The veins of the cranio-cervical junction

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general organization

the cranial venous system

cerebral venous system

- supratentorial and infratentorial superficial and deep venous systems
- dural venous sinuses

neurocranial venous system

- meningeal veins (sinuses)
- diploic veins

emissary veins

general organization

the bulk of the cerebral venous outflow reaches the internal jugular veins and the vertebral venous system by way of the dural venous sinuses of the posterior fossa

a small proportion of the cerebral venous outflow also reaches the external jugular vein by way of the cavernous sinus (CS) and its venous derivation pathways

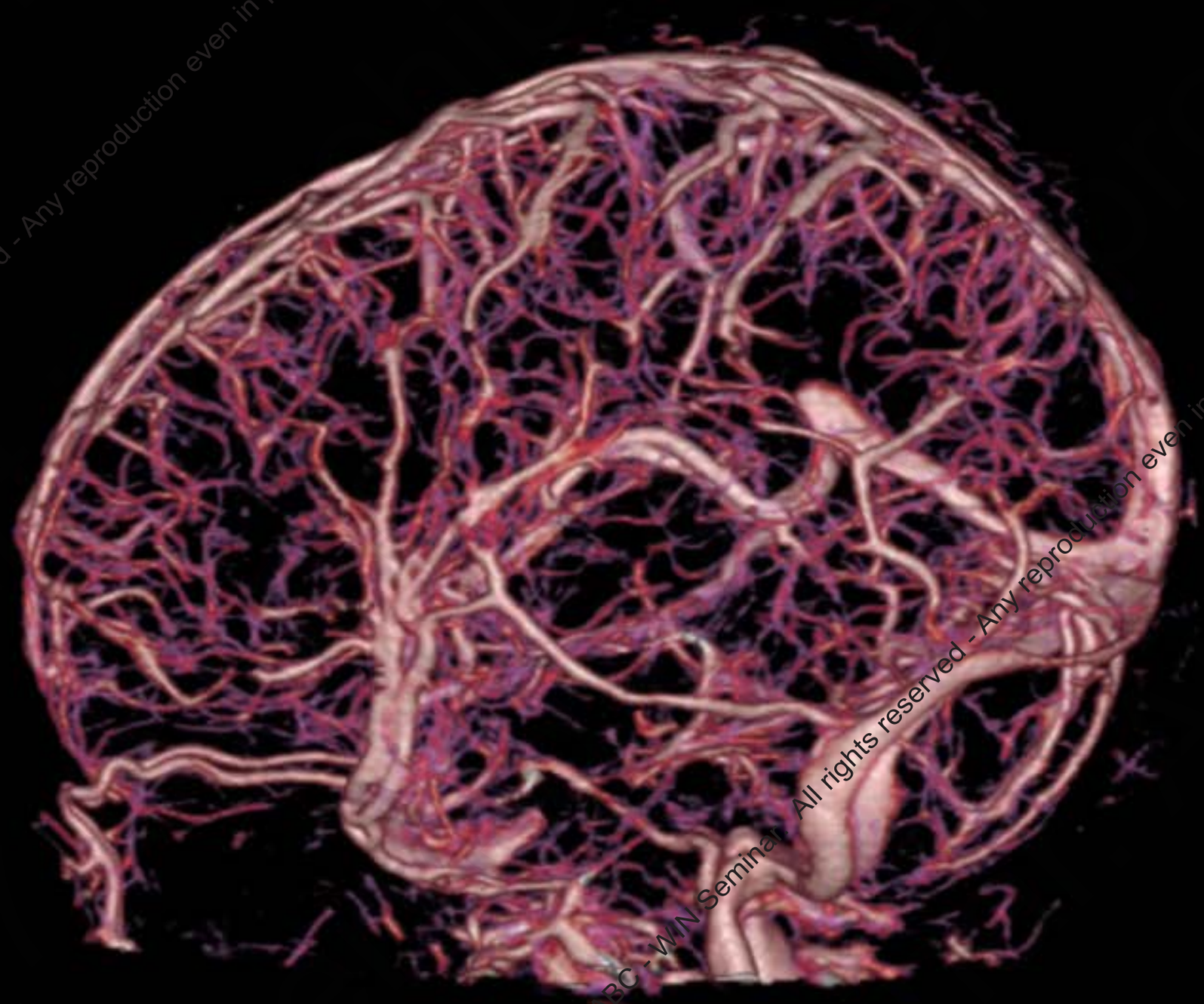
general organization

primary cerebral venous outflow pathways of the neck :

- internal jugular vein
- vertebral venous system
  - external vertebral venous system
    - vertebral artery venous plexus
    - deep cervical veins
    - (suboccipital venous plexus)
  - internal vertebral venous system
    - anterior internal vertebral venous plexus
    - posterior internal vertebral venous plexus

