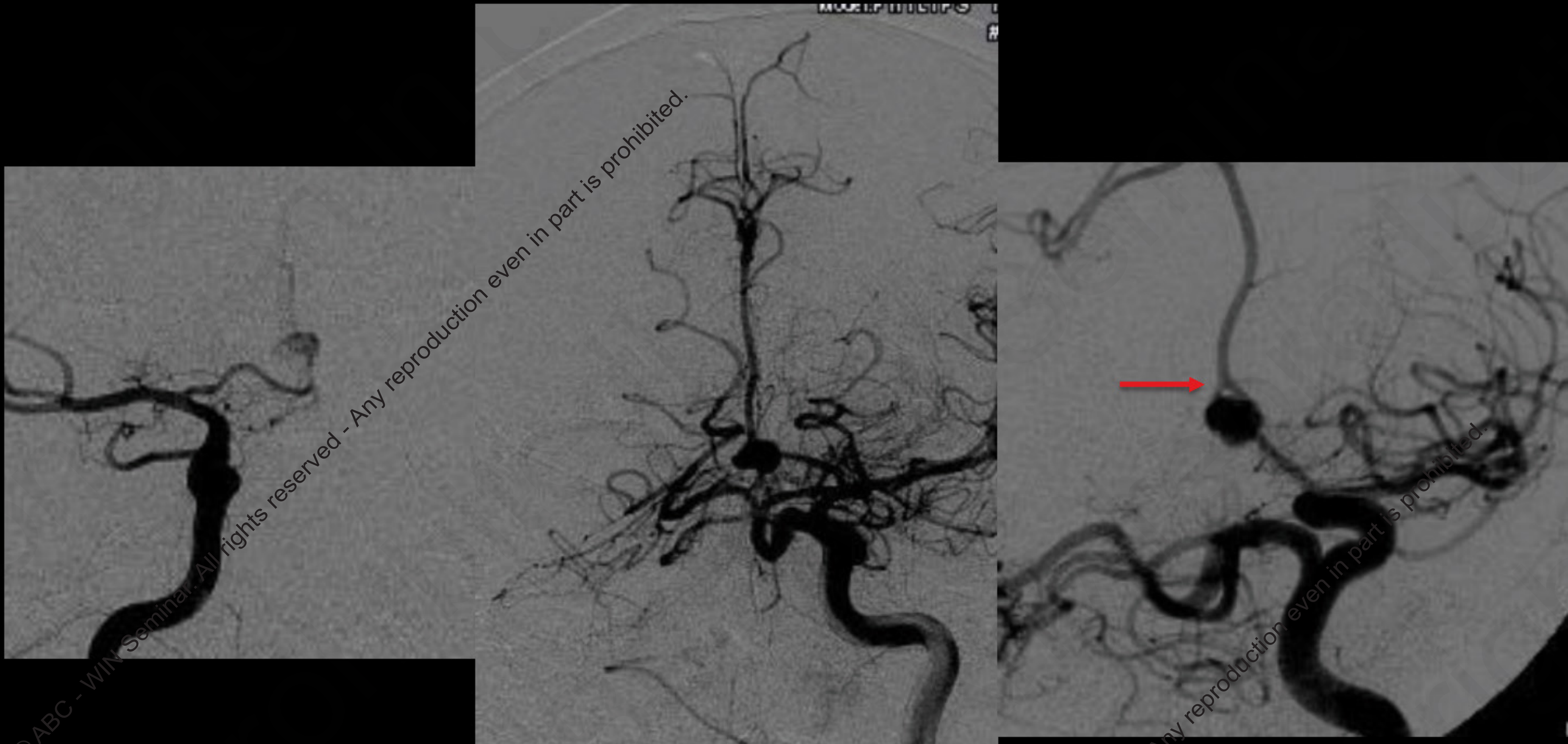
Azygos type 2

“bihemispheric” ACA (12% patients): one side A2 segment branches running across the midline to both hemispheres, with contralateral A2 segment either hypoplastic or with a short course towards the genu.





AZYGOS type 2 (bihemispheric) with A2 fenestration distal to an AcomA

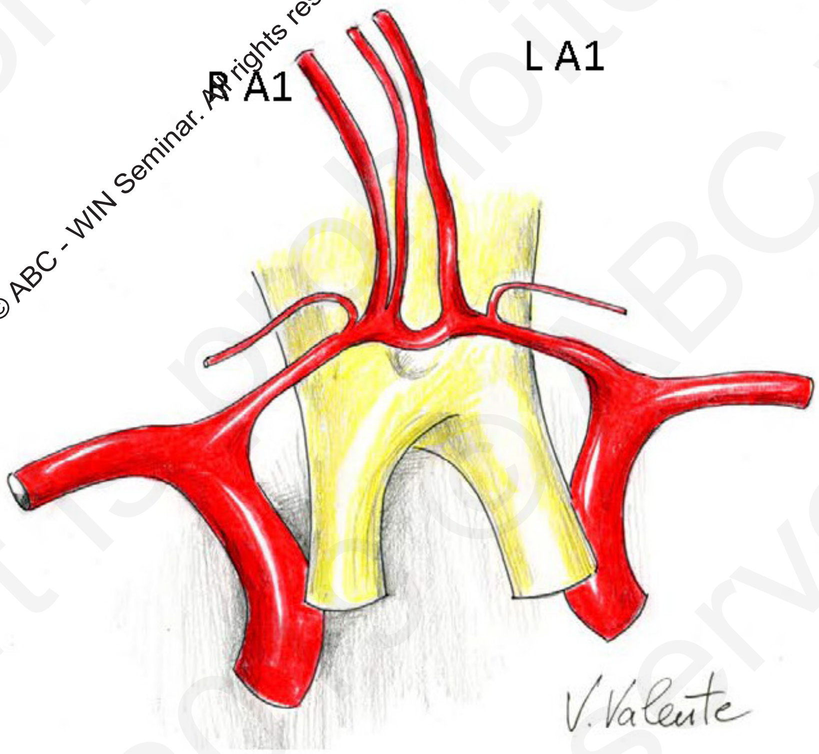
Saccular cranial oriented aneurysm

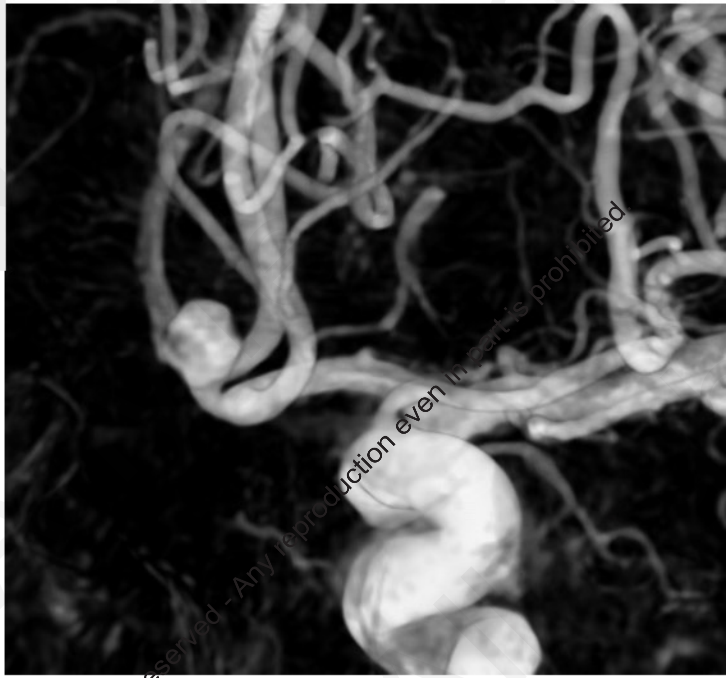
Azygos Type 3 :

(ACCESSORY ACA or pre callosal artery)

presence of a median artery interposed between normal A2 Tracts .

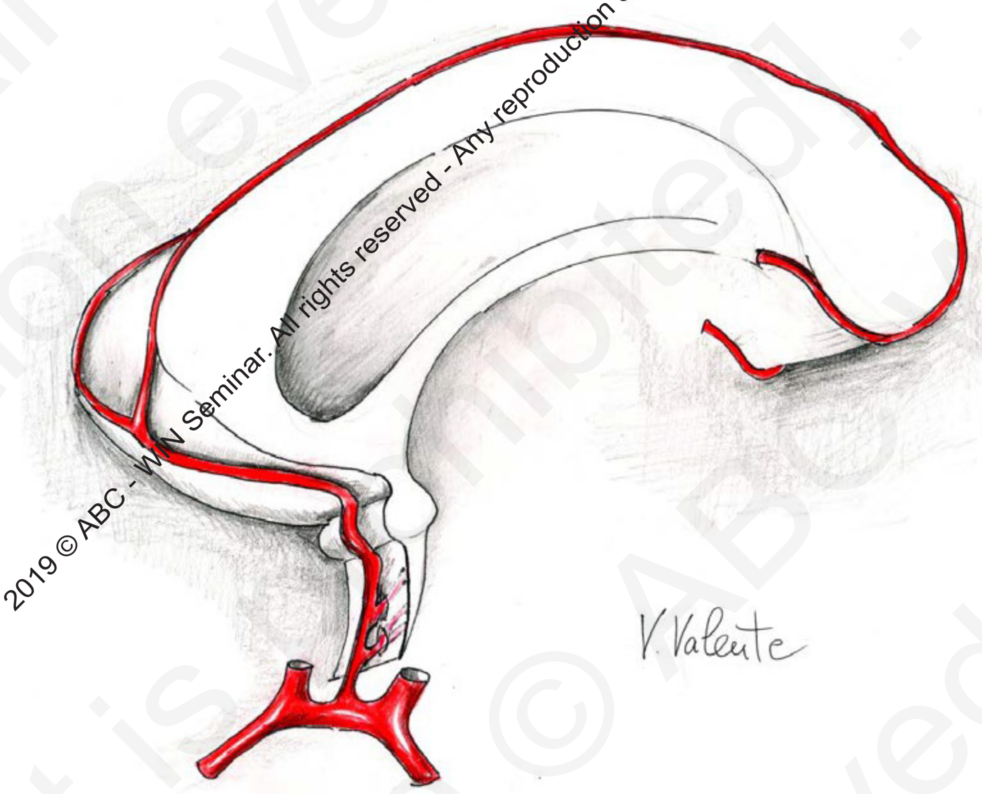
The **third artery, called Precallosal artery or Accessory ACA**, takes its origin from the AComA and may be considered an hypertrophic Median artery of the corpus callosum (MACC)





THIRD ANTERIOR CEREBRAL ARTERY
(PRECALLOSAL ARTERY)

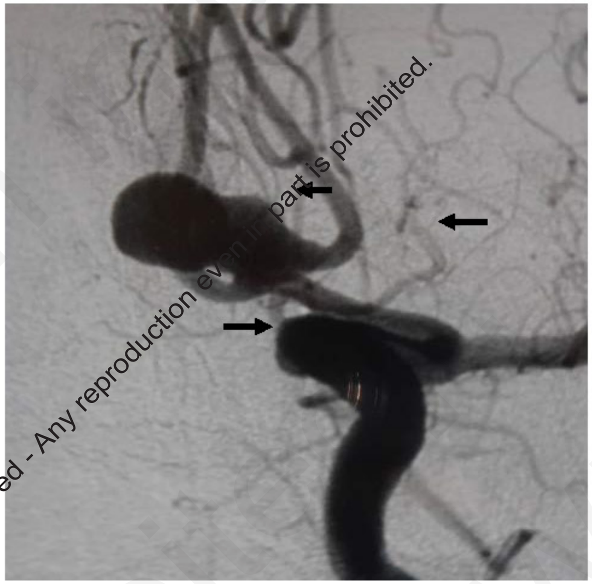
A.Corporis mediana callosi (MACC)

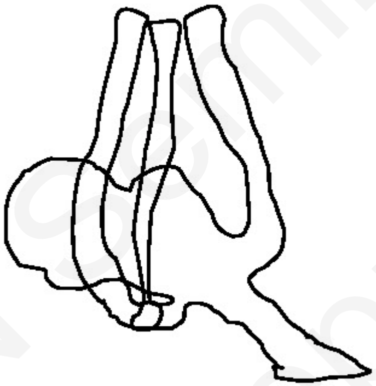


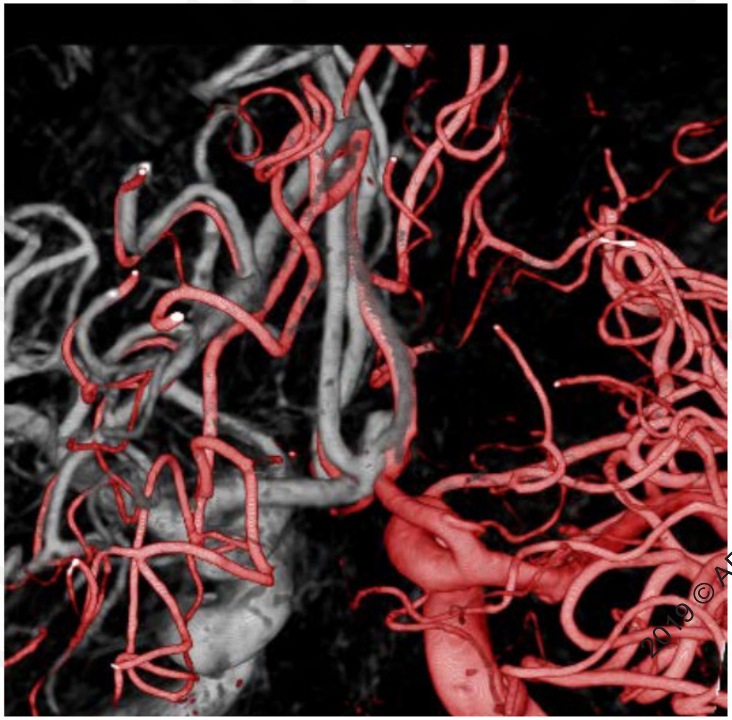
Embryogenesis

MACC originates during (44 days)

MACC regresses and disappears as A2 segments mature, but remnants account for the accessory ACA.







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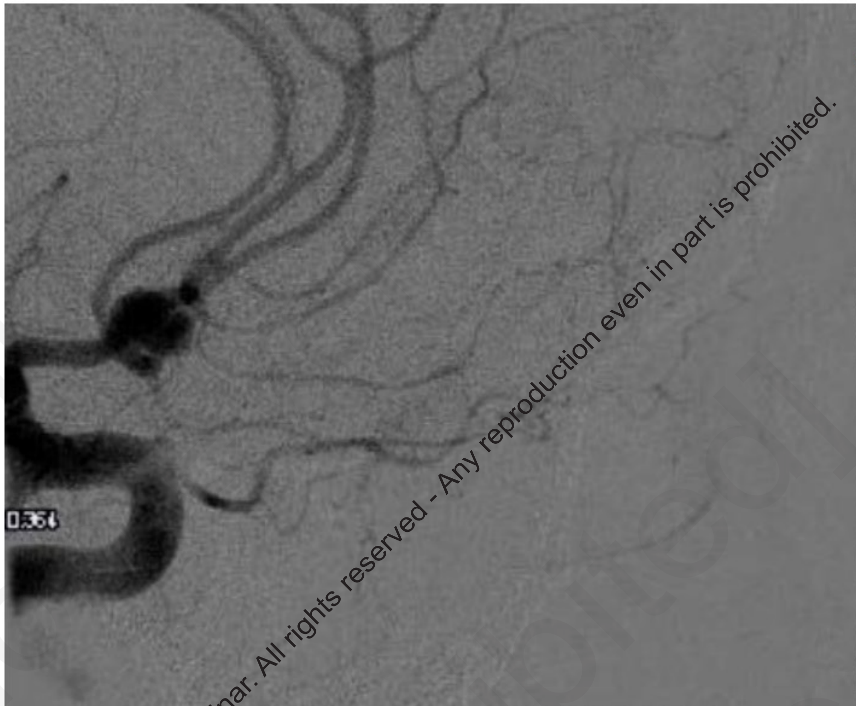
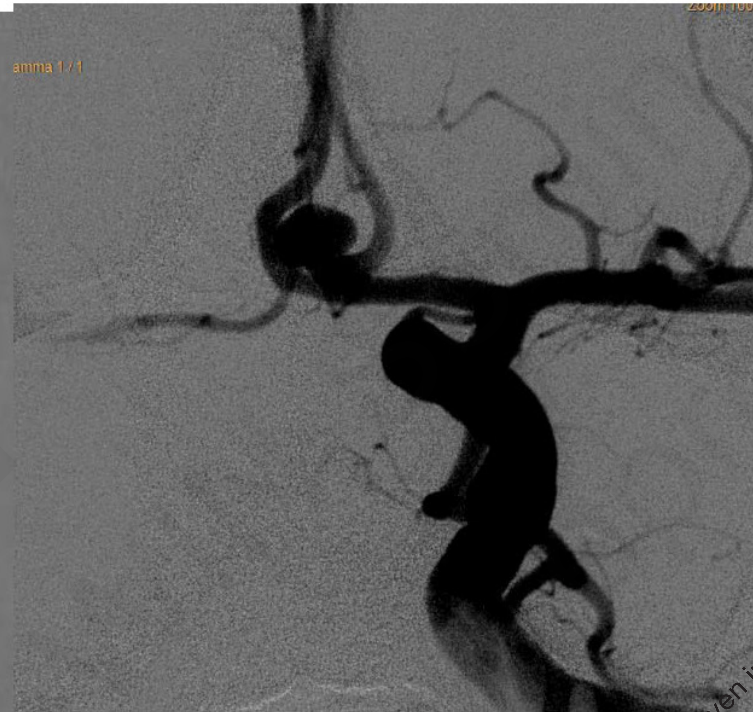
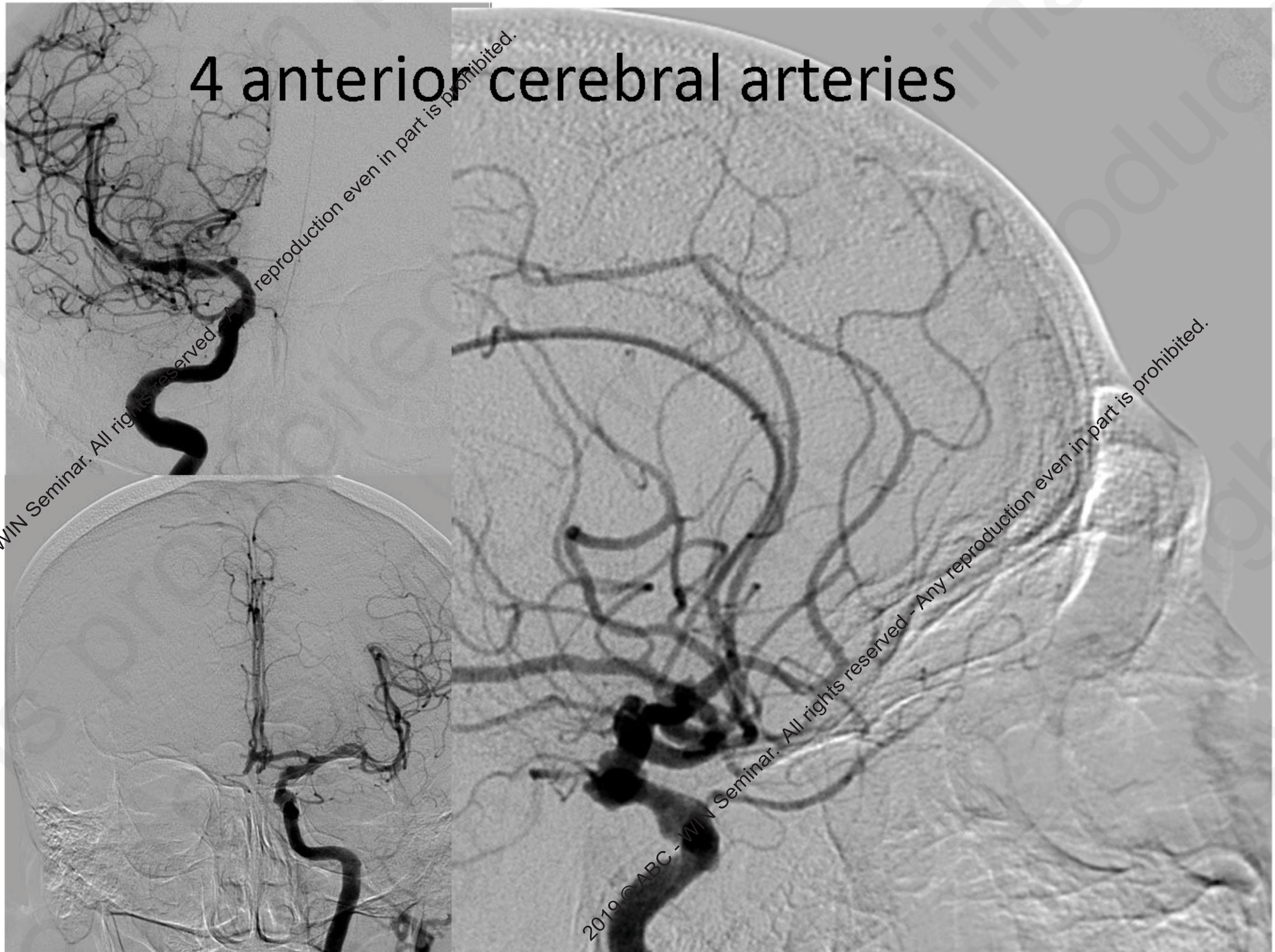




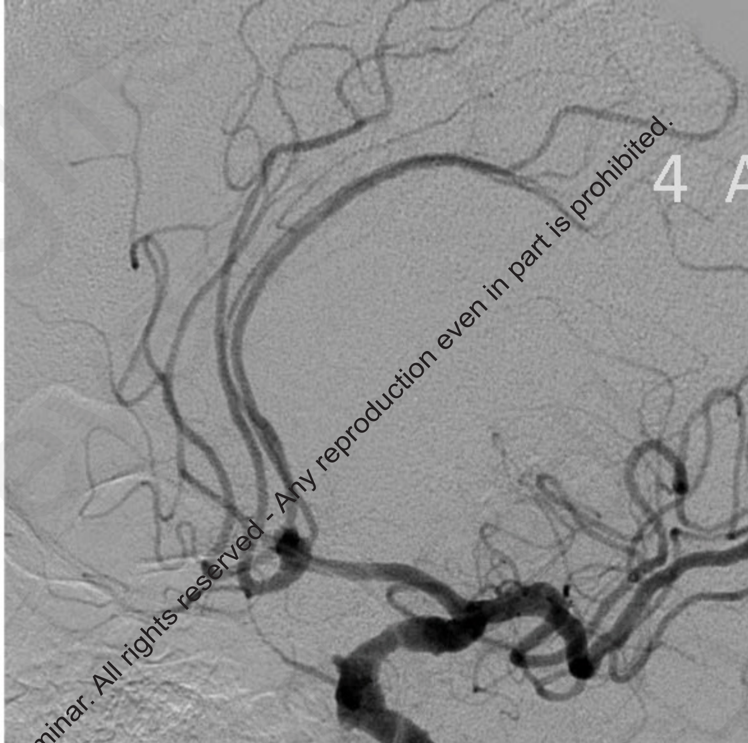
in this case the **accessory anterior cerebral** artery takes its **origins from A1** (that bifurcate in 2 branches):

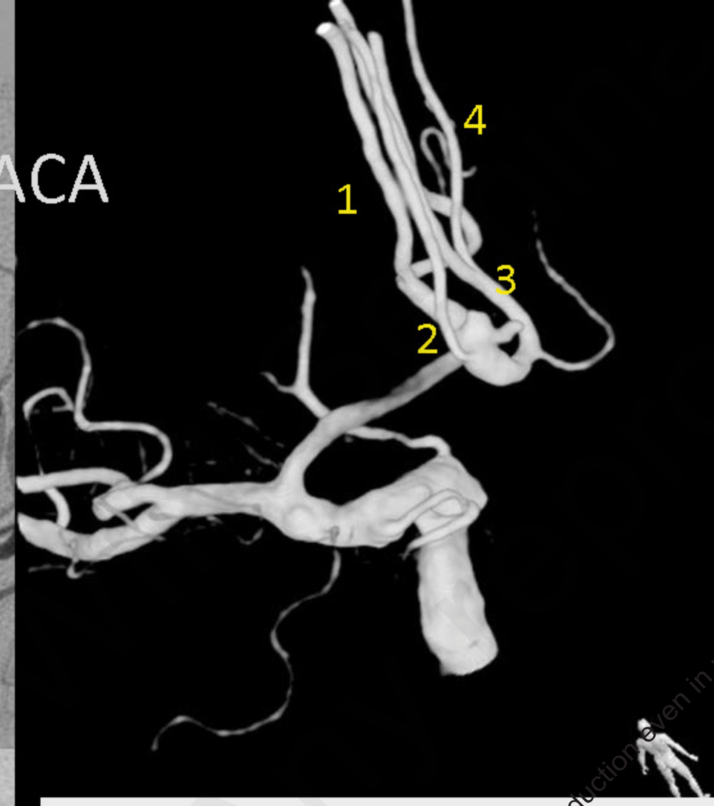
- the first one (1) direct towards the AcomA is the normal A1 tract
- the second one (2) that does not interfere with AcomA passes distally to give the ipsilateral orbitofrontal artery and frontopolar artery superior frontal artery

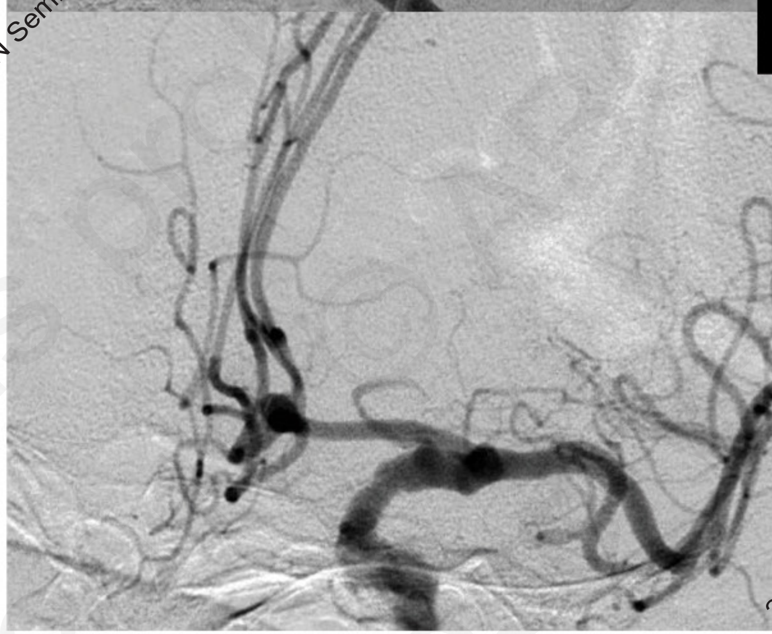
4 anterior cerebral arteries



4 ACA



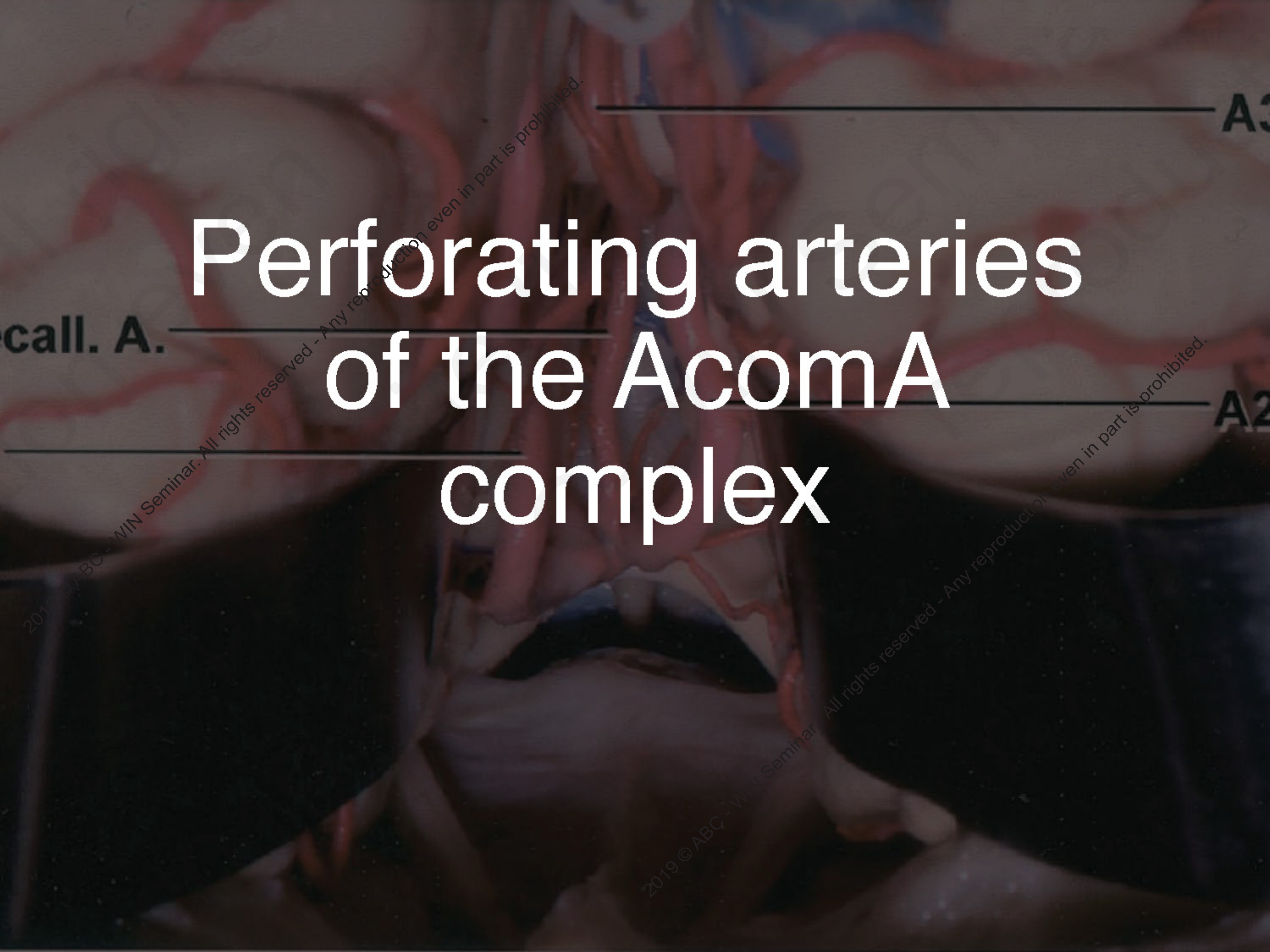




Contralateral A1 agenesia
All 4 arteries have origin from the AcomA

2 pericallosal arteries
2 arteries with prevalent distribution to the marginal callosum area, where they give origin to the frontal orbital arteries

Perforating arteries of the AcomA complex

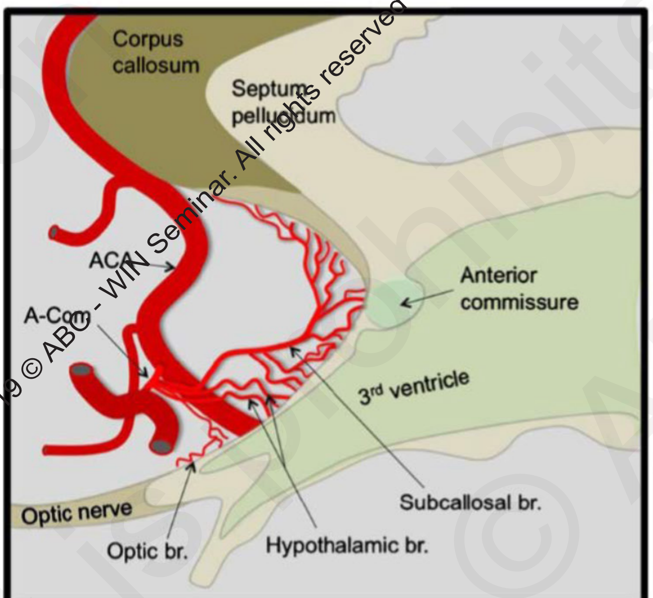


- **medial olfactory** artery becomes the ACA proper give origin to the **Hypotalamo chiasmatic branches** (Lasjaunias) or anterior diencephalic arteries (Lang)
- **Lateral olfactory artery of the POA** include the stiato cortical branches
- **recurrent artery of Heubner,**
- anterior choroidal artery,
- lateral striate artery,
- the lateral MCA

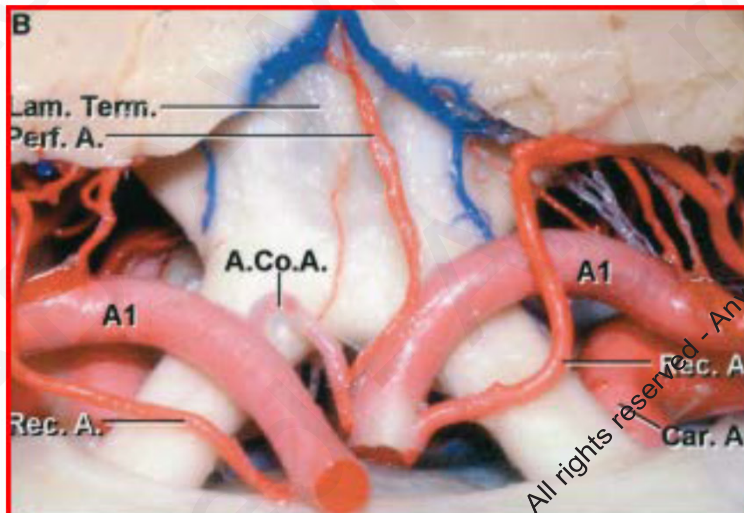
- **According to the embrylogical origin the ACA the perforator arteries are classified as arteries Hypotalamo Chiasmatic branches (MOA) striato cortical branches (LOA)**

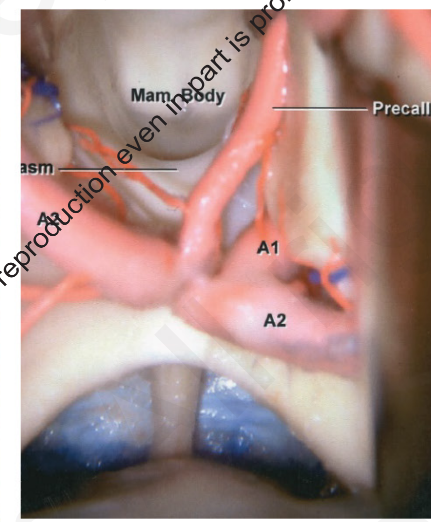
Hypothalamus perforators

from the ACoA's superior and posterior surfaces and ascend to the hypothalamus, it supplies the **median paraolfactory nuclei, genu of corpus callosum, columns of the fornix, septum pellucidum,**

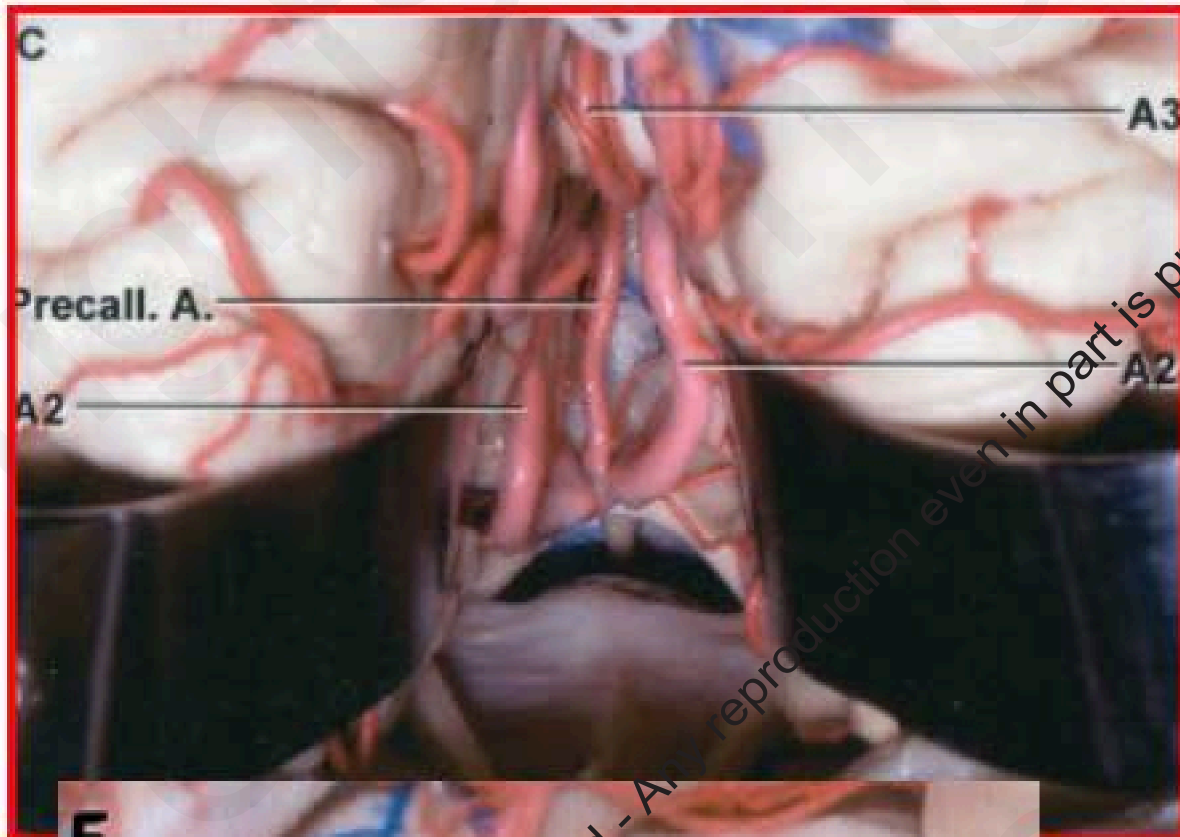


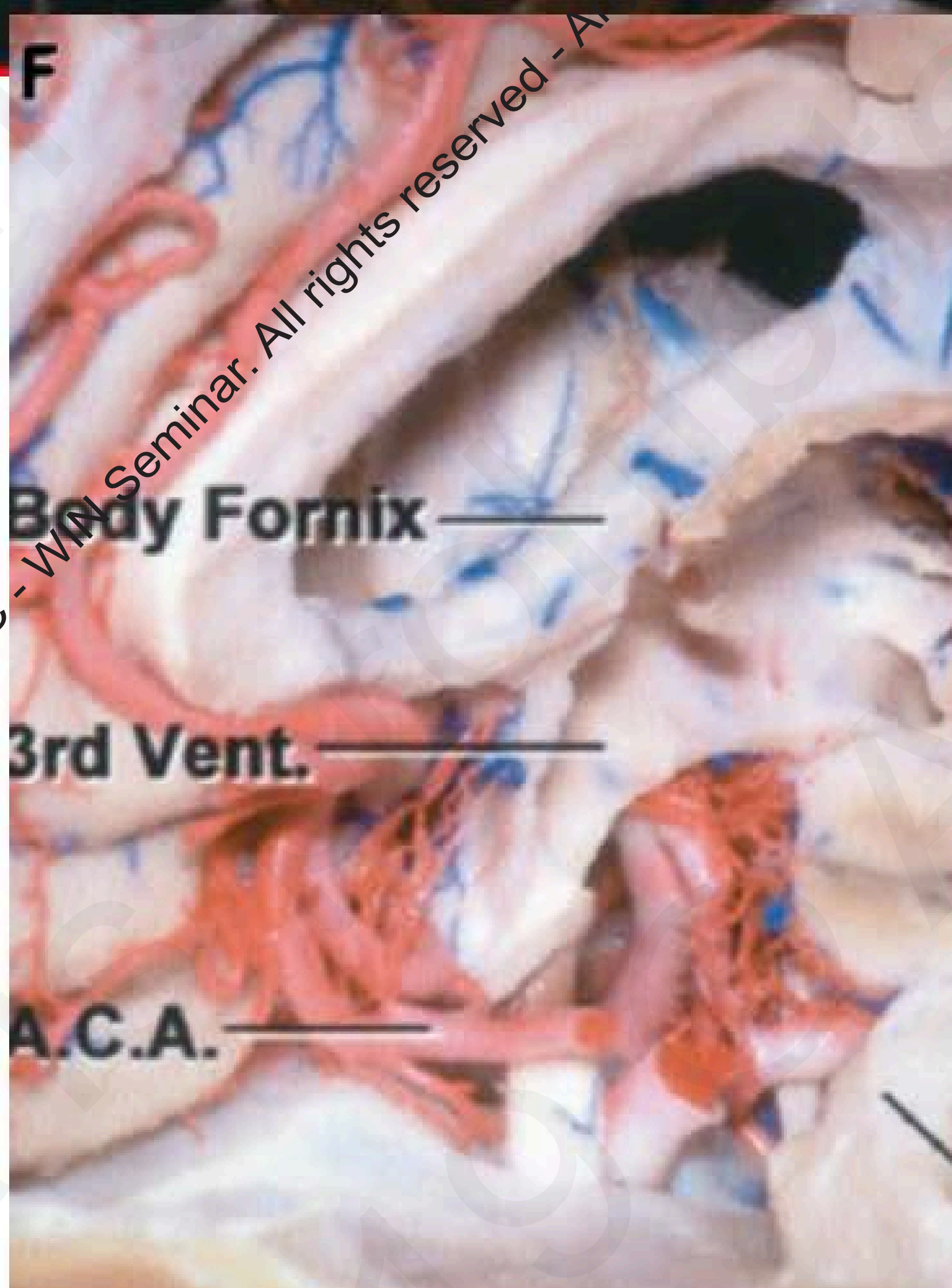
Dan Mella et al
Sub callosal artery stroke: infarction of the fornix ..
Interventional Neuroradiology

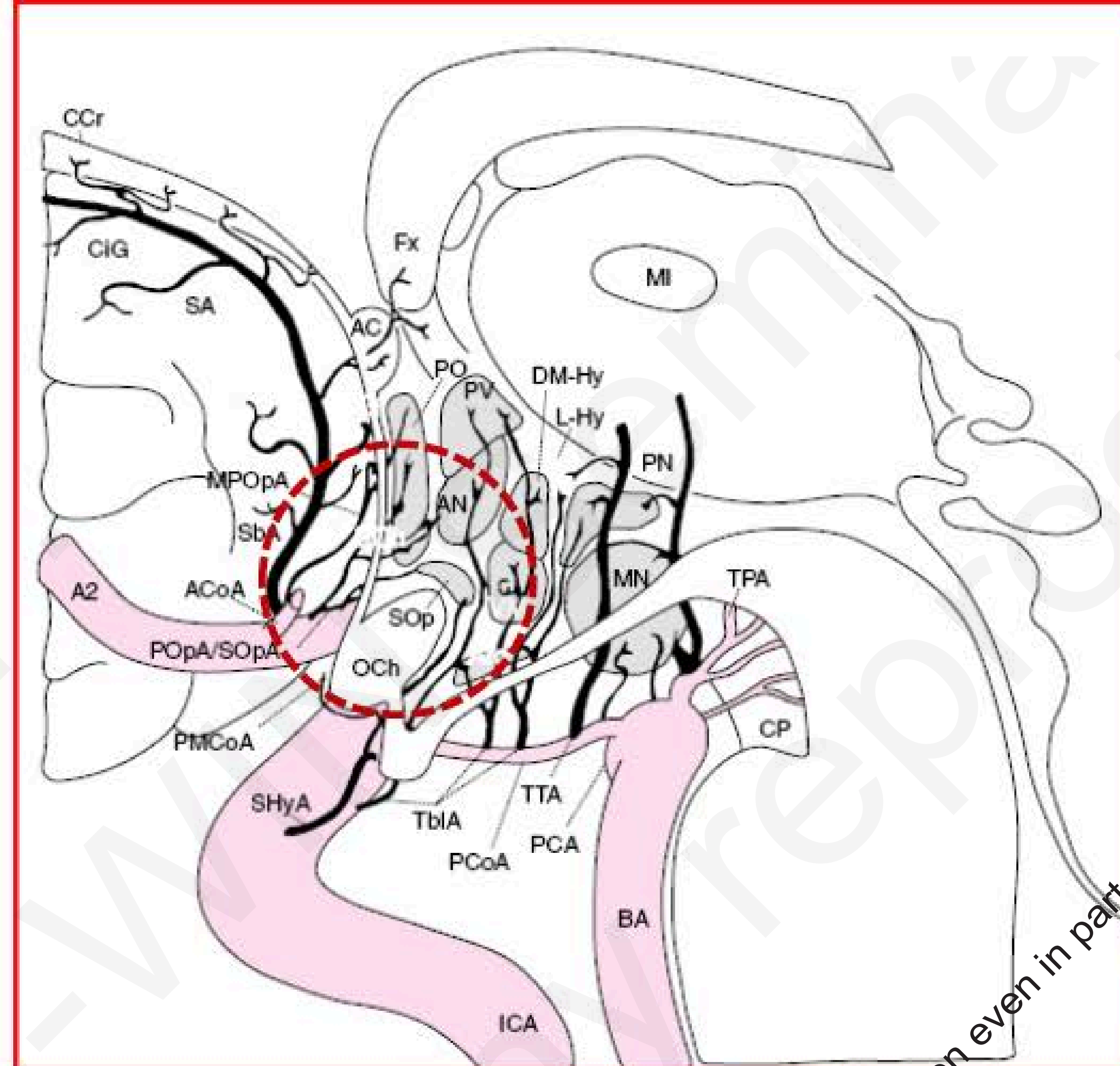




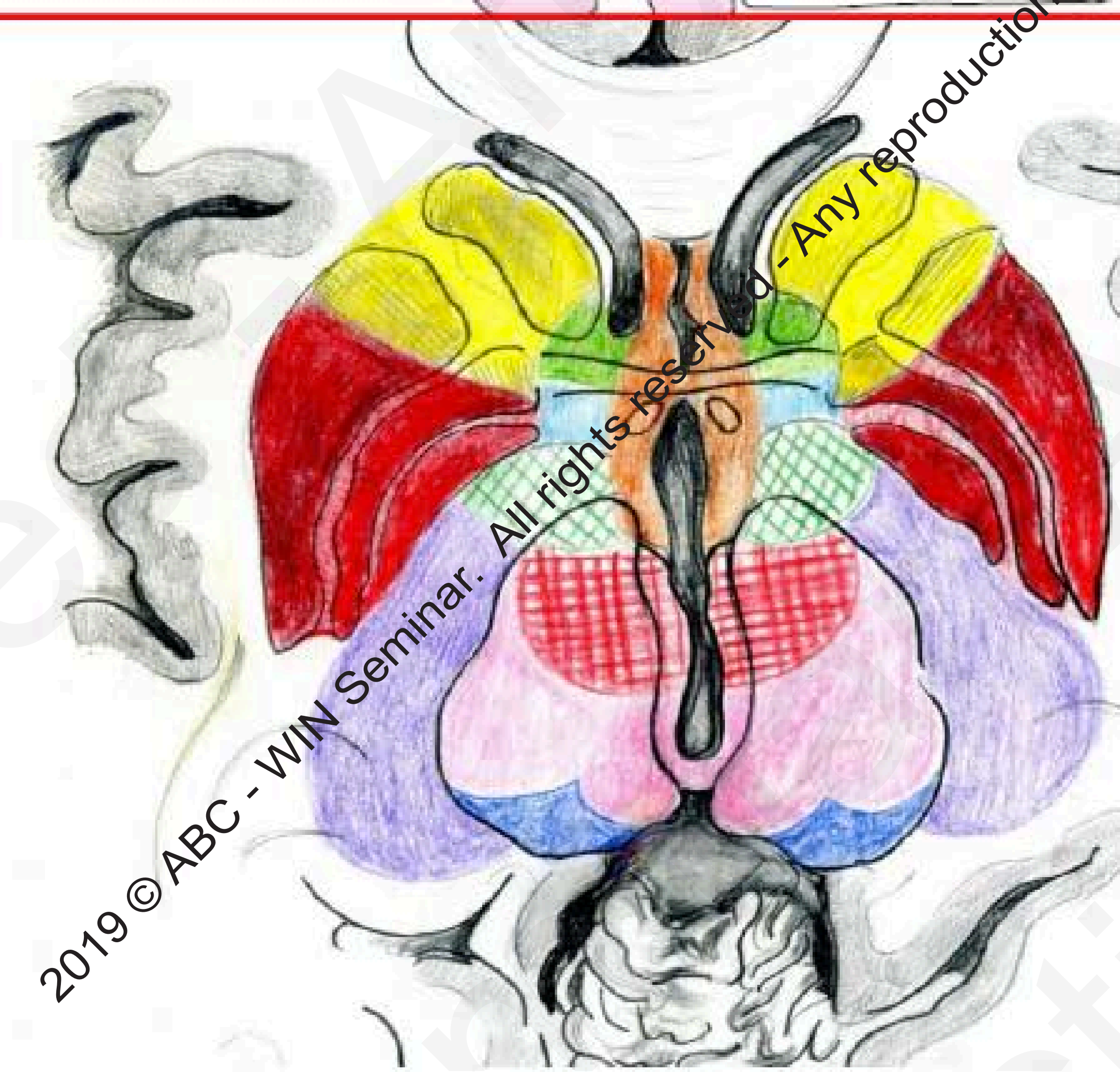
From: Rhoton, Neurosurgery 51: 53 (2002)