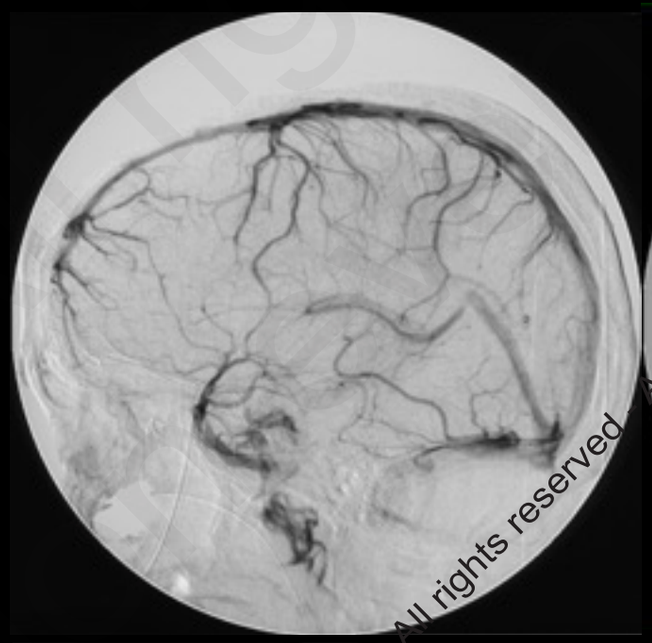
(external jugular vein)