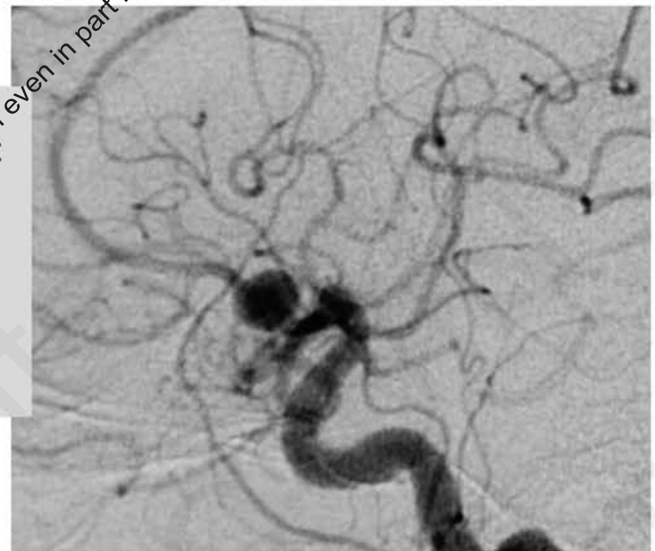
Takahashi Neurovascular Imaging

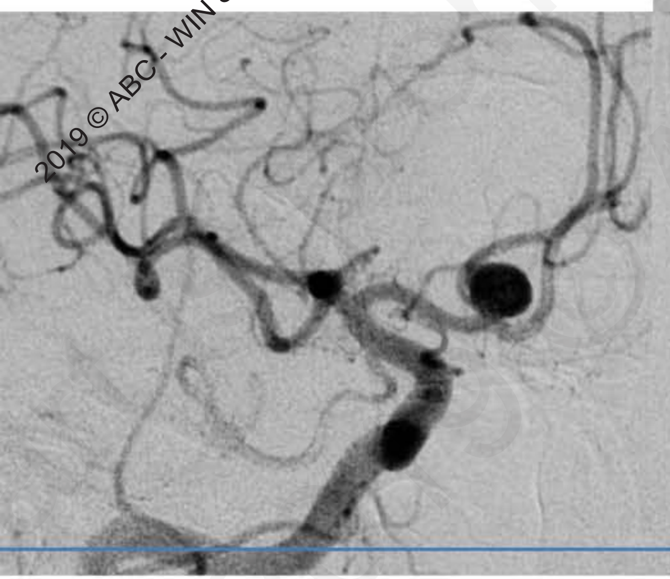


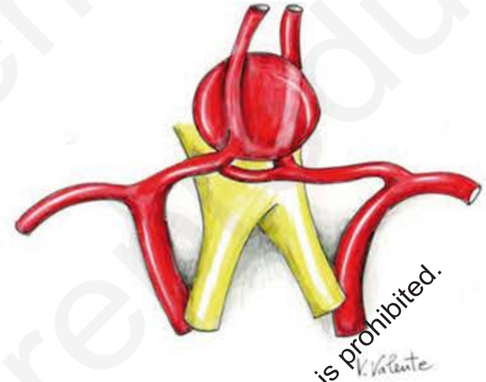
The piercing branches of the anterior communicator pass to the diencephalon through The region of the lamina terminalis.

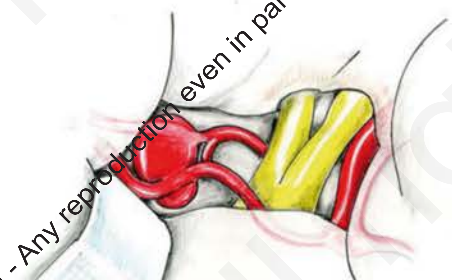
Challenging aneurysm for surgery
(supero-posterior projection;)

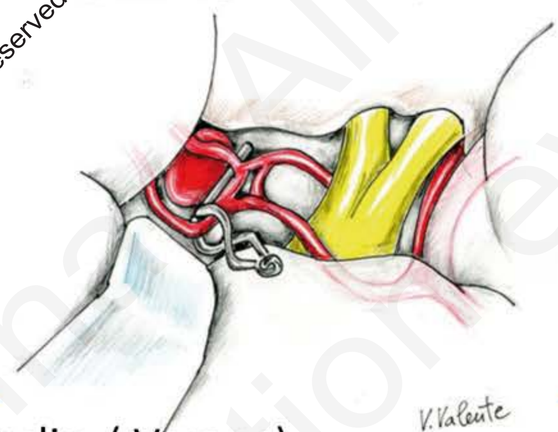
- intimately associated with the infundibular and hypothalamic perforators
- both A2 segments may be densely adherent to the body of the aneurysm





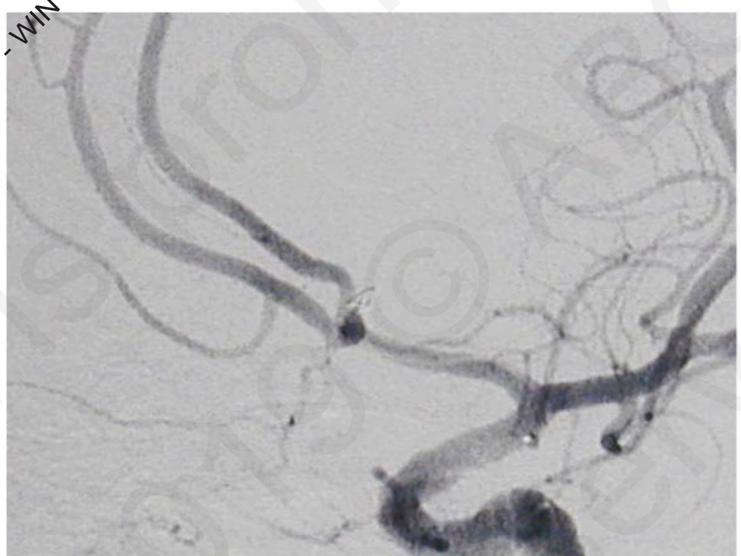


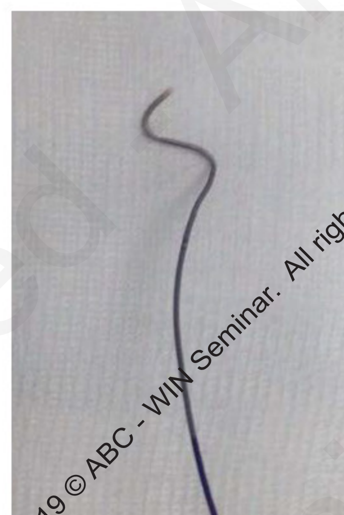




Courtesy prof Pasqualin (Verona)

And for embolization too





Courtesy Dr C.Cristaudo (Catania)

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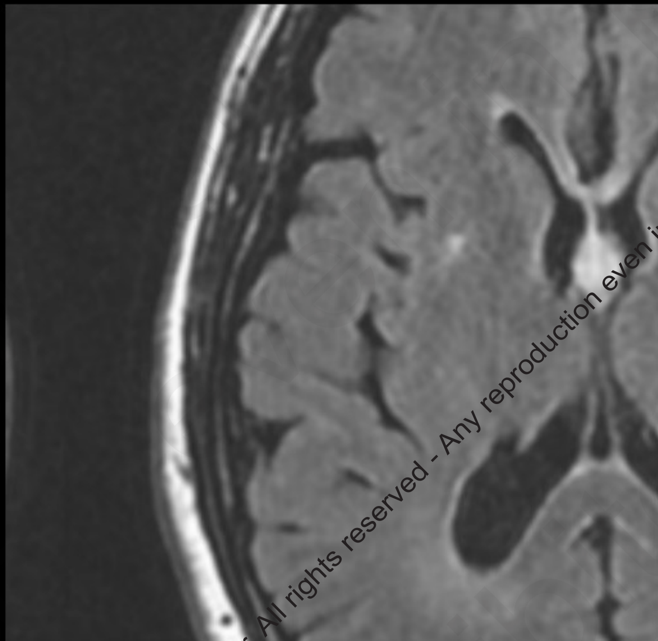
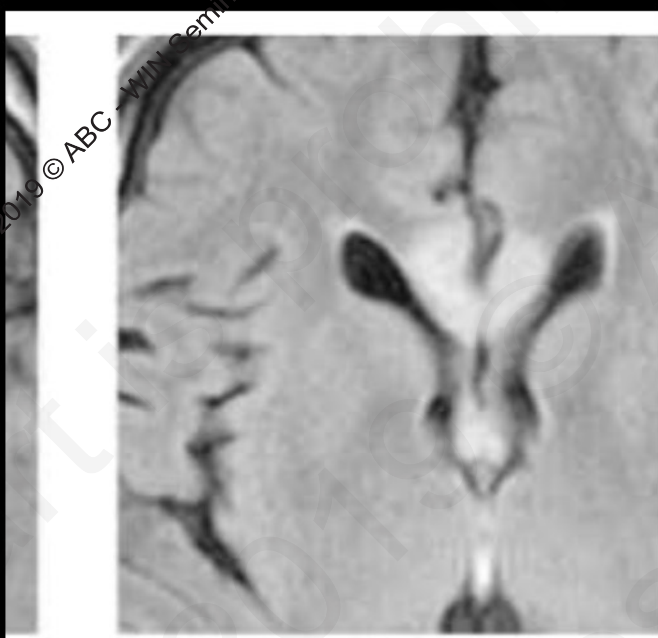


INTERVENTIONAL NEURORADIOLOGY

Subcallosal artery stroke: infarction of the fornix and the genu of the corpus callosum. The importance of the anterior communicating artery complex. Case series and review of the literature

Dan Meila · Guillaume Saliou · Timo Krings



ScA's interruption, especially during aneurysm surgery, may be followed by neurological and neuropsychological deficits.

- First, an acute phase of confusion with subsequent anterograde amnesia because of the involvement of the anterior columns of the fornix.
- Suffering of the genu of the corpus callosum, as seen in most of the cases, contribute to the presentations of the sudden-onset Korsakoff's syndrome (amnesia anterograde , mental confusion and confabulation)

ScA clinical symptoms

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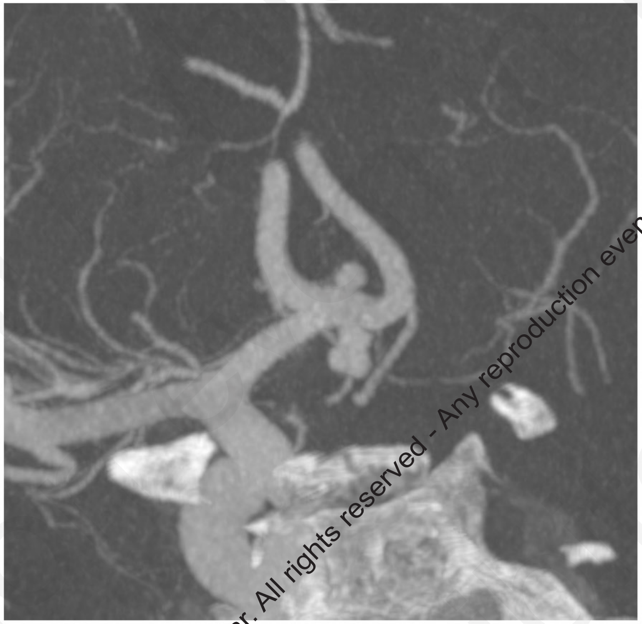
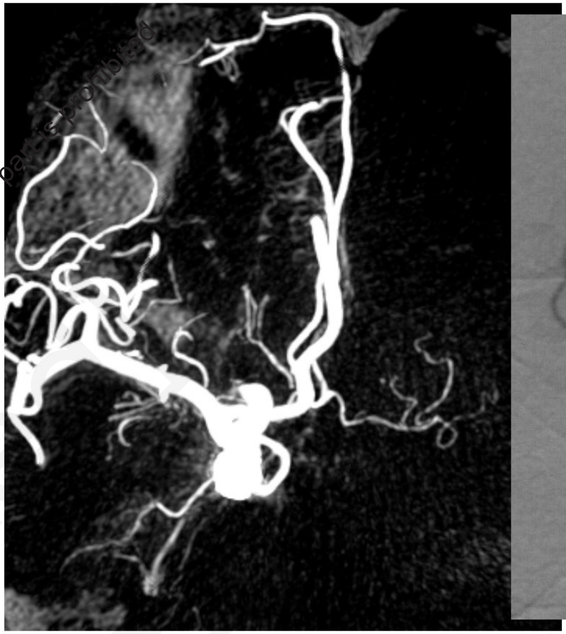
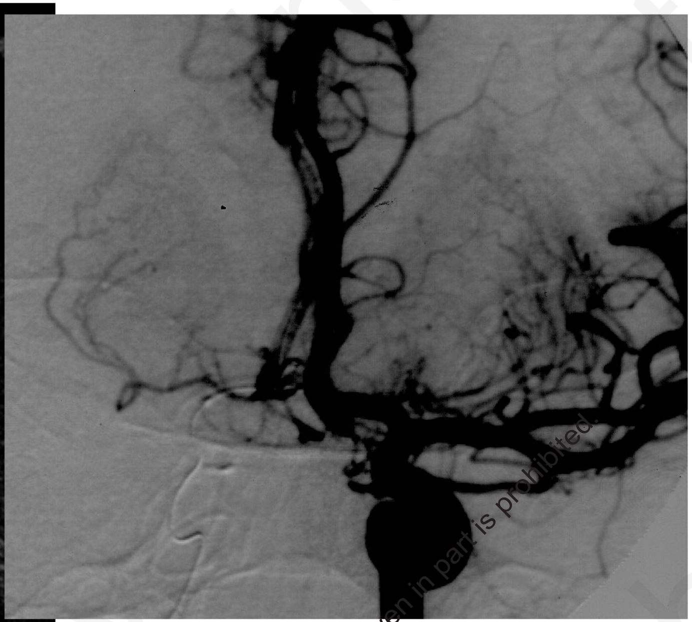
Perforators for optic chiasm

- Perforators originate from the anterior and inferior aspects of the ACoA and descend to the dorsal optic chiasm.

The recurrent of artery of Heubner derives from the primitive olfactory artery (**lateral olfactive artery**) that presents a perforators

- RAH arises at the junction of the A1 and A2 segments and passes laterally above the bifurcation of the carotid artery to be distributed to a long strip of the anterior perforating substance. It commonly loops forward on the gyrus rectus.

absent in 1.26 % of cases. single RAH in 96.22 % o, double in 2.38 %and triple in 0.14 % of cases.

RAH may take origin from

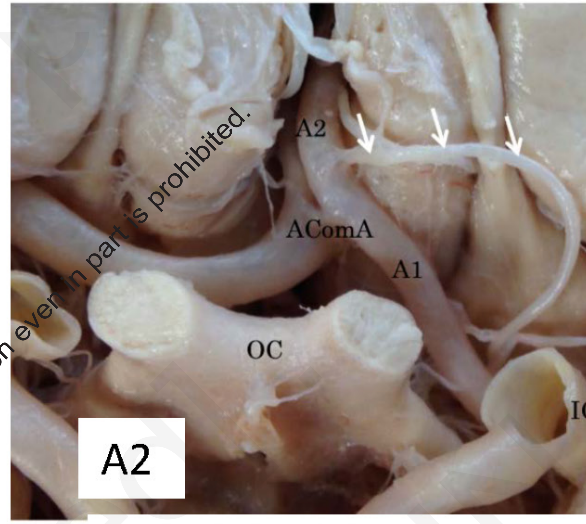
the junction of the A1 and A2 segment of the ACA.

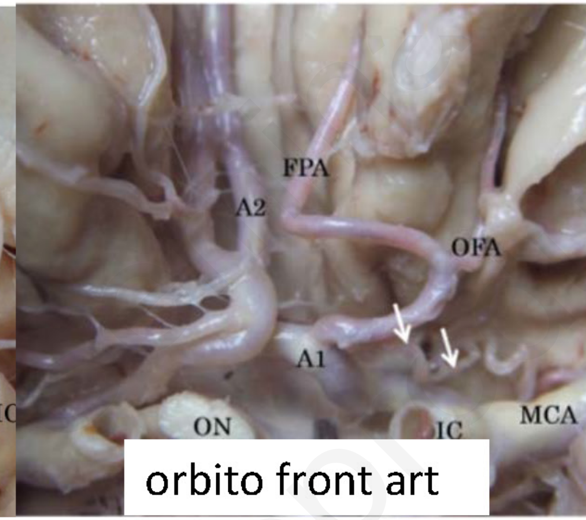
the A2 segment of the ACA 17%. the A1 segment of the ACA. (8%) A1 A2

Wakoto Matsuda

1Anat Sci Int DOI 10.1007/s12565-017-0415-9

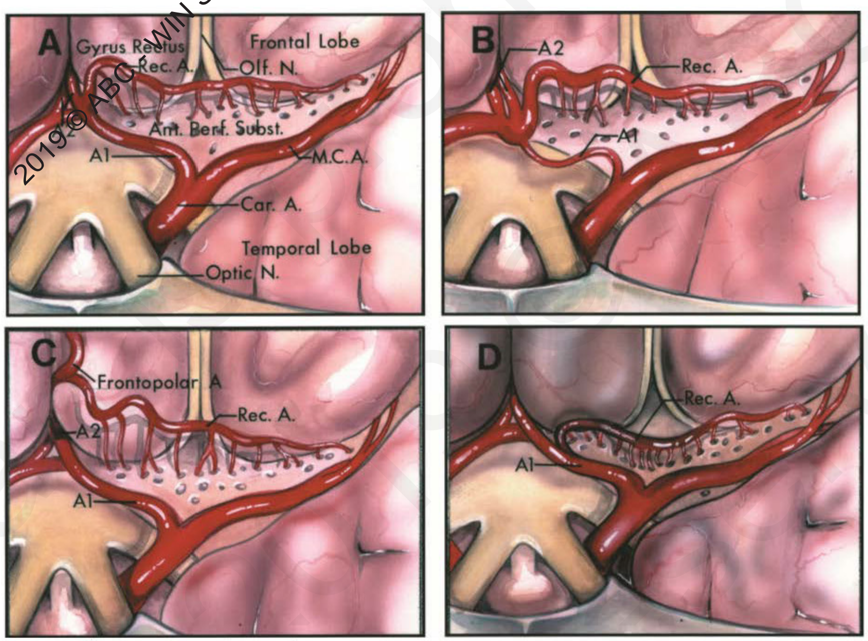
It is essential for neurosurgeons to understand the detailed anatomical variations of the RAH before operating, to prevent operative complications resulting in neurological deficits

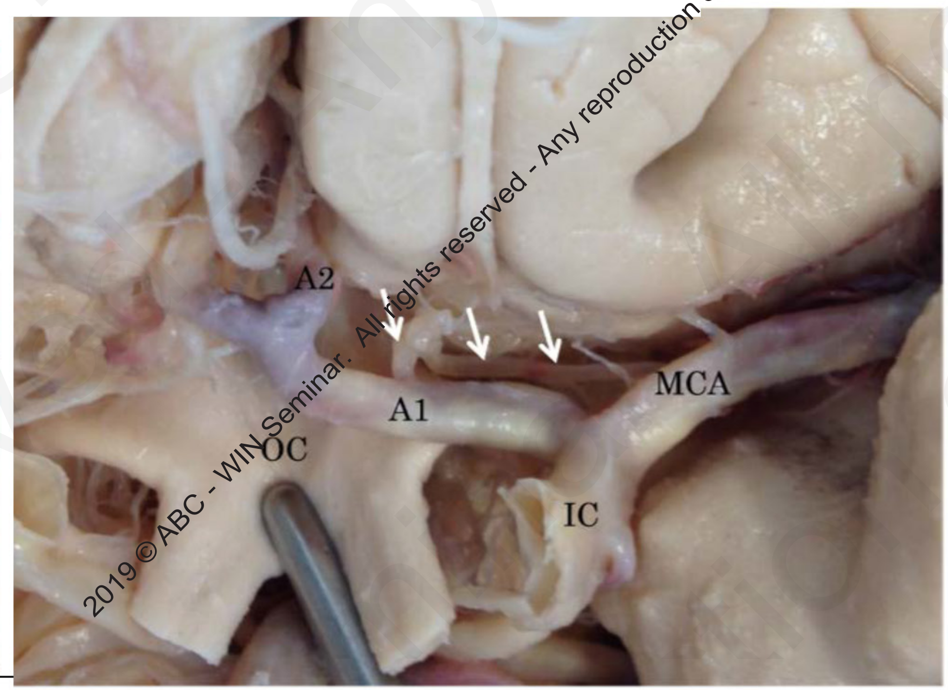




Anatomical variations of the recurrent artery of Heubner: number, origin, and course

Wakoto Matsuda[1,6] · Takahiro Sonomura[2,7] · Satoru Honma[2] · Sachi Ohno[3,8] · Tetsuya Goto[3] · Shuichi Hirai[4,9] · Masahiro Itoh[4] · Yoshiko Honda[5] · Hiroki Fujieda[5] · Jun Udagawa[1] · Shuichi Ueda[6]





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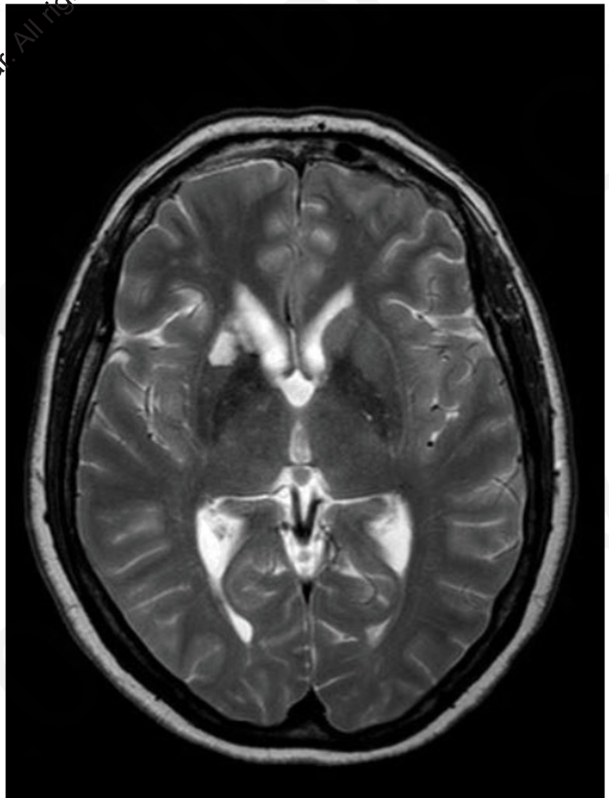
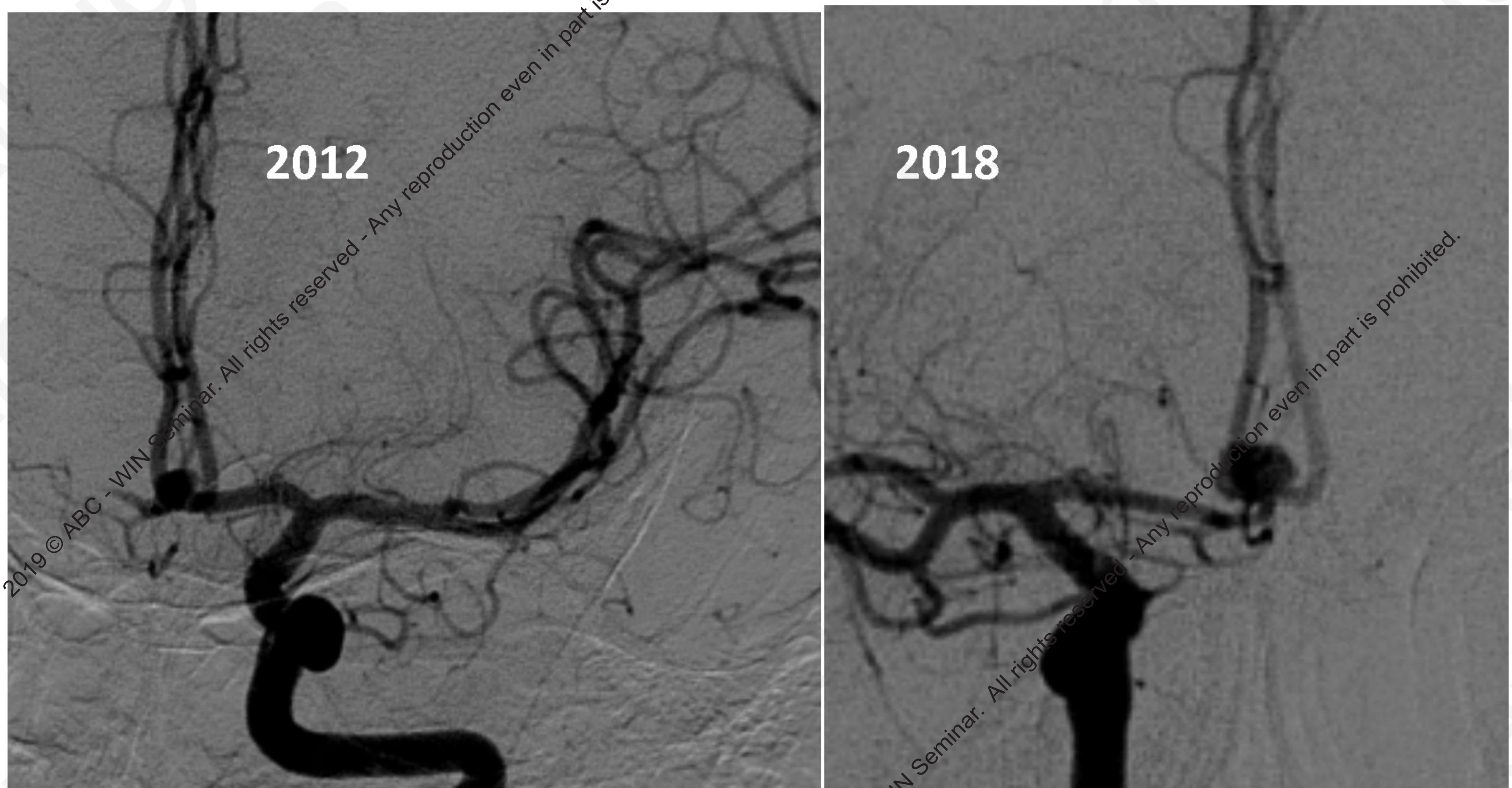
RHA supplies blood flow to the Head of caudate nucleus anterior–inferior striatum, the anterior limb of the internal capsule, the olfactory region, and the anterior hypothalamus (Perlmutter and Rhoton 1976).



Anatomical configuration of AComA complex



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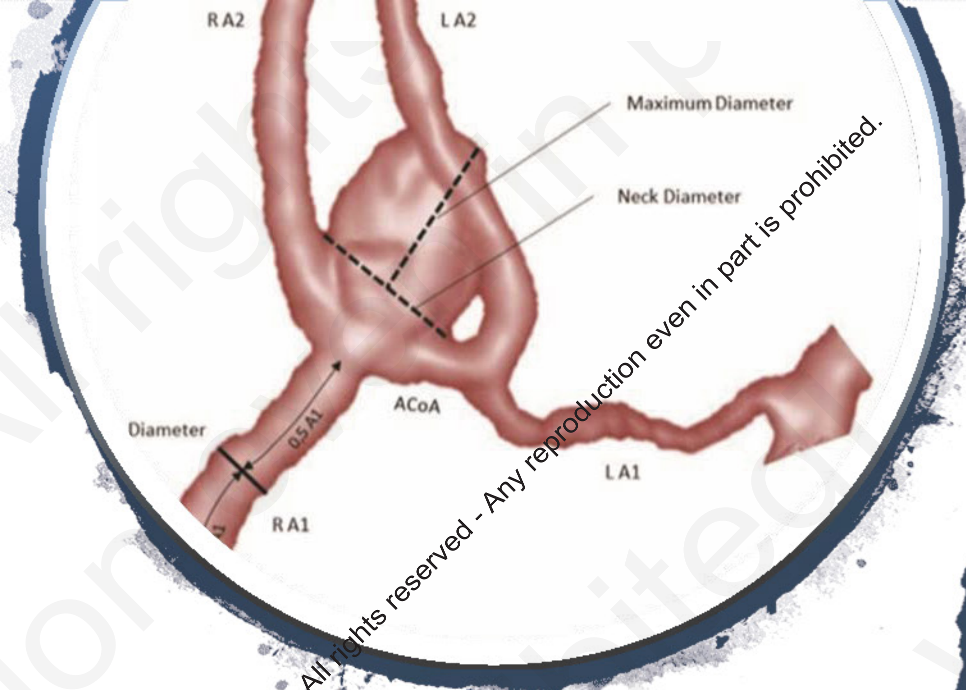
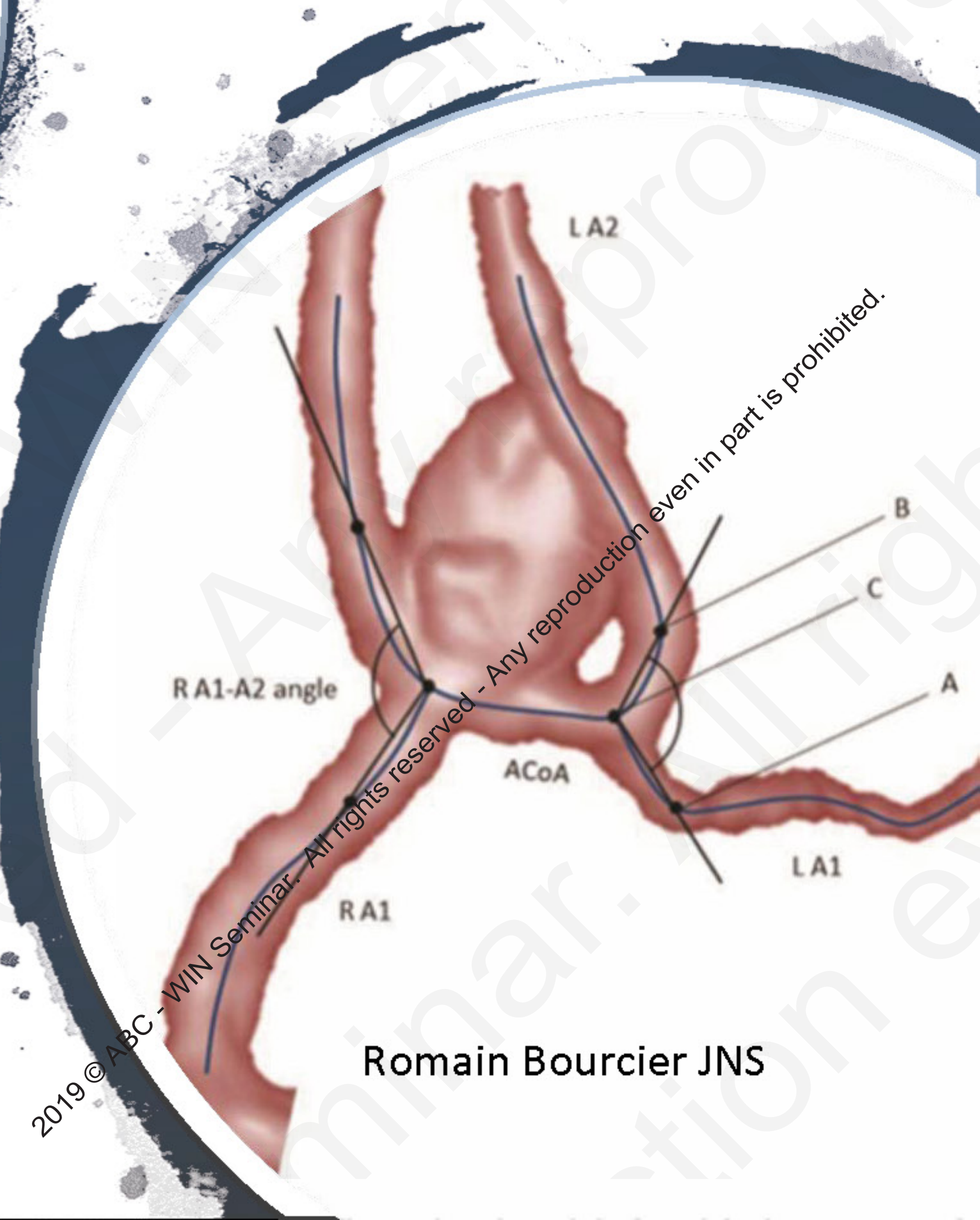


geometry of the ACoA complex related to the bifurcation angle and asymmetry of the branch diameter may significantly modulate both the magnitude and the distribution of hemodynamic stress at the junction of the A1 segment and ACoA and to be cause of aneurysmal developing



Romain Bourcier JNS

Hypoplasia of the artery is a risk factor in the process of aneurysm formation

Kasuya H, Shimizu T, Nakaya K, et al. Angles between A1 and A2 segments of the anterior cerebral artery visualized by three-dimensional computed tomographic angiography and association of anterior communicating artery aneurysms. Neurosurgery 1999;45:89–93, discussion 93–84

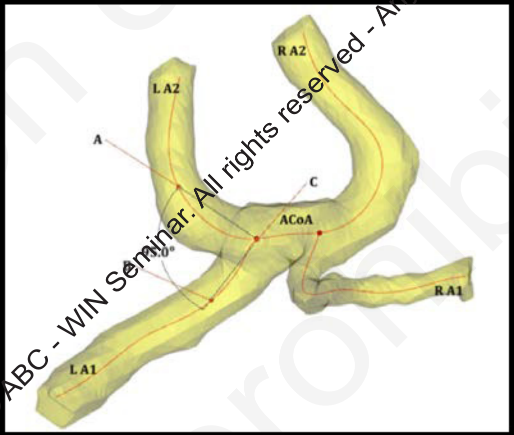
Significant association between smaller A1 to A2 angle and prevalence of an aneurysm

H Kasuia , T .Shimizu
Angles between A1 and A2 segment of anterior cerebral artery visualized by trhee dimensional Computed tomographic angiography and association of Anterior comunicating artery aneurysms

Aneurysms were significantly more frequent in hypoplastic branches and bifurcations with sharper angles between parent artery and its derivatives

Bor AS, Velthuis BK, Majoie CB, Rinkel GJ.
Configuration of intracranial arteries and development of aneurysms: a follow-up study.
Neurology. 2008;70:700–705.

independent strong risk factors for ACoA aneurysm development.



smoking (odds ratio, 2.036; 95% confidence interval, 1.277–3.245)

asymmetry of A1 segment >40% (odds ratio, 2.524; 95% confidence interval, 1.275–4.996)

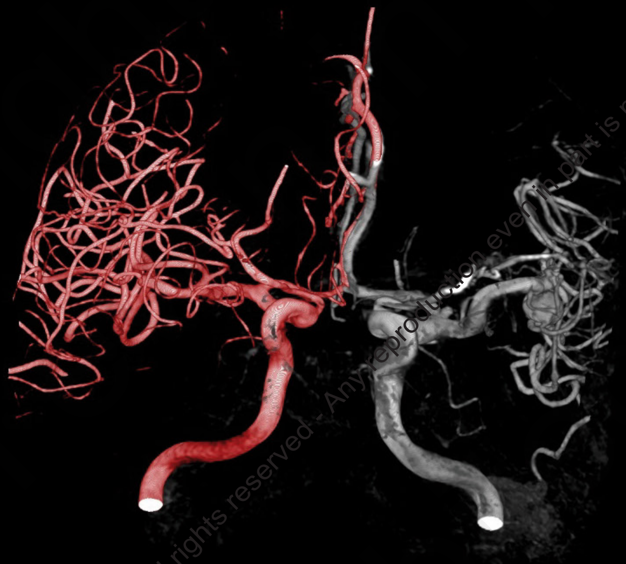
pulsatility index (odds ratio, 0.004; 95% confidence interval, 0.000–0.124)

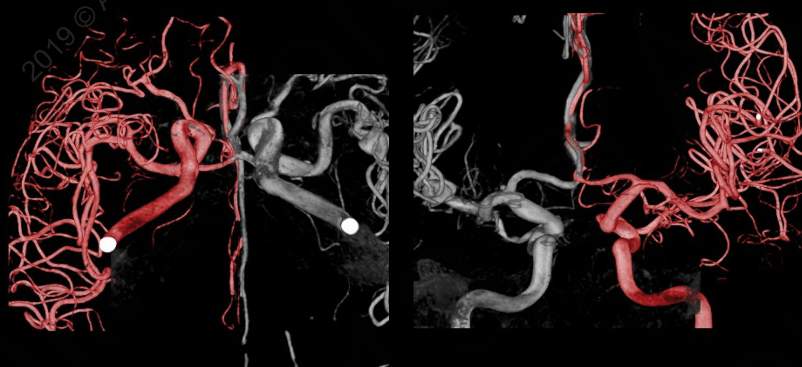
angle between A1 and A2 segments ≤100° (odds ratio, 4.665; 95% confidence interval, 2.247–9.687)

W. Kaspera, Communicating Artery Aneurysms Morphological, Hemodynamic, and Clinical Independent Risk Factors for Anterior Stroke 2014

- AcomA Aneurysms and AcoA Configurations

Symmetrical H configuration





Symmetry of AcomA complex means that the embryogenetic processes for the ACA formation on both sides proceeded at the same time following an identical development model

A delay with respect to the other side determines morphological differences in caliber and course of A1 segments with a final asymmetry of the entire configuration

Synchronism is symmetricity
(different morphological configurations)

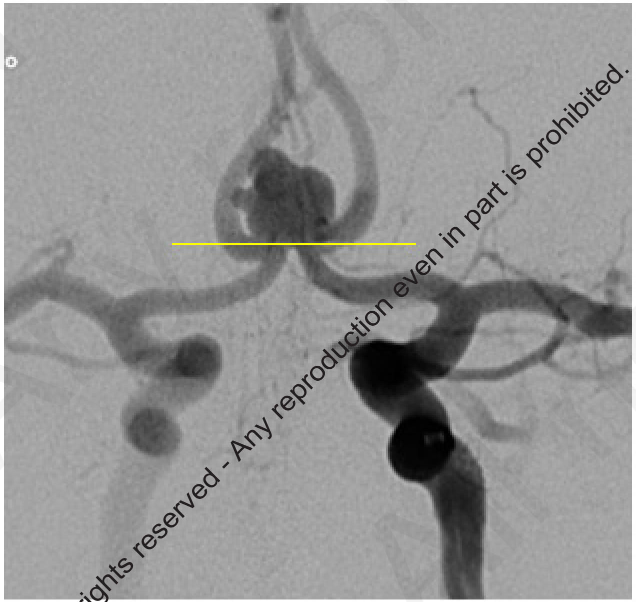
Symmetrical H configuration

If bilateral A1 segments have the **same caliber** and symmetrical **course** AComA will not be diverted from one side and AComA will maintain an **horizontal axis** on the coronal plane

A1 A2 angles also will be **symmetrical**
Both **A2 tracts** will be **parallel** on the sagittal plane

In this case the **aneurysm** will be **centered in the middle of the AComA** and it will maintain this position during his growth towards the two A1 A2 angles

Aneurysmal Projection is on **vertical** plane

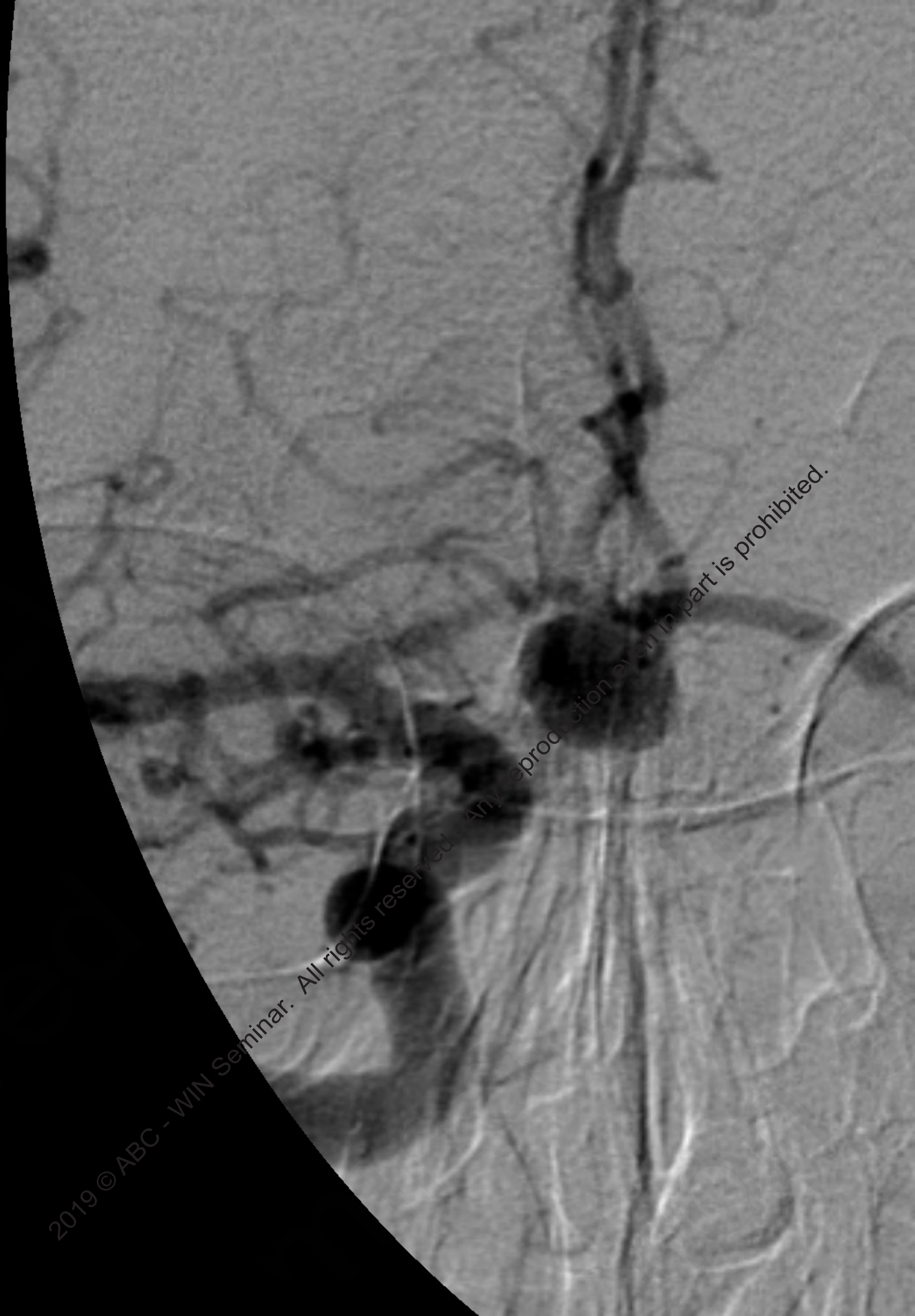


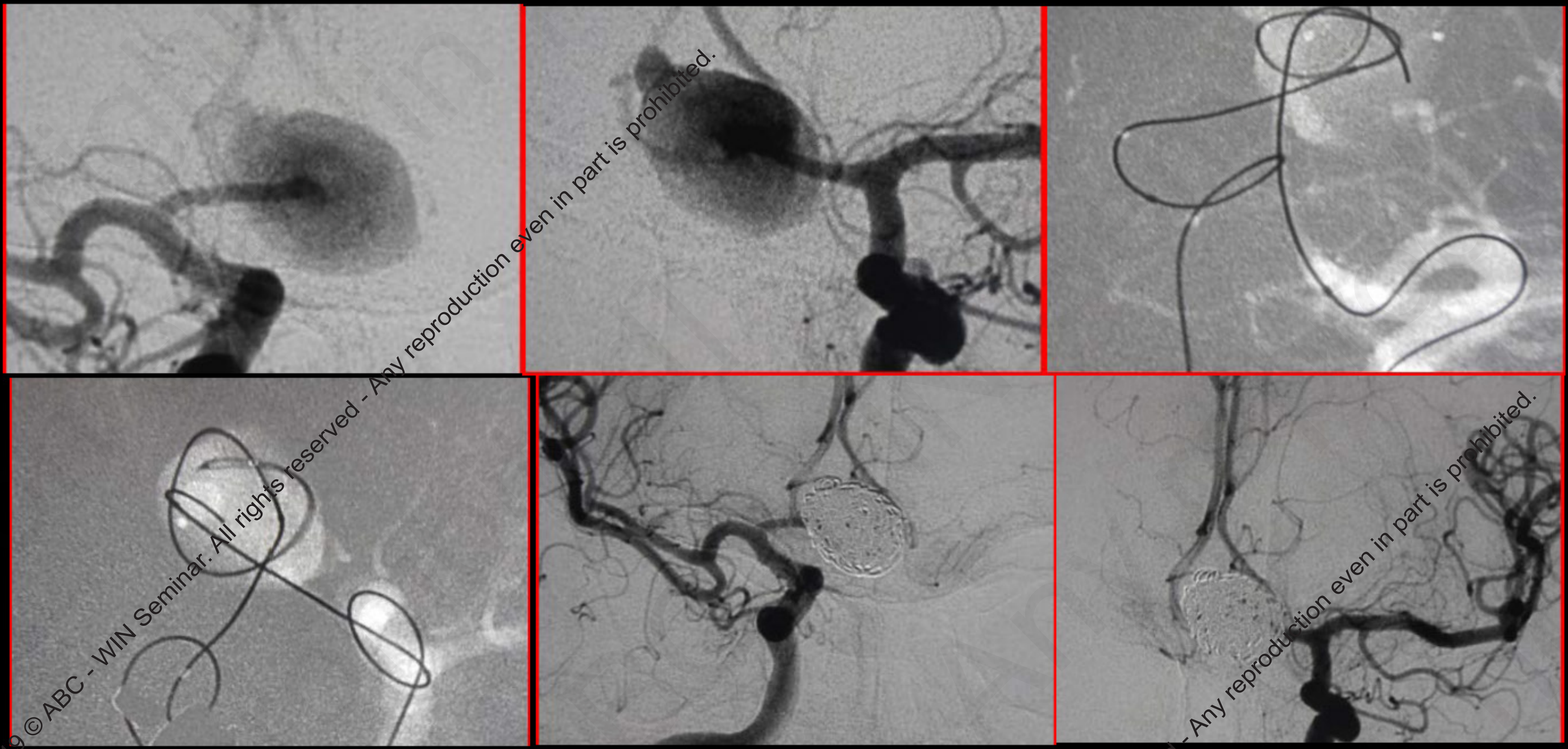
Strategy of treatment

- Aneurysm is visualized on **both sides** during DSA examination **without** maneuver of contralateral carotid **compression**