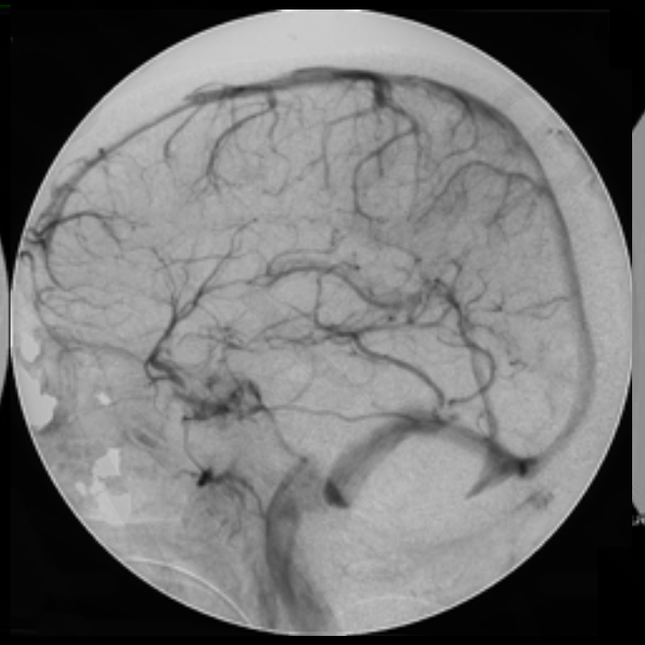
general organization

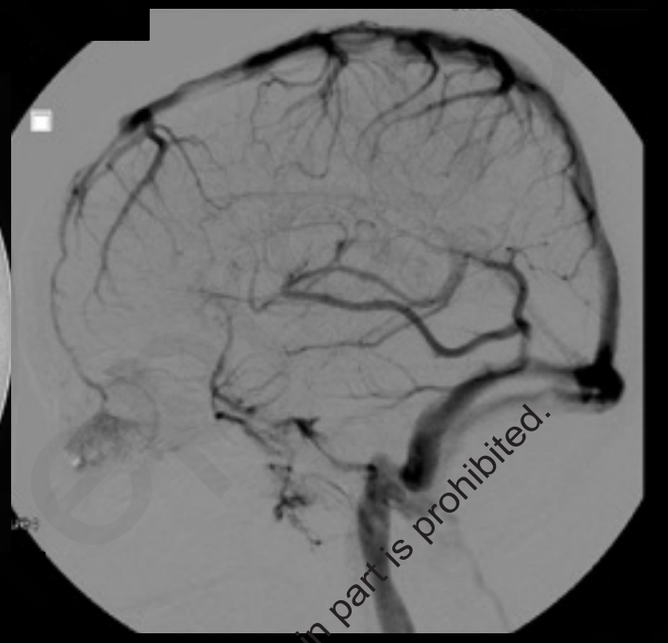


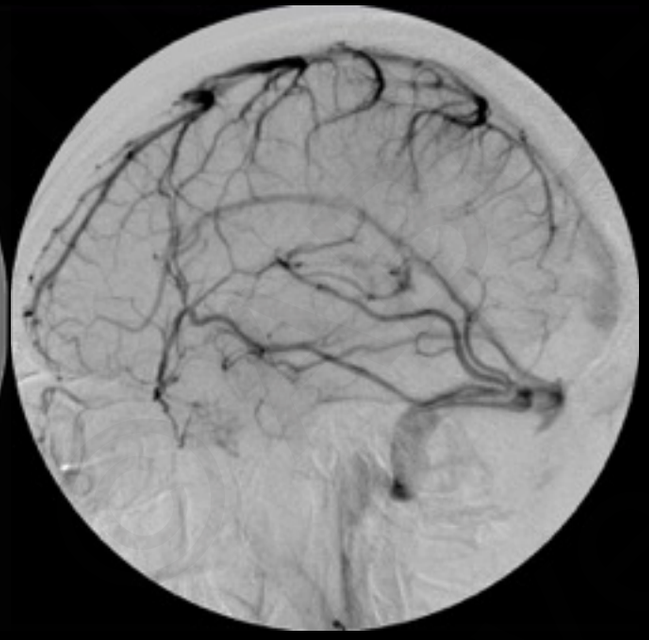
dynamic- CTA
320-MDCT

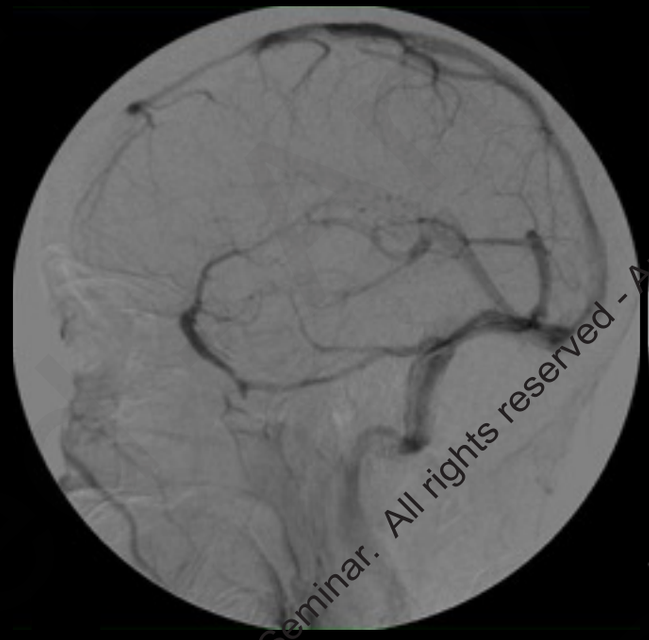
general organization

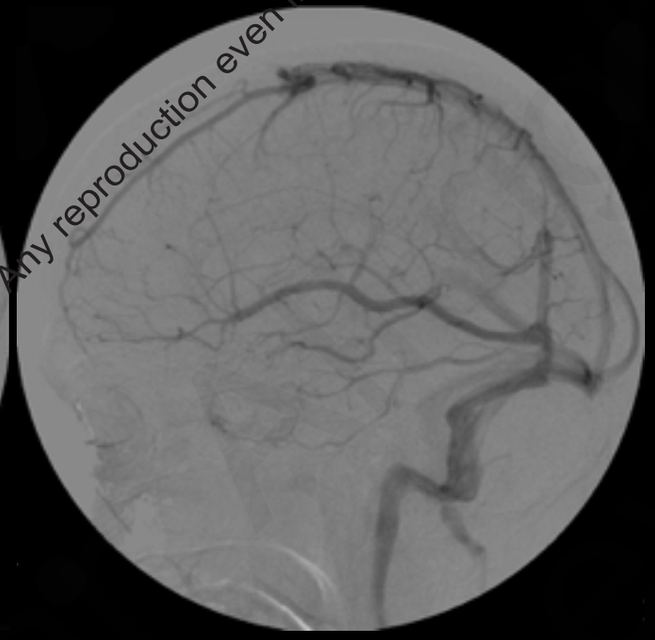








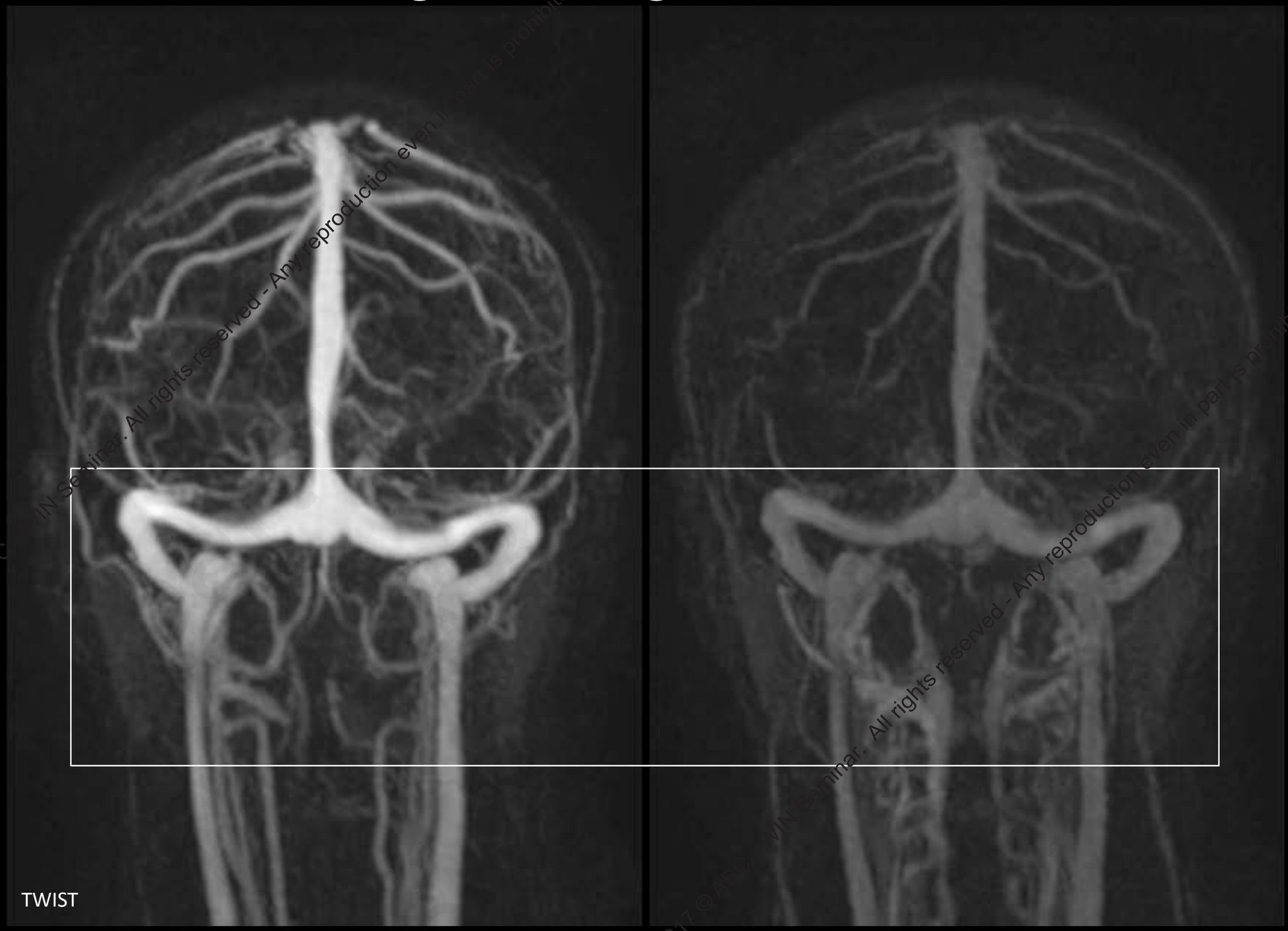




general organization

TWIST
child

general organization



TWIST

plan