- If the aneurysm extend symmetrically toward the A1 A2 angles **both corners must be protected** during sac occlusion

- Endovascular **approach** to the sac may be done from **both sides**





bilateral coiling

The modality to protect of the neck depends on the shape of A1 A2 angles

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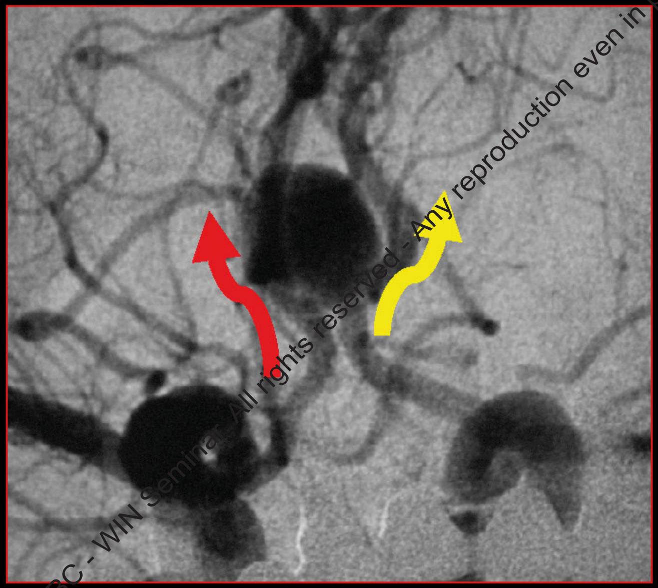
Cross passage

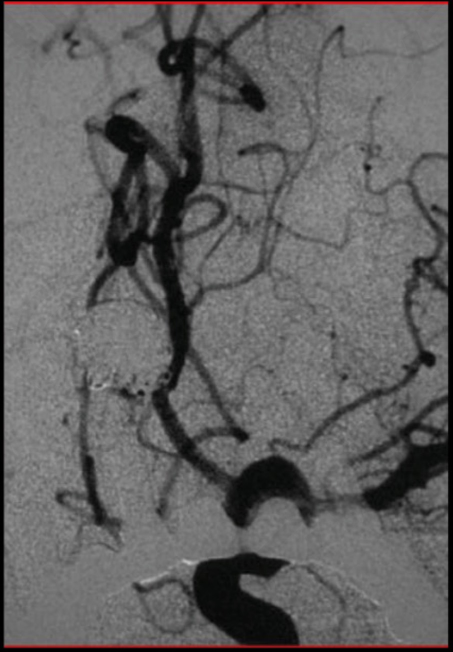
- Balloon or stent crosses the AComA from homolateral A1 to contralateral A2
- Coiling may be performed from the contralateral side of the ballon/stent access

Balloon crossing the AComA
left A1 to right A2 due to acute angle A1 A2 on the right side

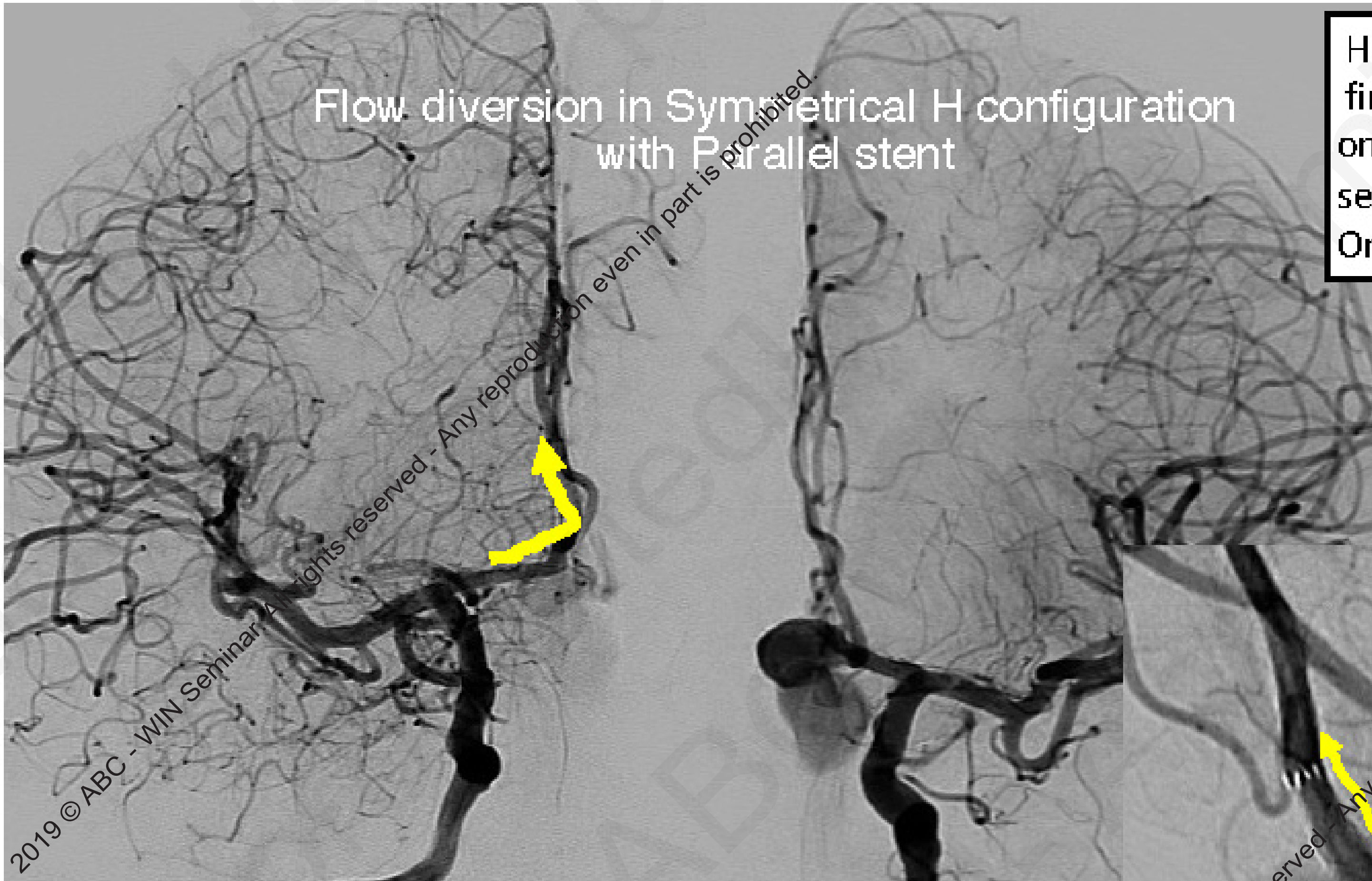


Parallel stenting

- Two stents may be placed in parallel (omolateral A1-A2) to exclude the aneurysm and to achieve a complete coiling of the sac occupying entirely both A1-A2 Angles

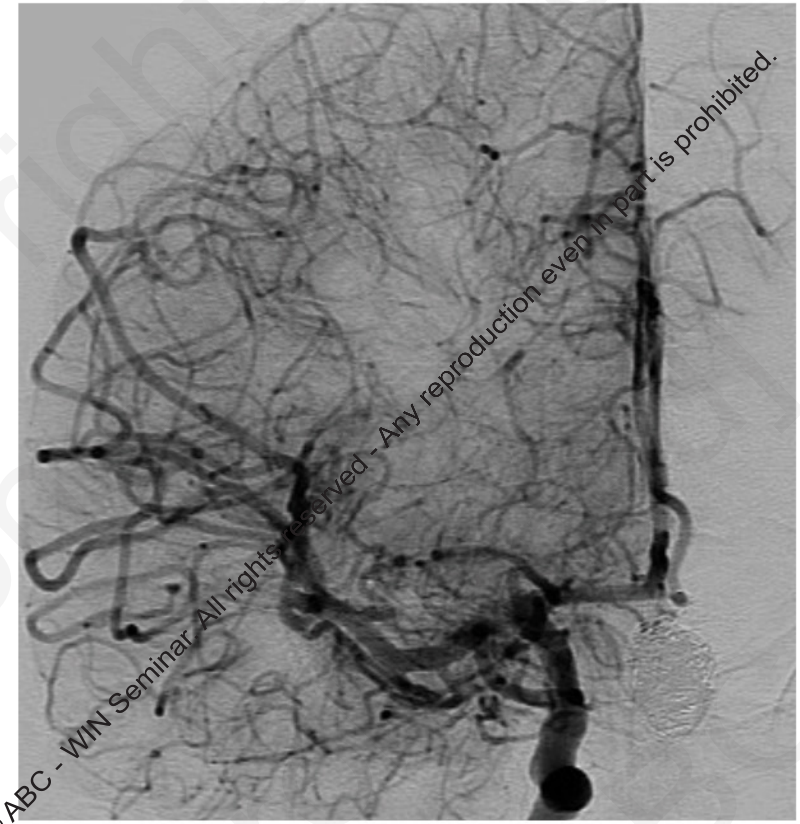


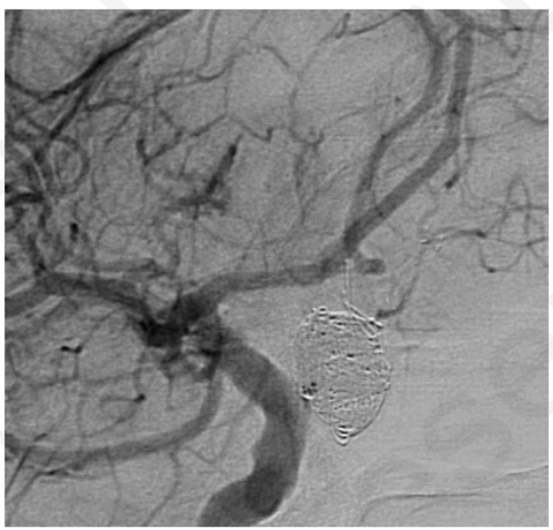
Flow diversion in Symmetrical H configuration with Parallel stent



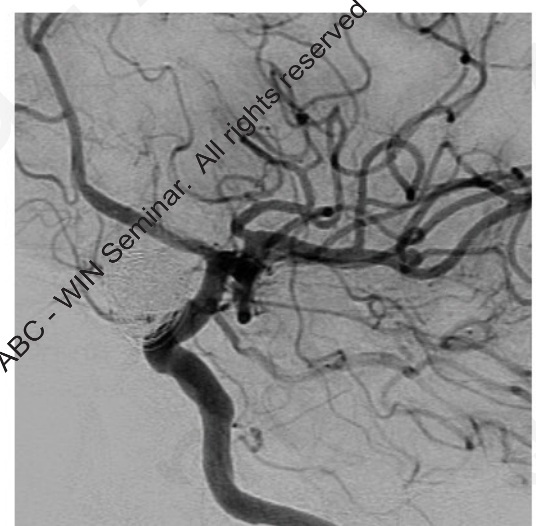
H pipe
first step
omolateral left A1 - A2
second step
Omolateral right A1 –A2

Courtesy prof C.Cognard (Toulose)





18 m



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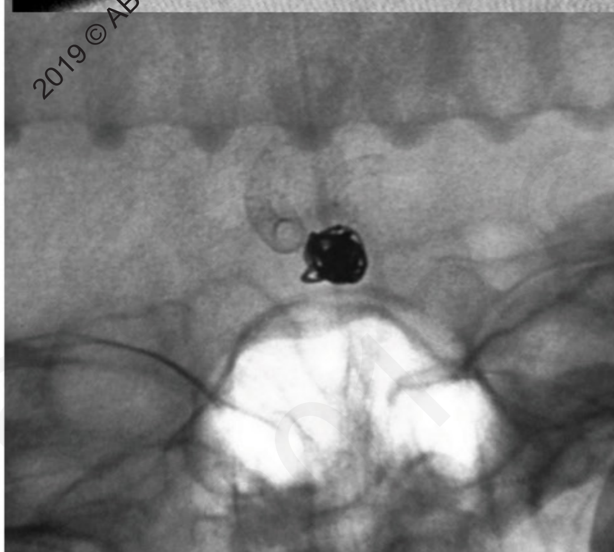

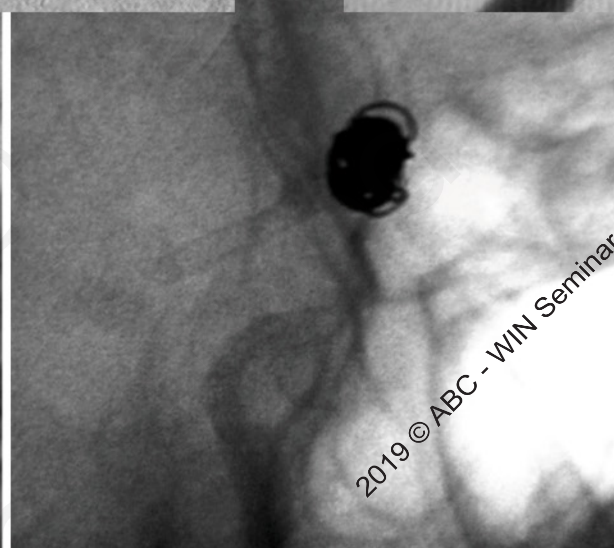

Bleeding aneurysm
Partially Coiled in acute phase

H pipe for basal regrowth

Courtesy Dr Delehaye (Naples)

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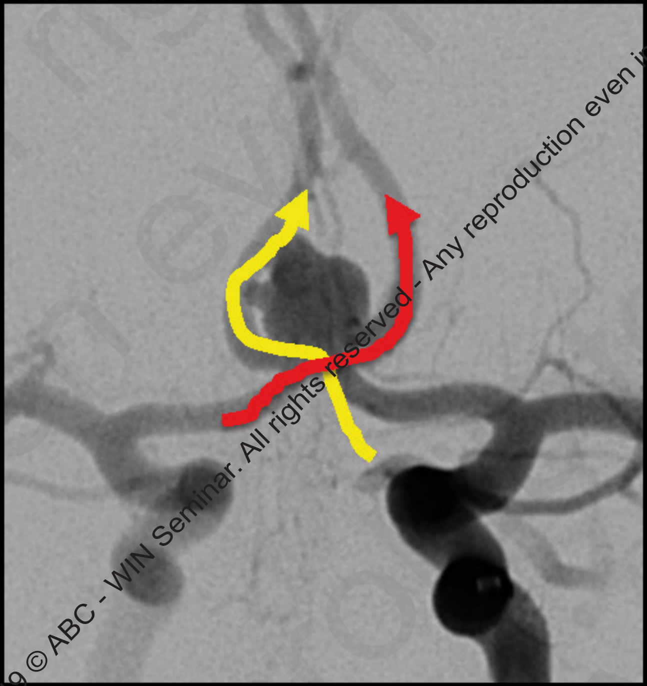
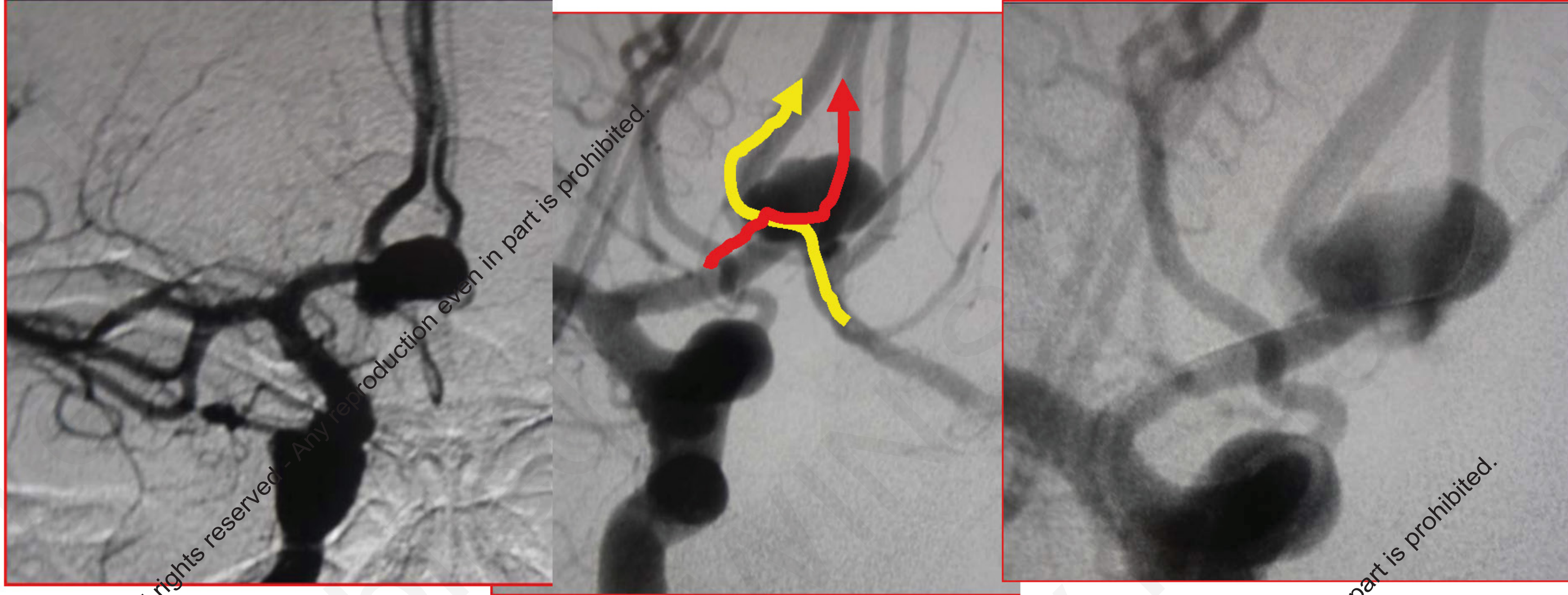
X stenting

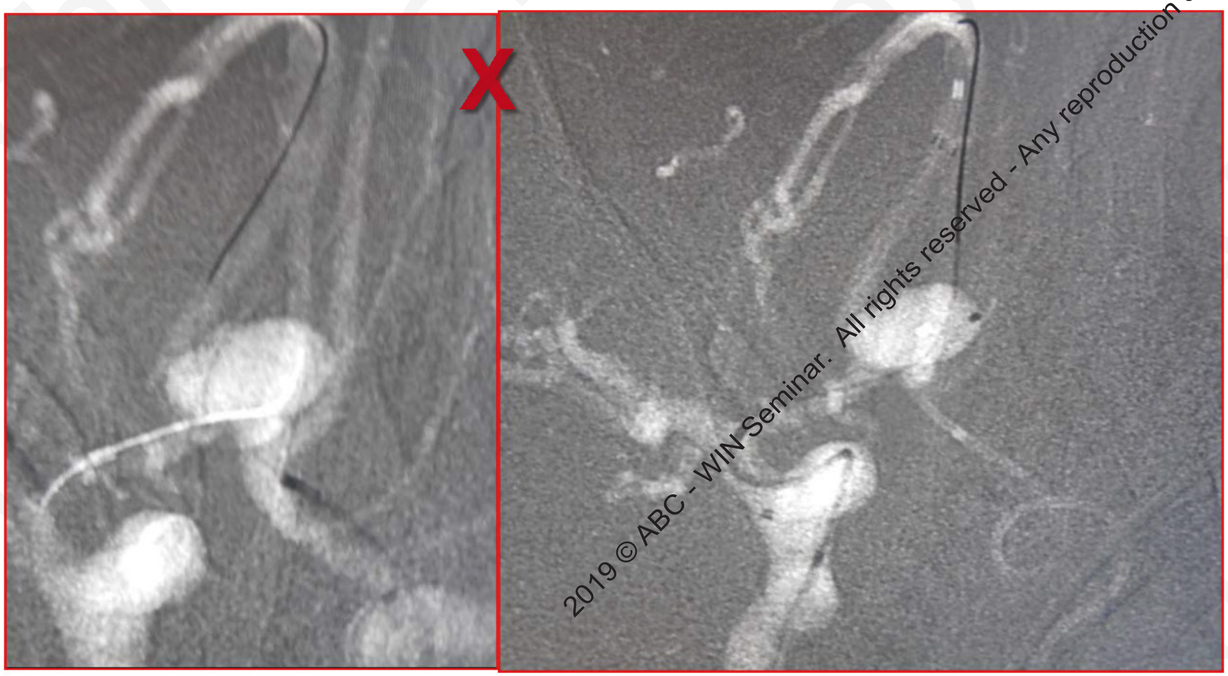
<90°



- double stent in X-configuration is used only if both A2 tracts cannot be catheterized from omolateral side (parallel stenting not possible)
- only one stent crossing the base does not guarantee the protection of both A1 A2 angles (crossing stent)