the descending venous pathways

- vertebral venous system
  (internal / external jugular veins)

the connections between the intracranial venous system and the descending venous pathways

- emissary veins and other venous channels

persistent venous channels leading to anatomic (extreme) variation

specific anatomical dispositions

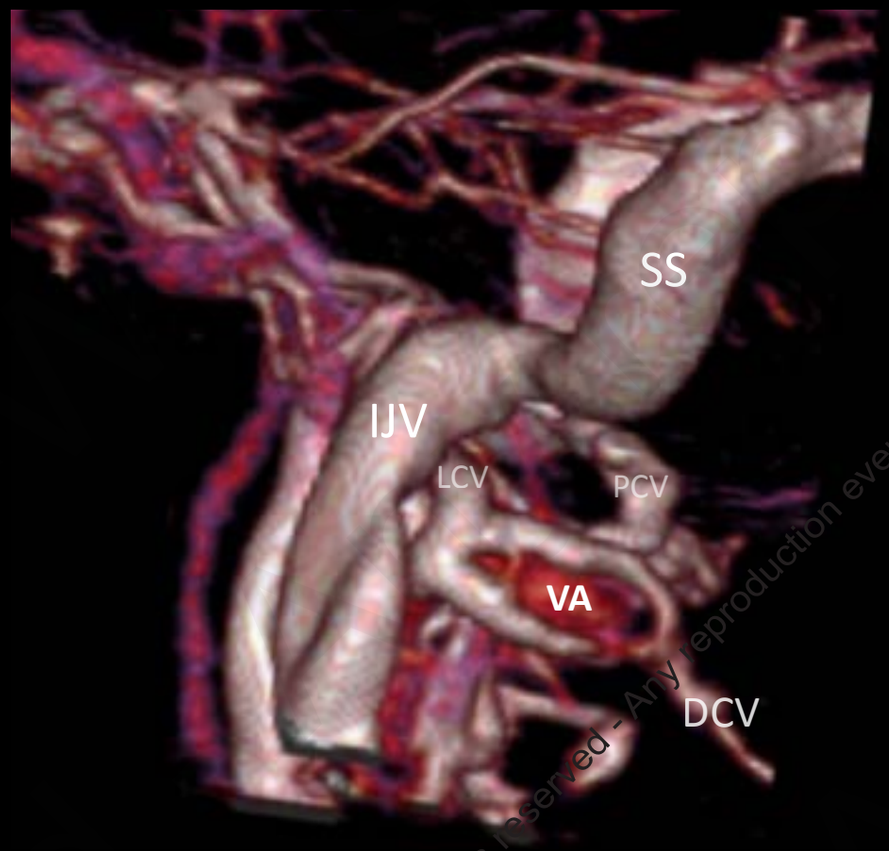
the vertebral artery venous plexus (VAVP)