3 cerebral arteries



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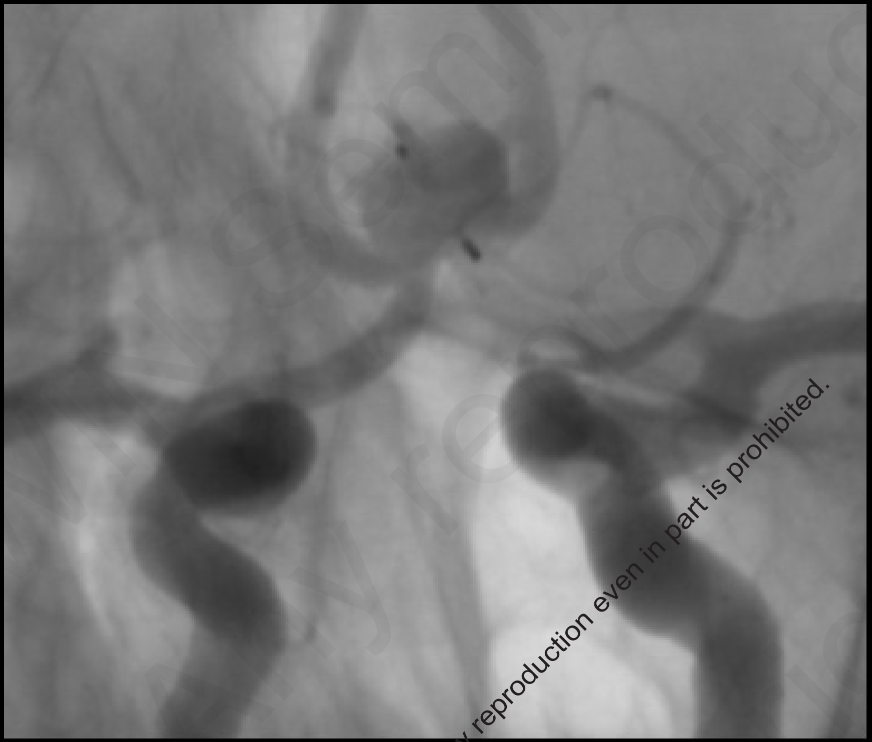
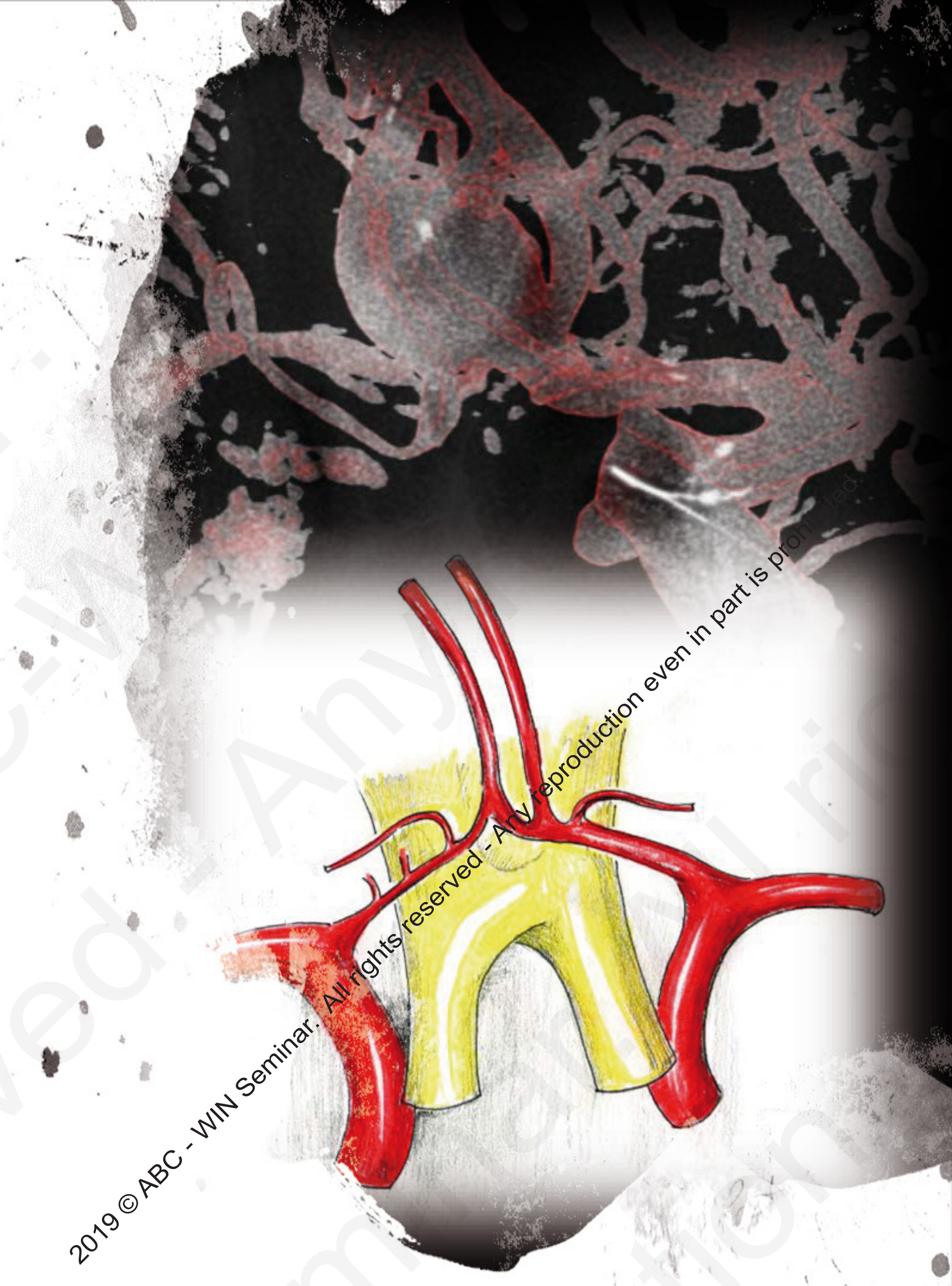


Alternative to X-stenting may be used a WEB

or Clipping

Asymmetrical H configuration

- A1 segment with same course and difference in caliber



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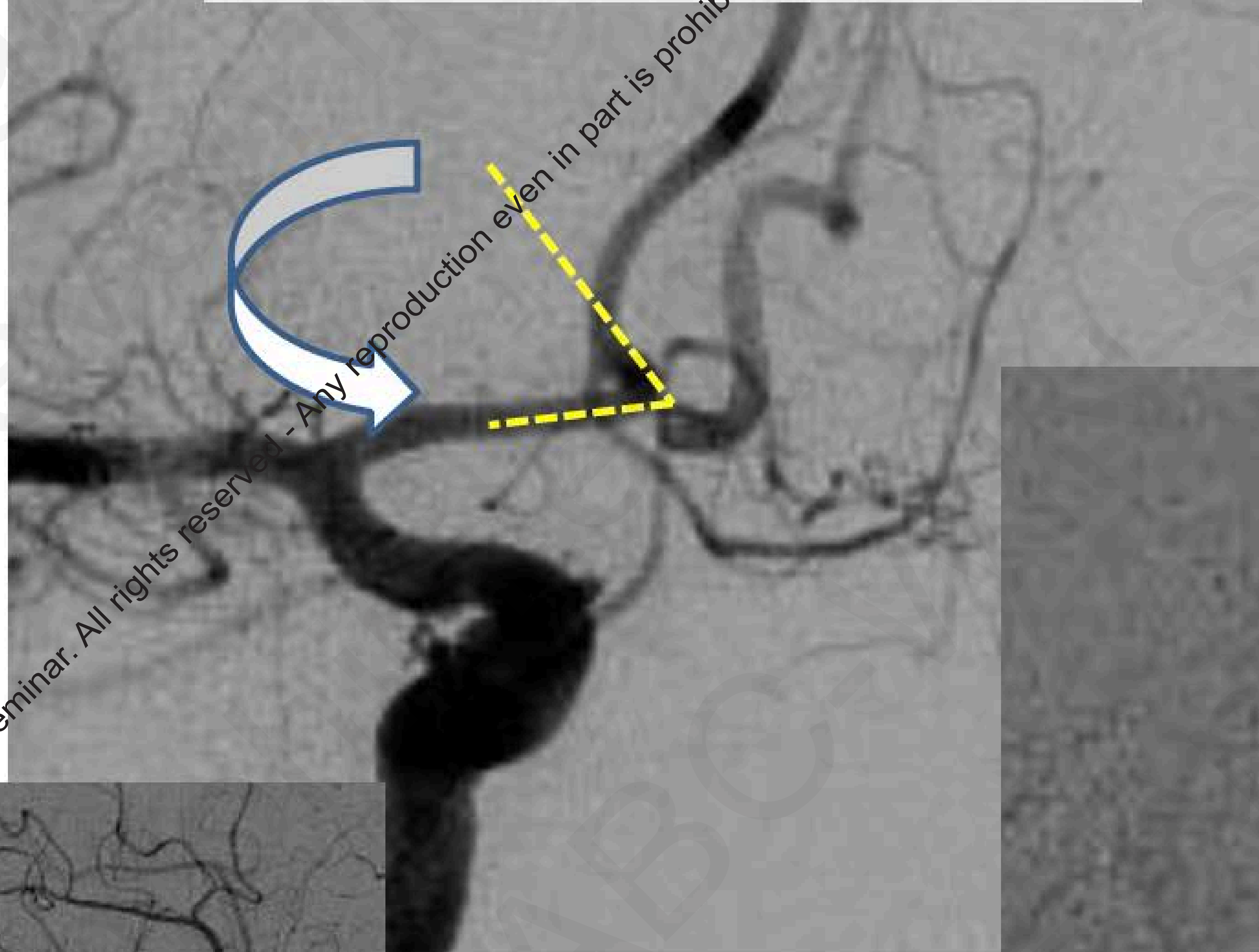
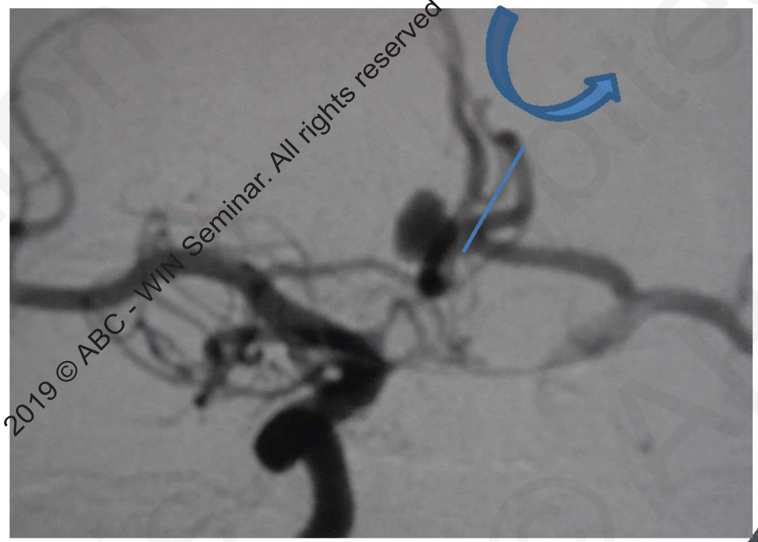
A1- A2 angle dominant side becomes acute (less then 90°)



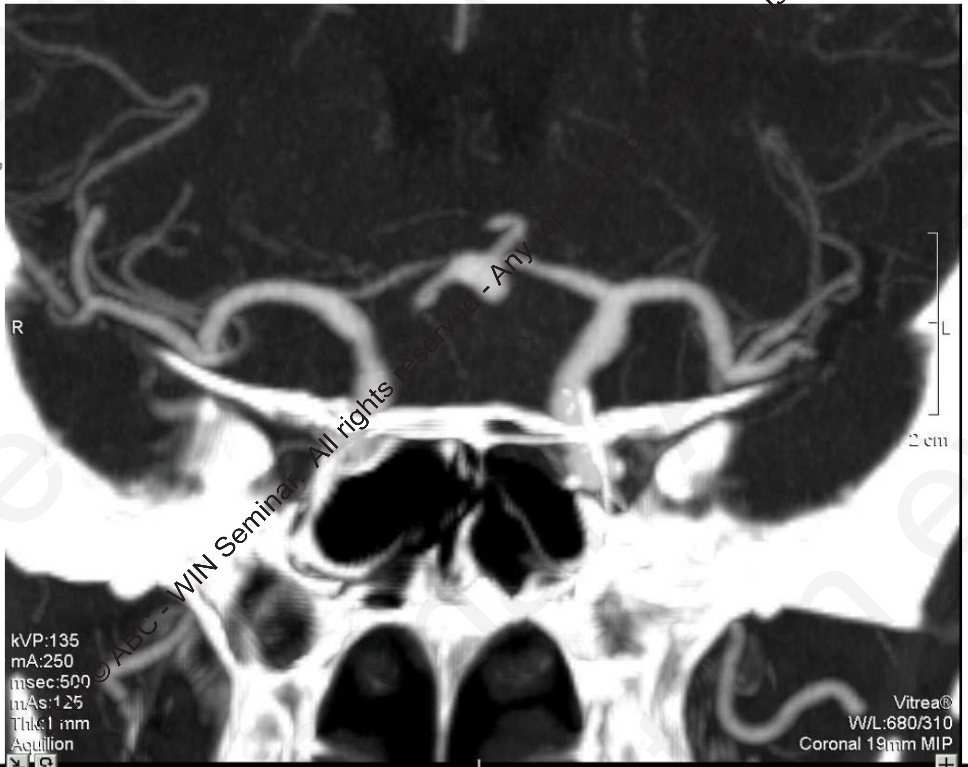
Tilting of AcoA axis
On coronal plane


The more is the
difference between
calibers the more
evident the tilting effect
on the aneurysmal base



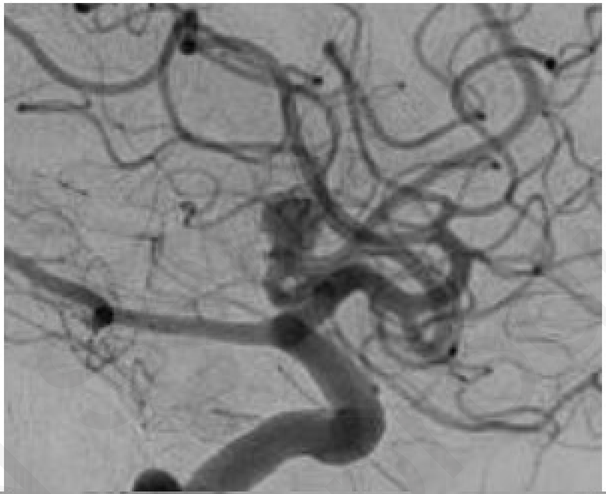
Lowton : Seven neurysm

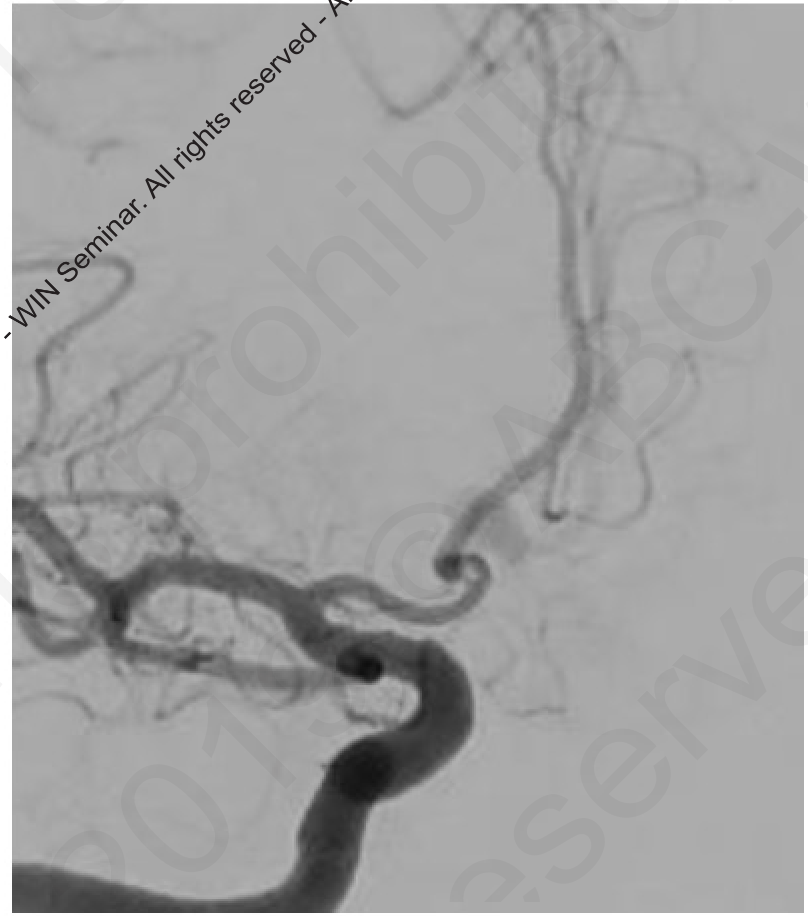
- Because of the tilting effect the dominant A1-A2 angle is displaced downward and posteriorly
- the A2 dominant segment is twisted backward

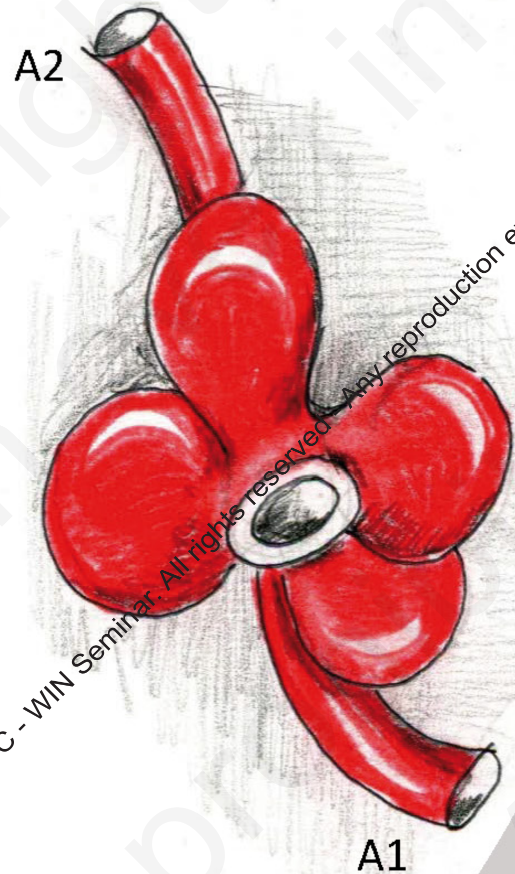


The **direction in which the fundus of an aneurysm points is determined**

Asymmetry of caliber and asymmetry of corse of the ACAs proximal to their junction





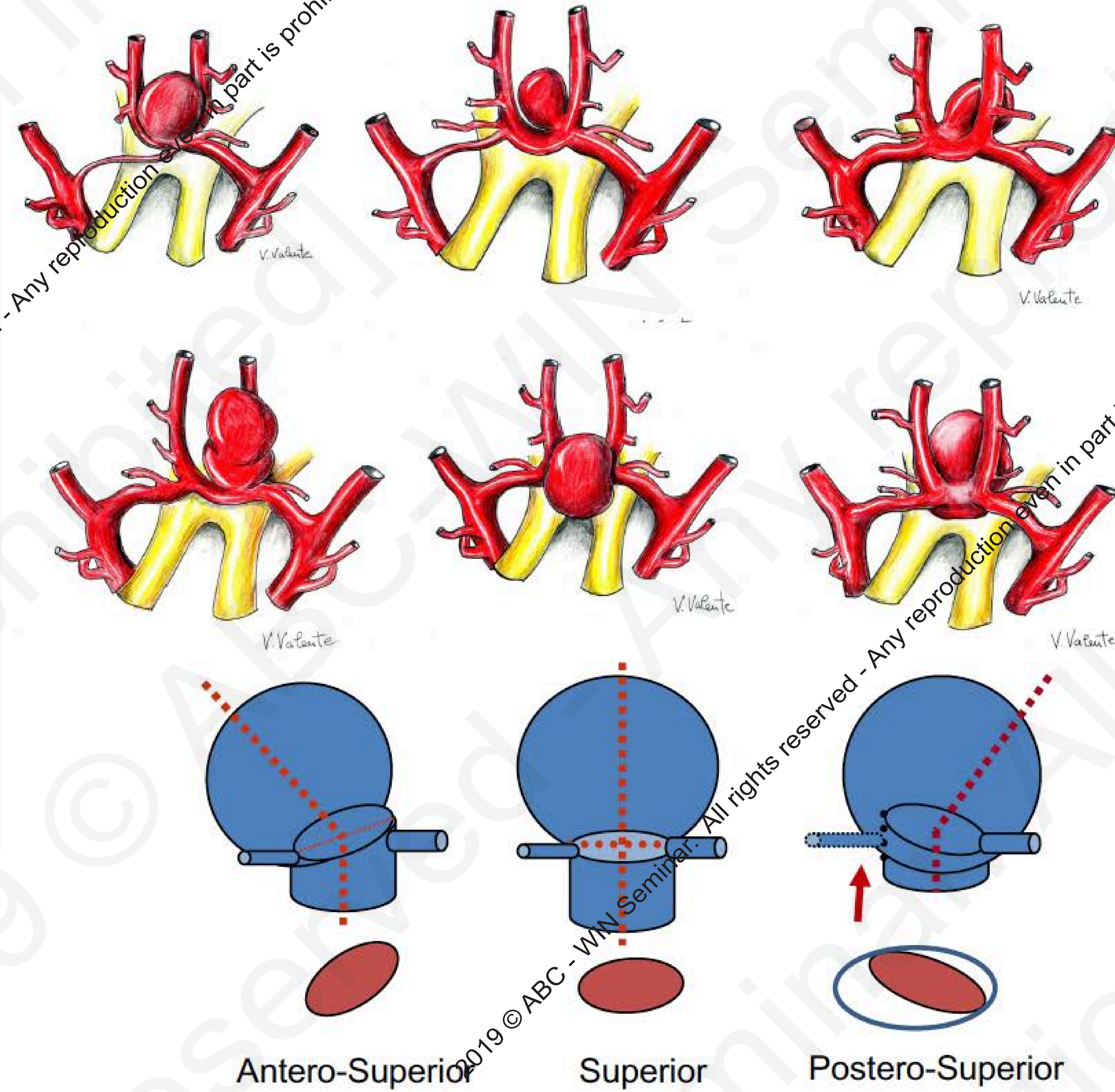


34.4% projected superiorly,
22.7% projected anteriorly,
14.1% projected posteriorly,
12.8% projected inferiorly,

16% had complex, multilobulated projections.