the vertebral artery venous plexus (VAVP)

- the vertebral artery venous plexus (VAVP) :
  - belongs to the external vertebral venous system
  - courses longitudinally along the transverse foramina from C1 to C7
  - intimate relation with the vertebral artery (VA), surrounds the VA from V2 to VA dural crossing at V3/V4 junction
  - connects to:
    - ← anterior condylar vein (ACV)
    - ← the intervertebral veins (IVV) ← the internal vertebral venous plexus (IVVP)
    - ← lateral condylar vein (LCV)
    - ← posterior condylar vein (PCV)
    - ← deep cervical vein (DCV)
    - ← internal jugular vein (IJV)
    - → one to several vertebral vein(s) → innominate / brachiocephalic veins
  - constant

the vertebral artery venous plexus (VAVP)

Dynamic-CTA
320-MDCT



CTV
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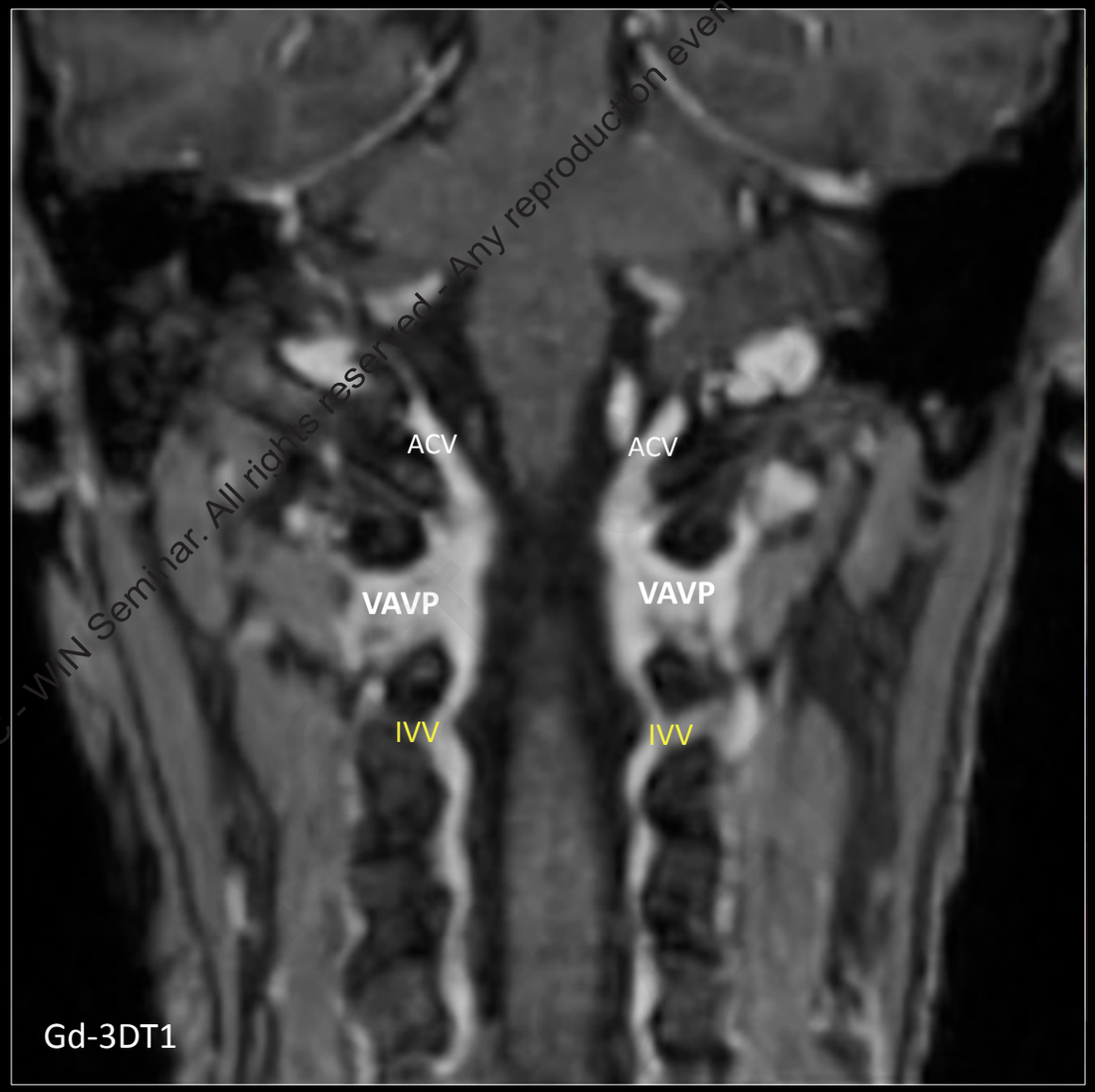
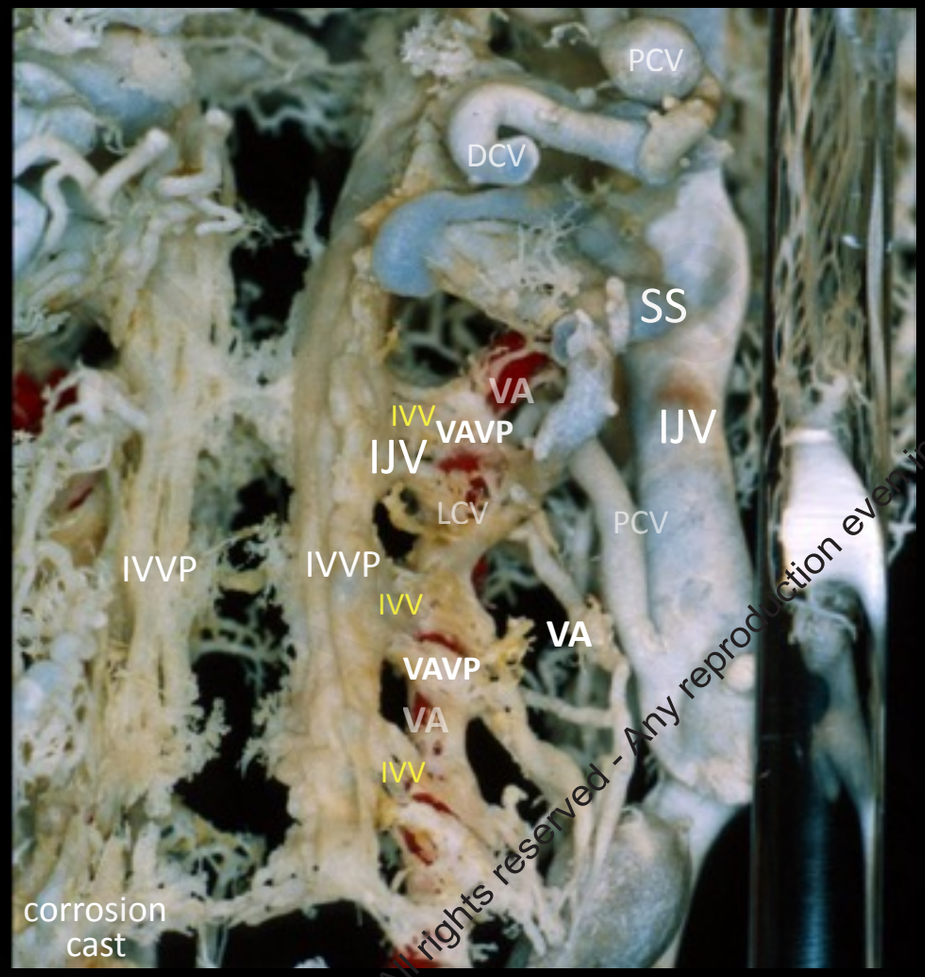
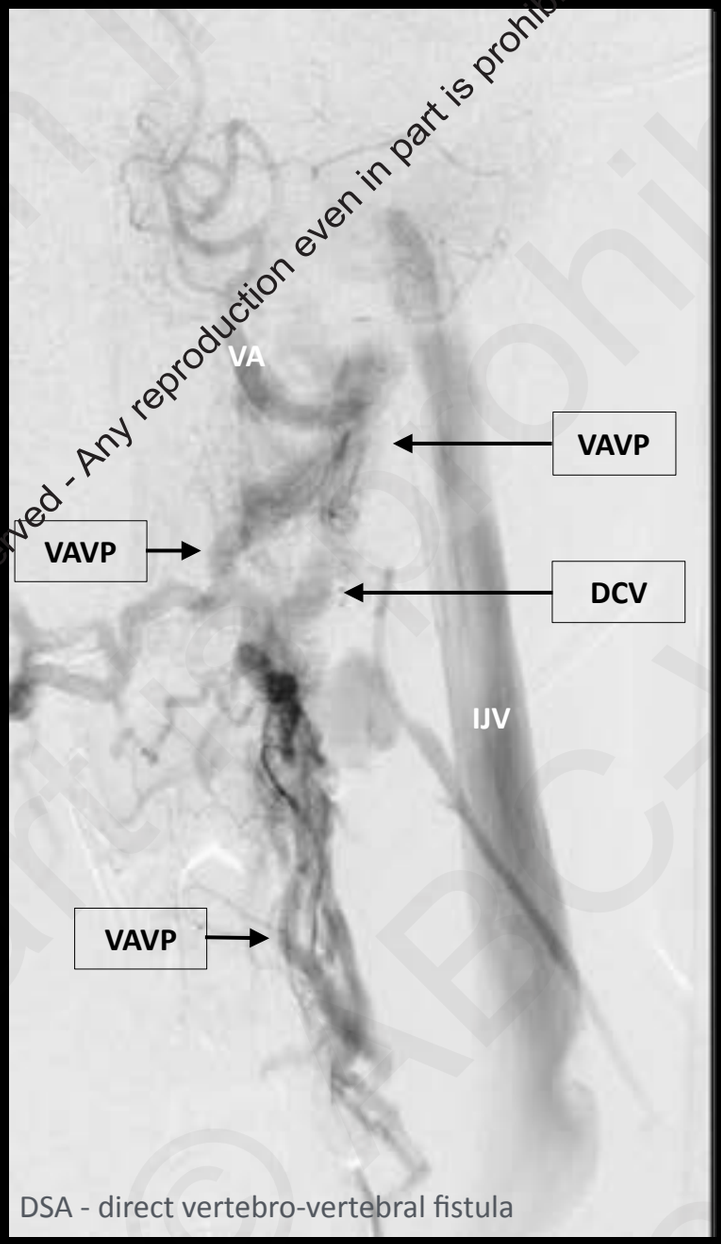
the vertebral artery venous plexus (VAVP)