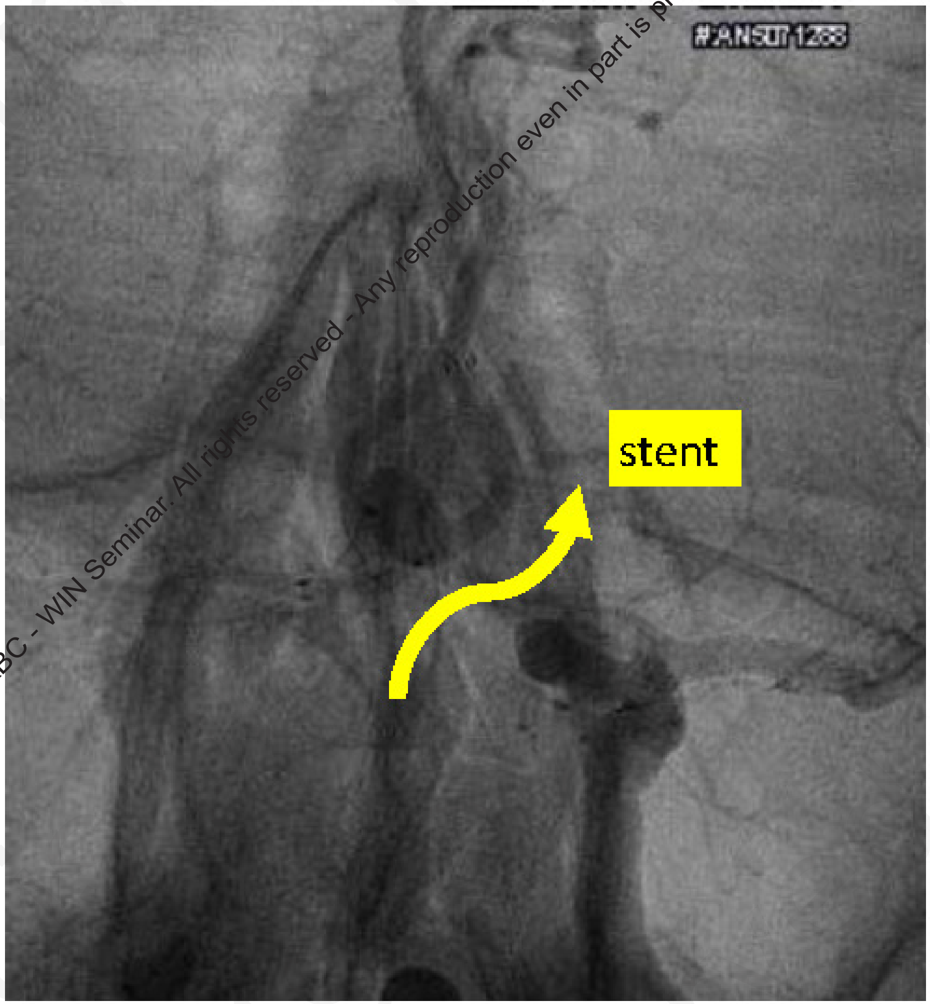
Changing the A1-A2 angle, the profile of the neck is modified according to the aneurysm projection

Consequently the inflow regimen and intra-aneurysmal hemodynamic are changed

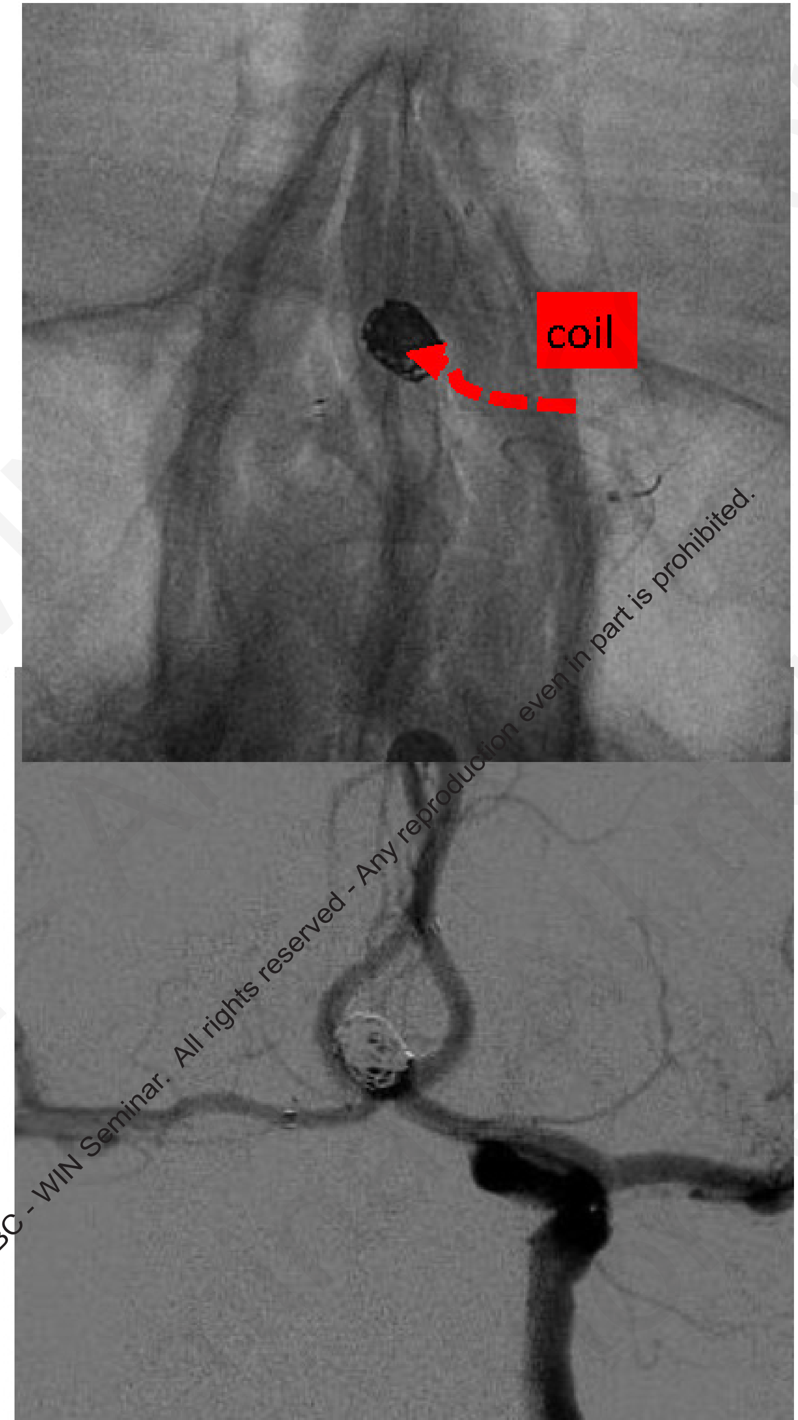


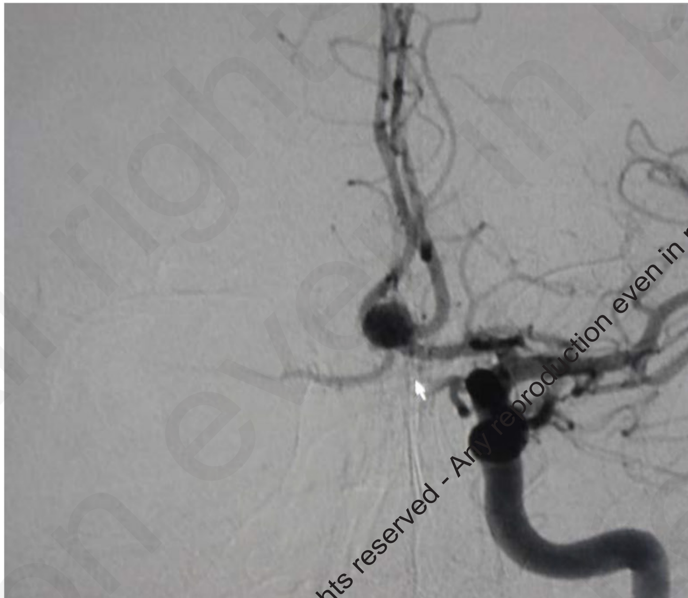
- It is possible to cover totally the neck of the aneurysm with a stent or balloon moving from A1 of one side to A2 of the contralateral following the inclined basal axis for easier micronavigation
- Microcatheterization of the sac is done through the larger A1 to maintain a central position in the neck

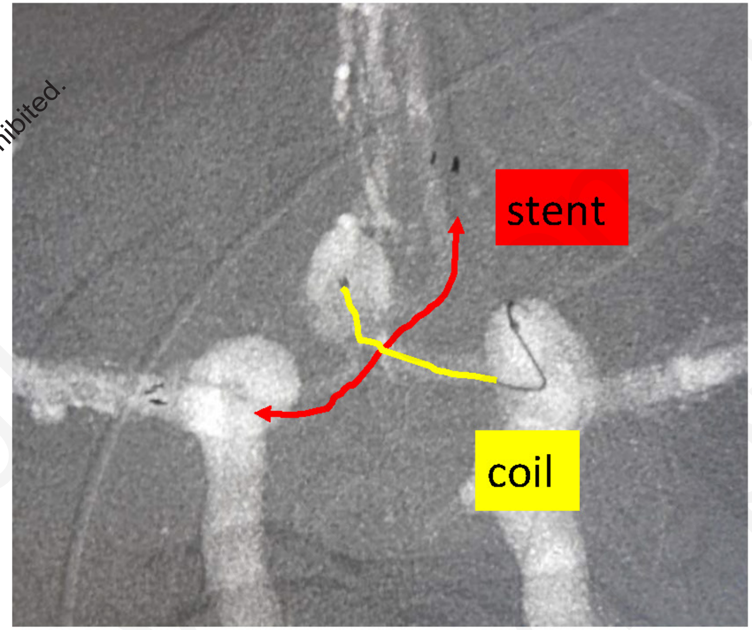
H asymmetrical disposition
Strategy of treatment

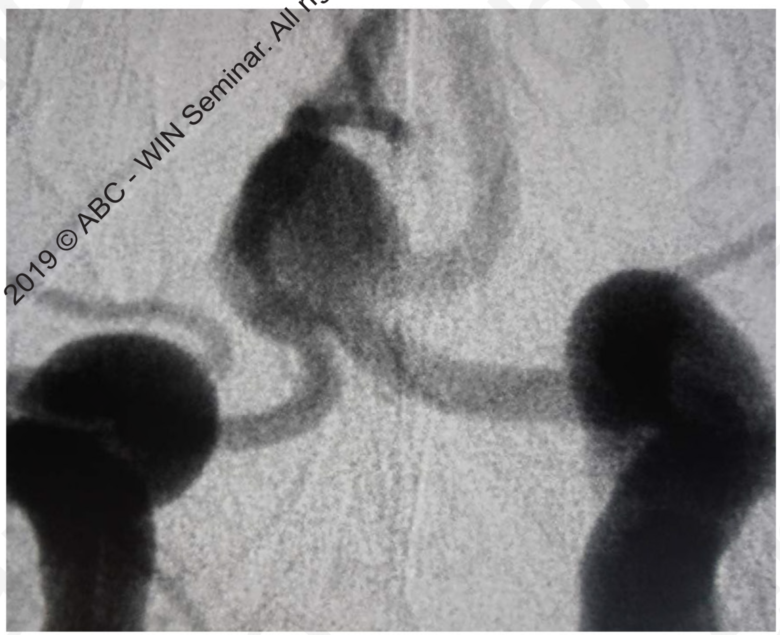


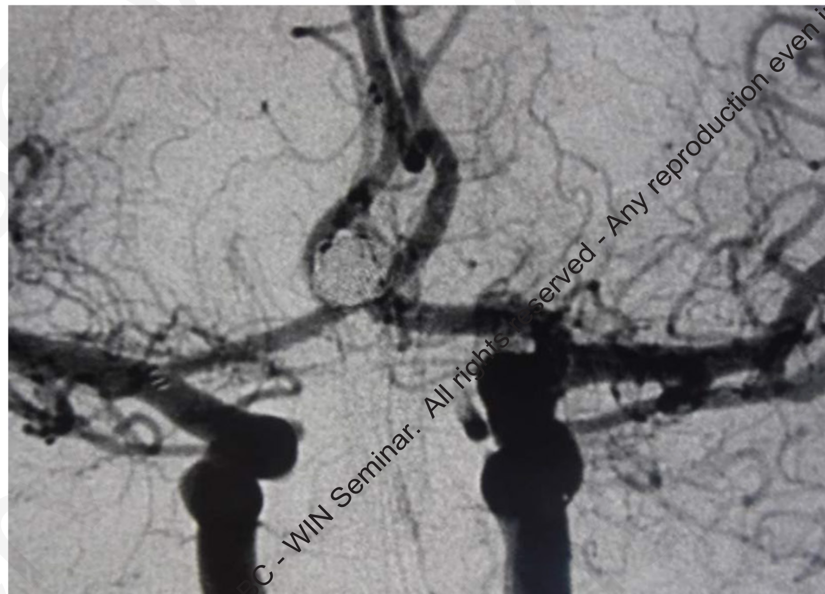
Cross passage











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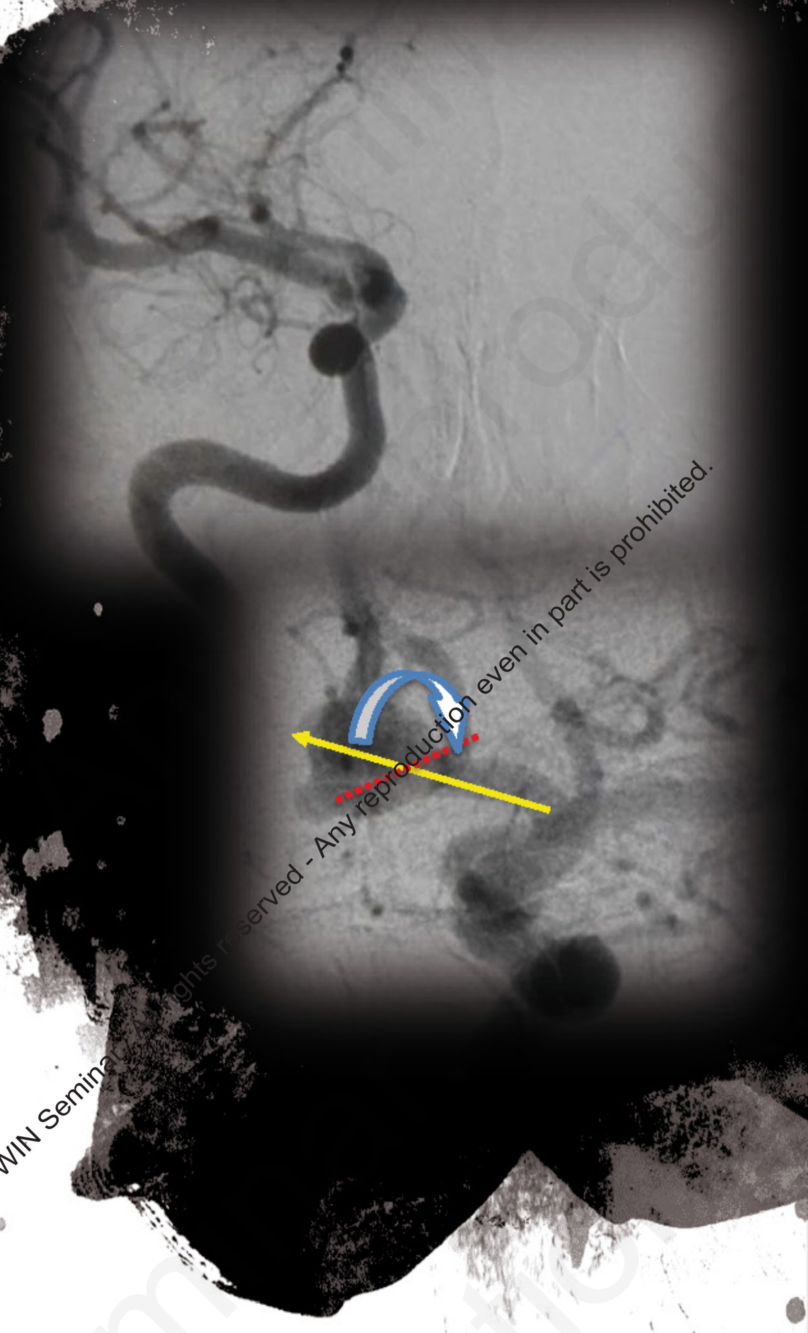
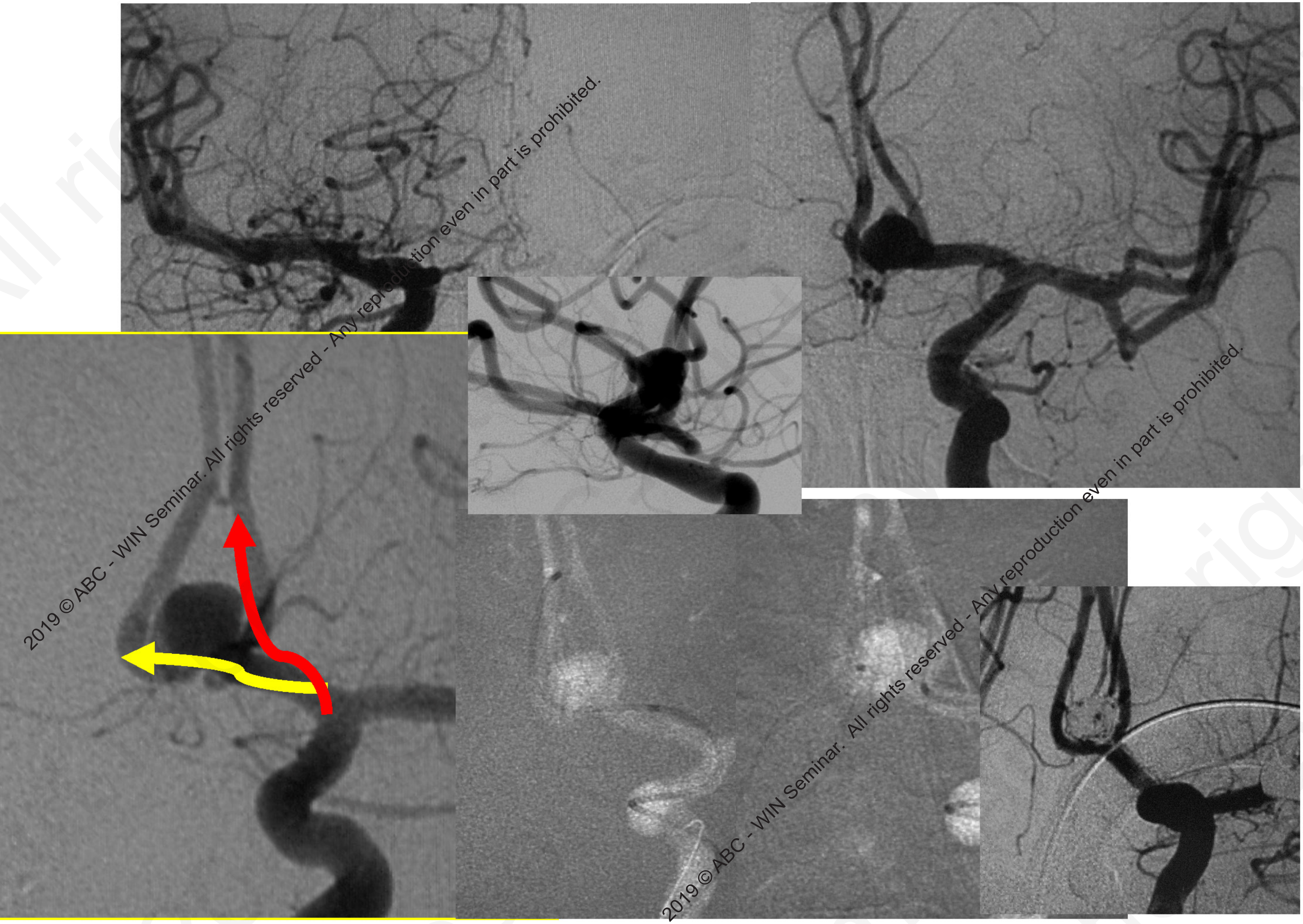
Hypoplastic-Agenesia of A1 Y configuration

- Aneurysm is centered on the bifurcation of A1
- The projection of the aneurysm is along the axis of the A1 segment
- The base of the aneurysm is greatly tilted with an aneurysmal angle > 90 °



- Unilateral access
- First stent should be deployed in the branch more difficult to catheterize
- Jailing technique
- First stent deployed should be longer than the second one to give more stability during the second crossing stent' maneuver

Strategy of treatment



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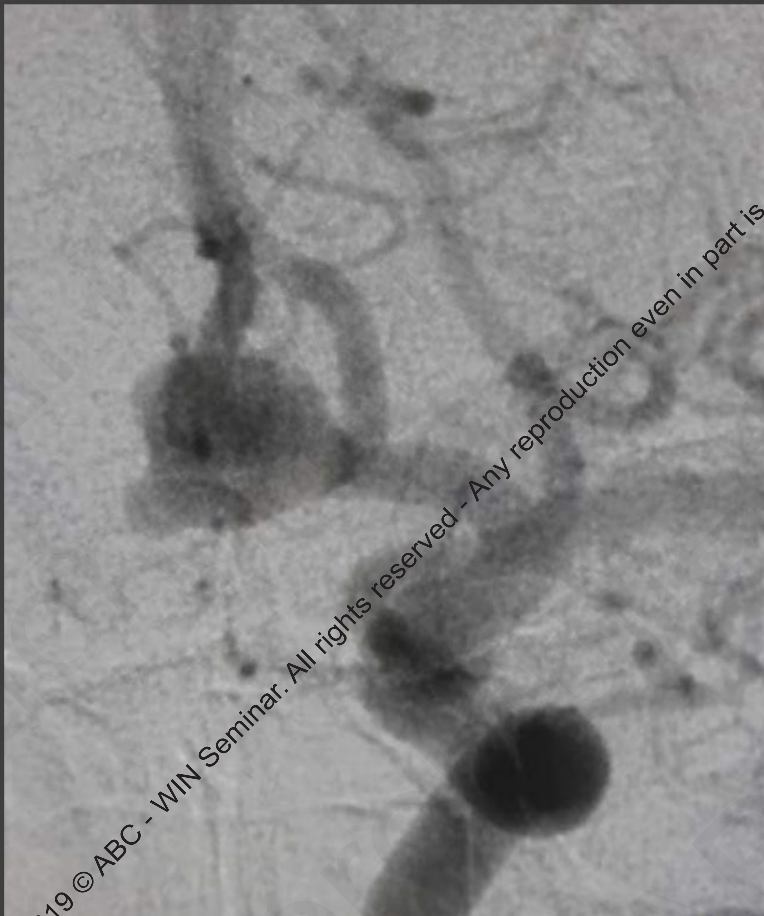

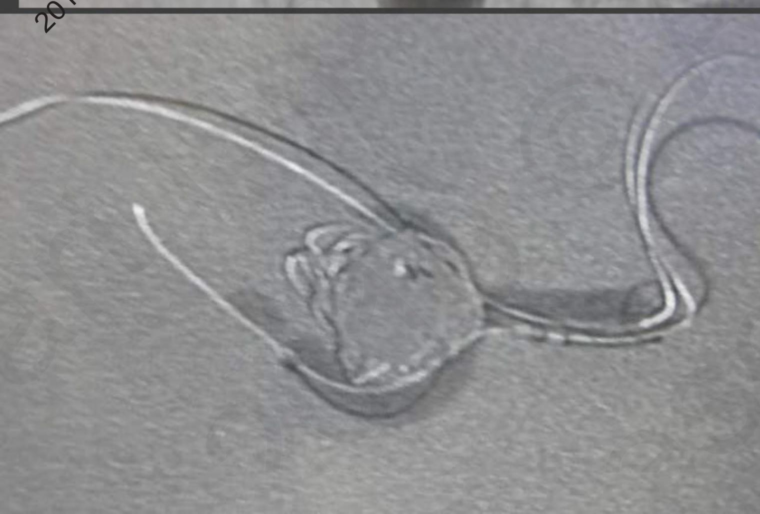

In acute bleeding
balloon remodeling

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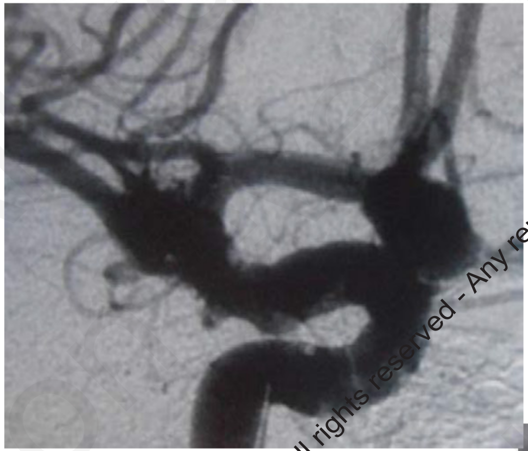
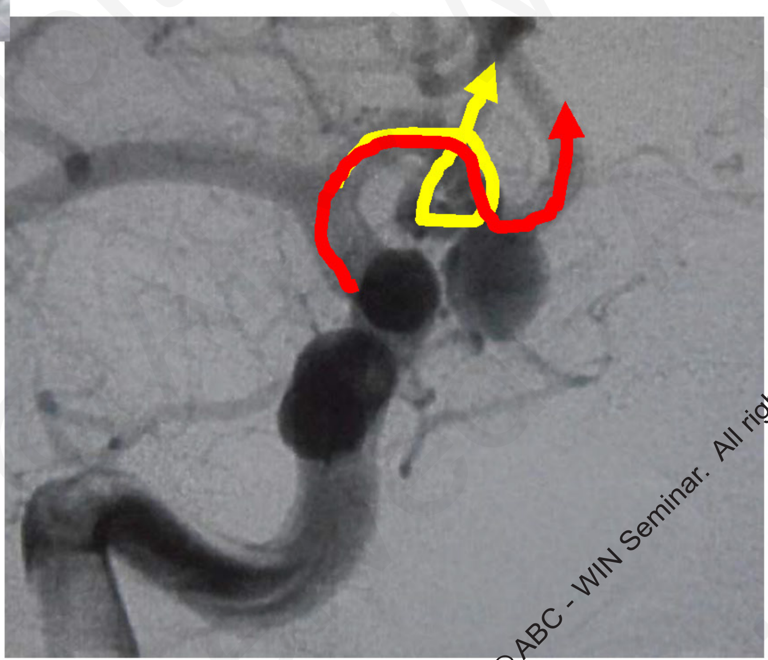
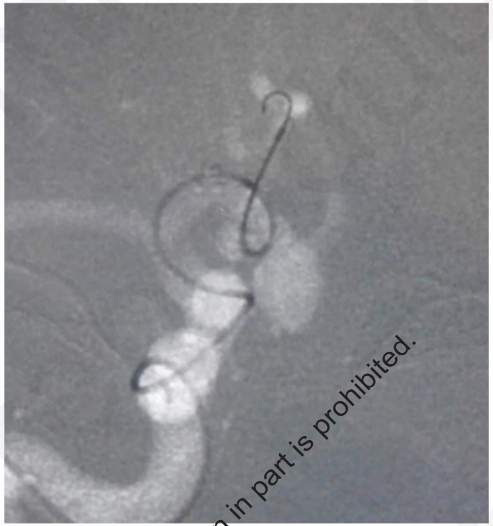
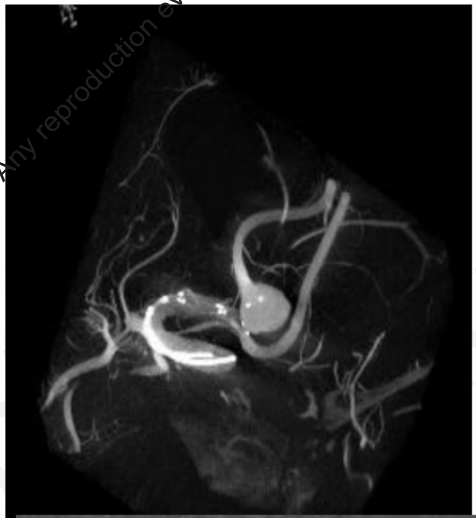