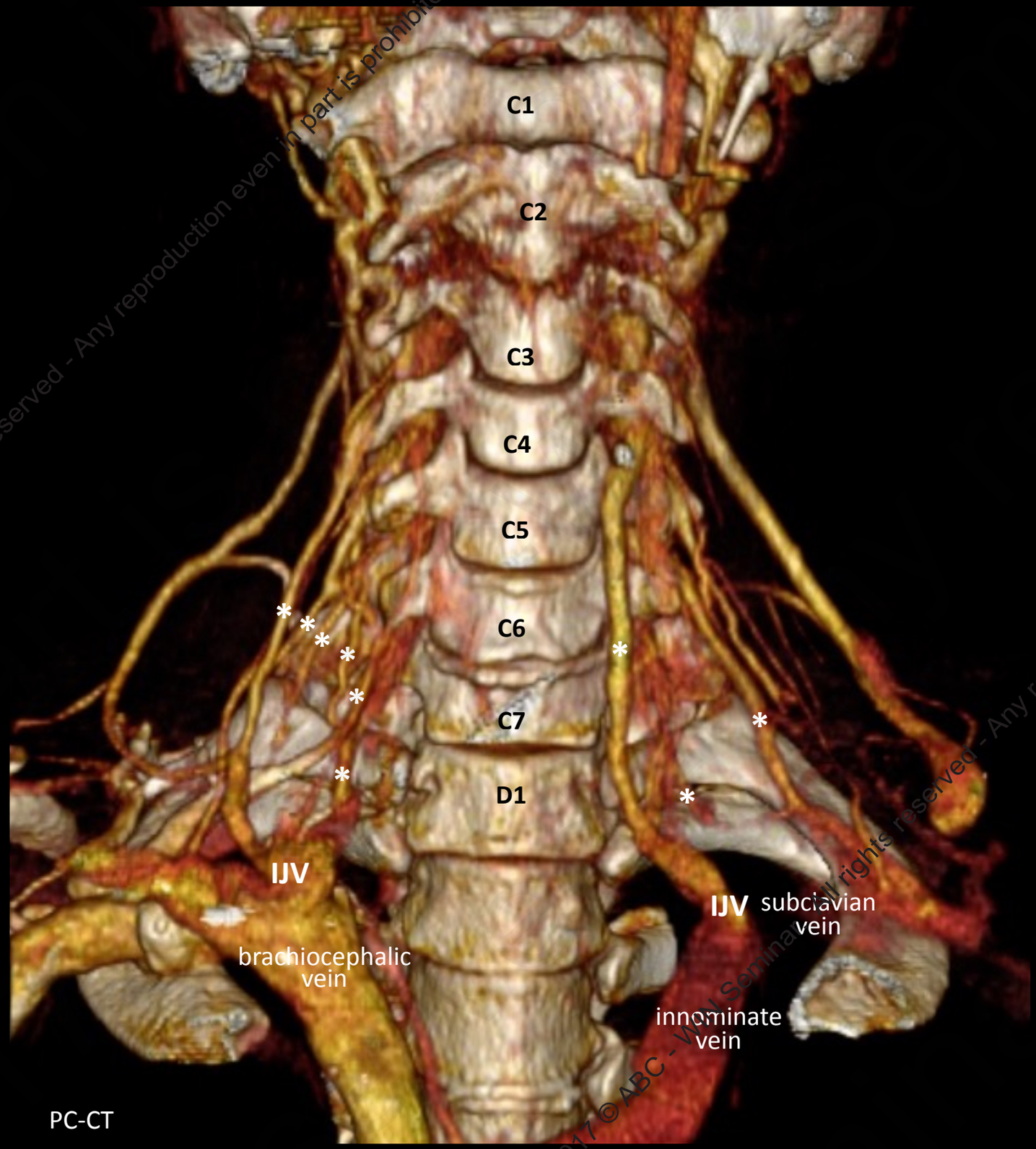
the external vertebral venous system (EVVS)