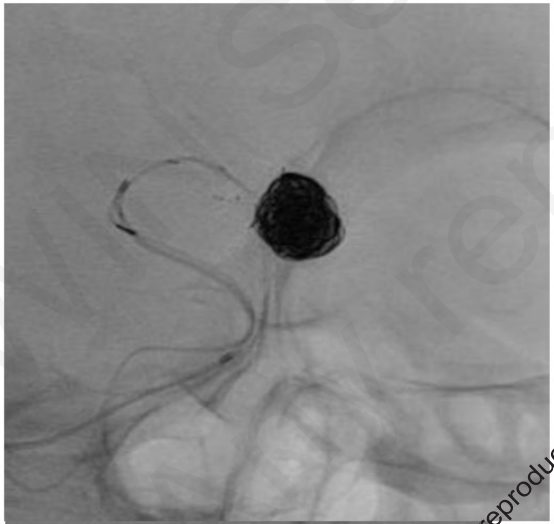
Recurrent branches
"arrow" shape bifurcation

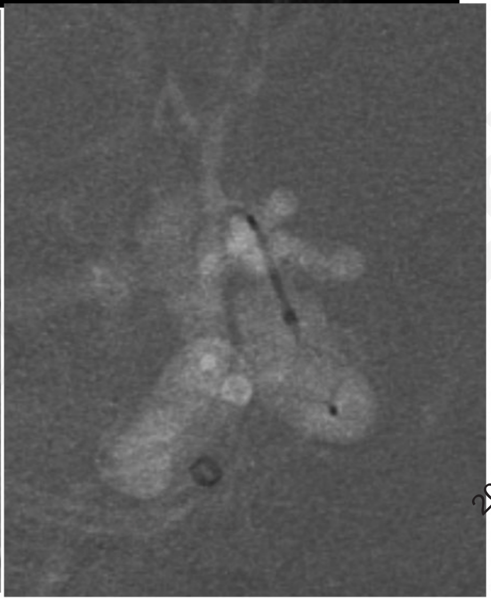


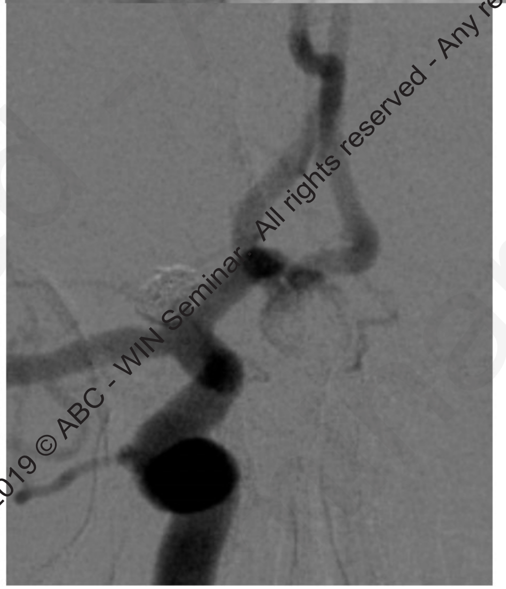


Pulserider or WEB instead of Y stenting









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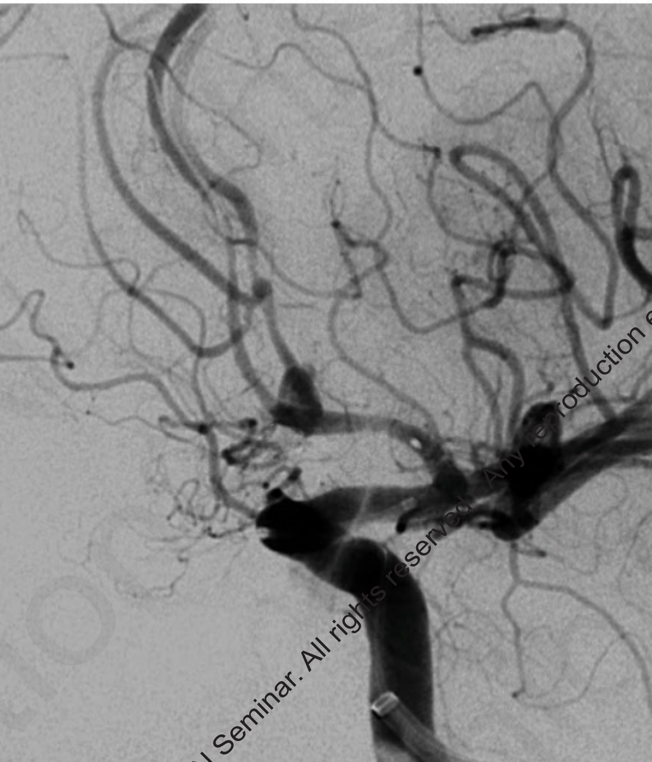
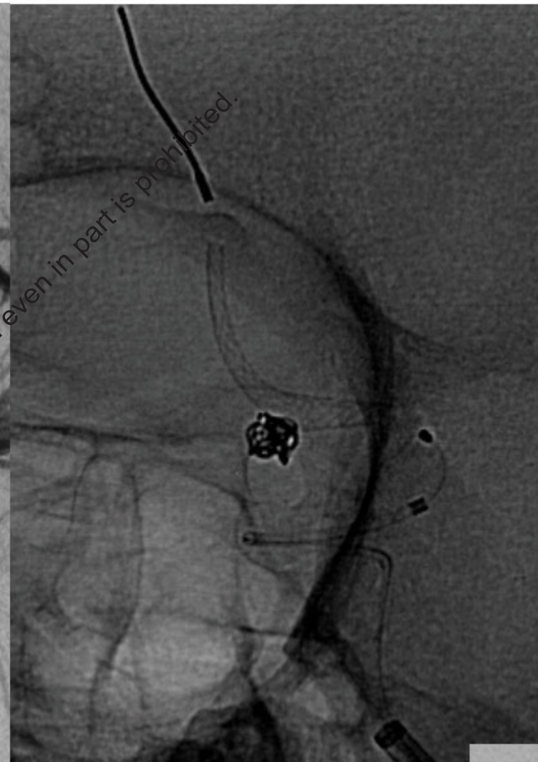
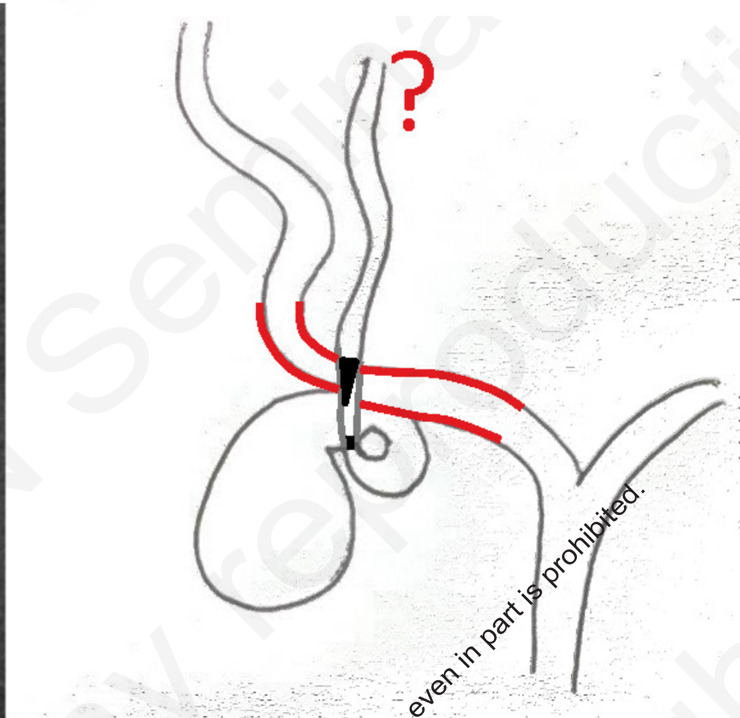
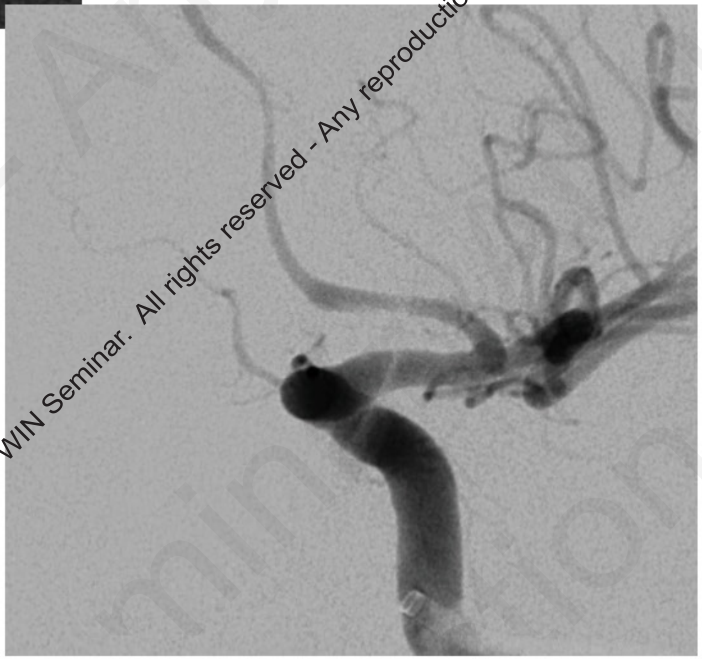
Flow diversion in H hypoplasic-agenesic configuration

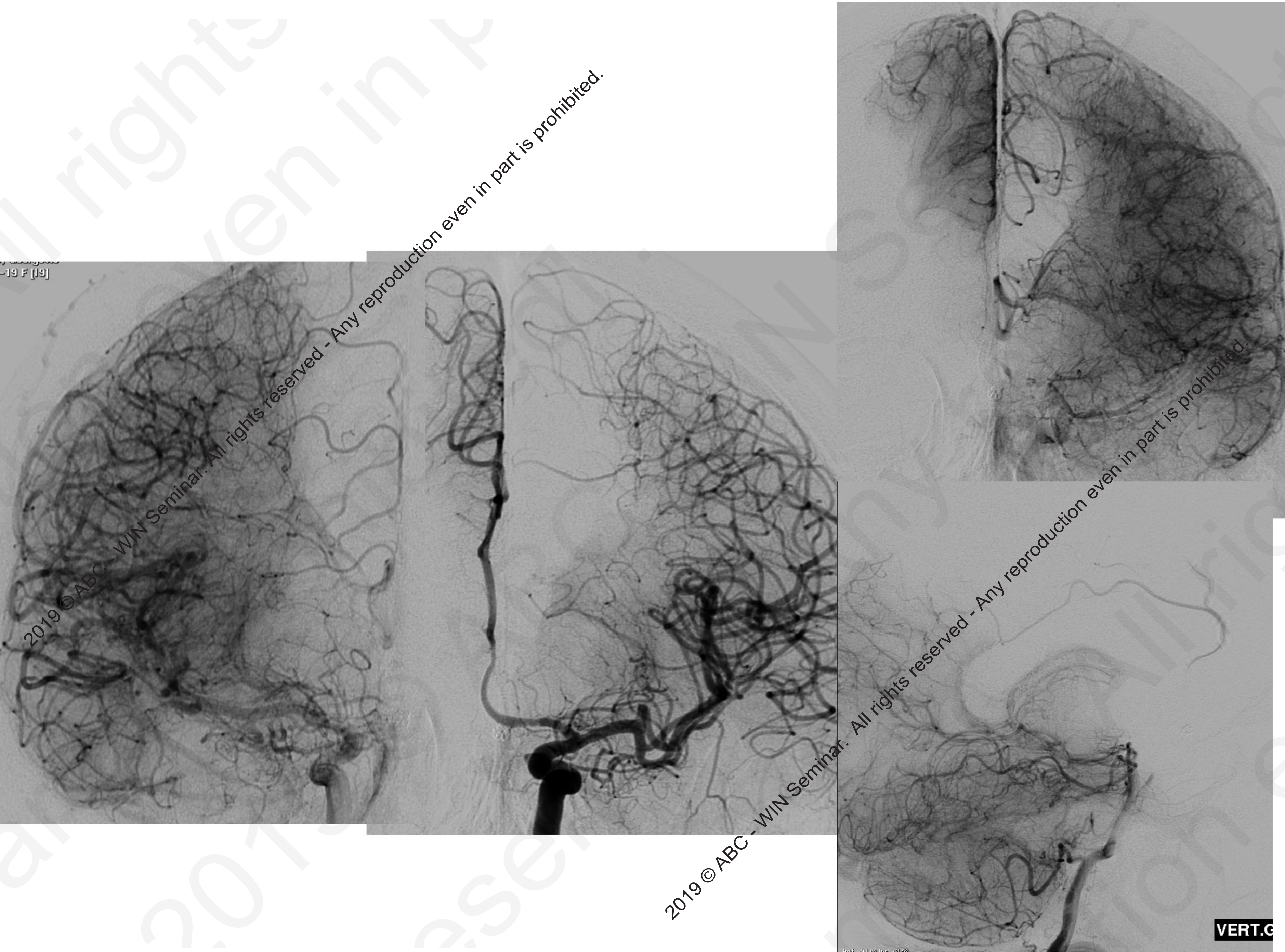








Courtesy Prof Cognard



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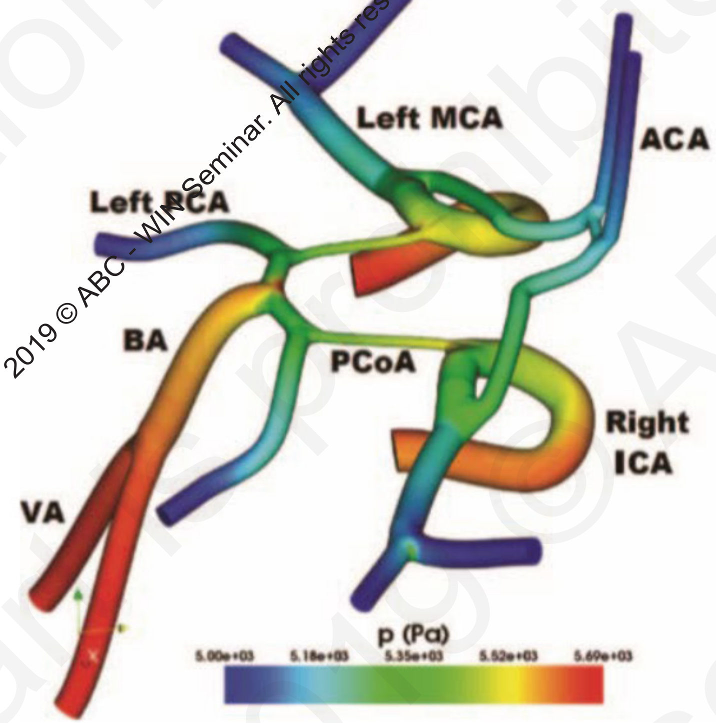
Impact of anatomical features on intra-cerebral Hemodynamics

Computation of Hemodynamics in the Circle of Willis

Martin Sandve Alnæs, MSc; Jørgen Isaksen, MD; Kent-André Mardal, PhD;
Bertil Romner, PhD; Michael K. Morgan, MD; Tor Ingebrigtsen, PhD



The circle of Willis changes the intra aneurysmal hemodynamic because the vessels proximal to the Willis circle hav additional factors such as bilateral asymmetrical filling , that determine wo minimization compared with more distal branches

- The possibility of two different AComA complex dispositions (H and Y) with high variability of morphological and hemodynamic parameters may explain the **unpredictable differences** in bleeding risk observed with a greater **propensity to bleed** even in smaller aneurysm in comparison with different locations

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anterior communicating aneurysms are more prone to rupture

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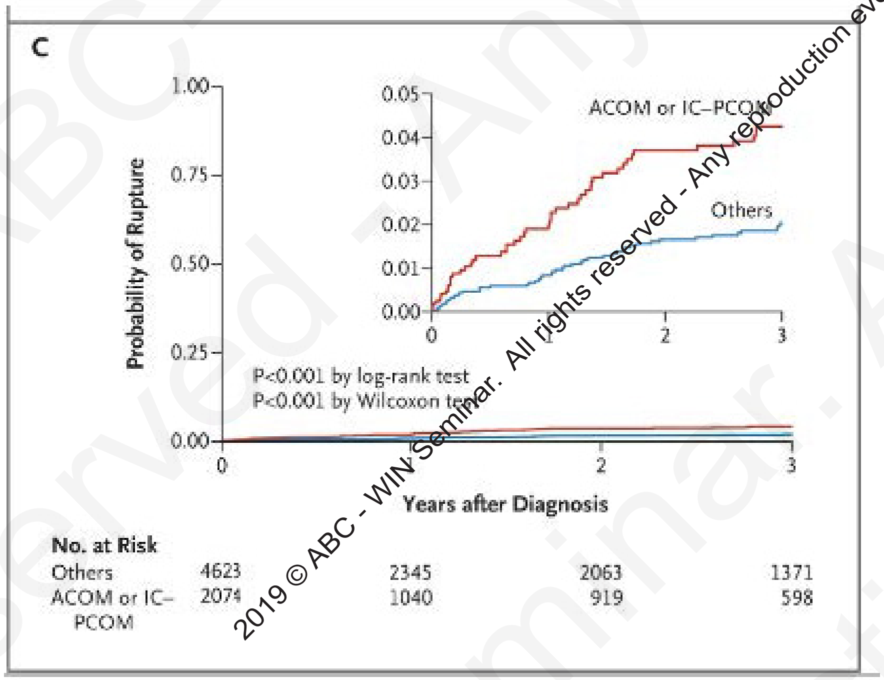
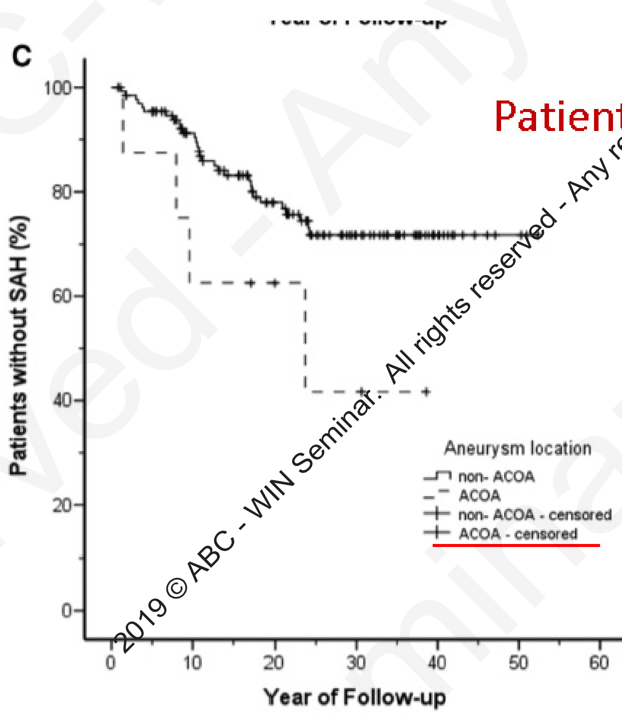
The Natural Course of Unruptured Cerebral Aneurysms in a Japanese Cohort The UCAS Japan Investigators *N Engl J Med 2012; 366:2474-2482

- Of the 6697 aneurysms studied, 91% were discovered incidentally. Most aneurysms were in the middle cerebral arteries (36%) and the internal carotid arteries (34%). The mean (±SD) size of the aneurysms was 5.7±3.6 mm. During a follow-up period that included 11,660 aneurysm-years, ruptures were documented in 111 patients, with an annual rate of rupture of 0.95% (95% confidence interval [CI], 0.79 to 1.15). The risk of rupture increased with increasing size of the aneurysm. With aneurysms that were 3 to 4 mm in size as the reference, the hazard ratios for size categories were as follows: 5 to 6 mm, 1.13 (95% CI, 0.58 to 2.22); 7 to 9 mm, 3.35 (95% CI, 1.87 to 6.00); 10 to 24 mm, 9.09 (95% CI, 5.25 to 15.74); and 25 mm or larger, 76.26 (95% CI, 32.76 to 177.54). As compared with aneurysms in the middle cerebral arteries, those in the posterior and anterior communicating arteries were more likely to rupture (hazard ratio, 1.90 [95% CI, 1.12 to 3.21] and 2.02 [95% CI, 1.13 to 3.58], respectively). Aneurysms with a daughter sac (an irregular protrusion of the wall of the aneurysm) were also more likely to rupture (hazard ratio, 1.63; 95% CI, 1.08 to 2.48).



Natural History of Unruptured Intracranial Aneurysms A Long-term Follow-up Study Seppo Juvela, MD, PhD; Kristiina Poussa, MD; Hanna Lehto, MD; Matti Porras, MD, PhD (Stroke. 2013;44:2414-2421.)

- A total of 142 patients with 181 unruptured intracranial aneurysms diagnosed between 1956 and 1978, when these were not treated, were followed up until death or subarachnoid hemorrhage, or until 2011 to 2012. Annual and cumulative incidences of aneurysm rupture and risk factors for rupture were studied using Kaplan–Meier survival analysis and Cox proportional hazards regression models. Results—The median follow-up time was 21.0 (range, 0.8–52.3) years. During 3064 person-years, there were 34 first episodes of aneurysm rupture, giving an average annual incidence of 1.1%. Eighteen patients died on account of an initial or recurrent aneurysm rupture. The cumulative rate of bleeding was 10.5% (95% confidence interval [CI], 5.2–15.8) at 10 years, 23.0% (95% CI, 15.4–30.6) at 20 years, and 30.1% (95% CI, 21.3–38.9) at 30 years. None of the index aneurysms bled after a follow-up of 25 years. g/week; 95% CI, 1.05– 1.53; P<0.05), but only in univariable Cigarette smoking (adjusted hazard ratio, 2.44; 95% CI, 1.02–5.88), location of the aneurysm in the anterior communicating artery (adjusted hazard ratio, 3.73; 95% CI, 1.23–11.36), patient age inversely (0.96 per year, 95% CI, 0.92–1.00) and aneurysm diameter ≥7 mm (adjusted hazard ratio, 2.60; 95% CI, 1.13–5.98) independently predicted subsequent aneurysm rupture, as did alcohol consumption (1.27 per 100 analysis. Conclusions—Cigarette smoking, patient age inversely, and the size and location of the unruptured intracranial aneurysm seem to be risk factors for aneurysm rupture. The risk of bleeding decreases with a very long-term follow-up.



In conclusion
Take home messages

- For the AcomA is important to carefully consider the anatomical disposition of the aneurysm in order to better evaluate the modality of treatment (way of access, use of one or more protection devices, technique of embolization, flow diversion) and to forecast the stability of the result
- comprehensive morphological evaluation is more important than isolated anatomic features
- In perspective, hemodynamic studies in different AcomA complex configurations will better define the role of flow diversion
- For complex aneurysms surgery must still be considered

Thank you for your kind attention

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