the external vertebral venous system (EVVS)

- vertebral artery venous plexus (VAVP)
- deep cervical veins (DCV)
- suboccipital venous plexus (SOVP)

the vertebral artery venous plexus (VAVP)



the anterior condylar confluence (ACC)

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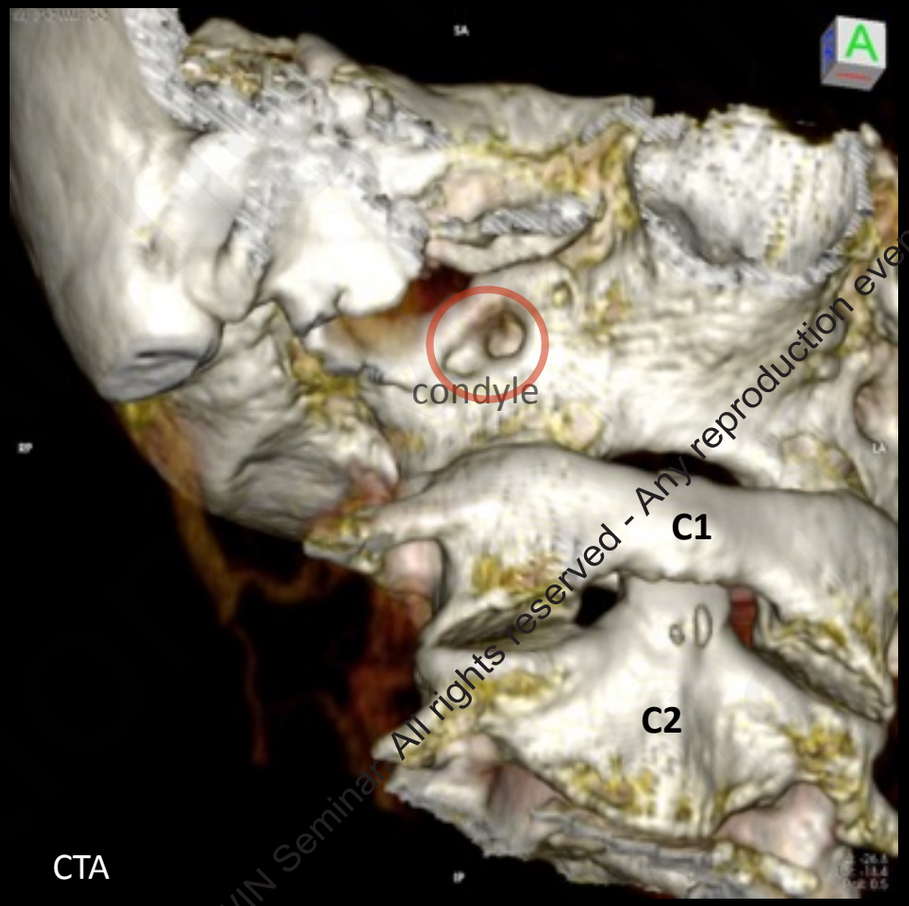

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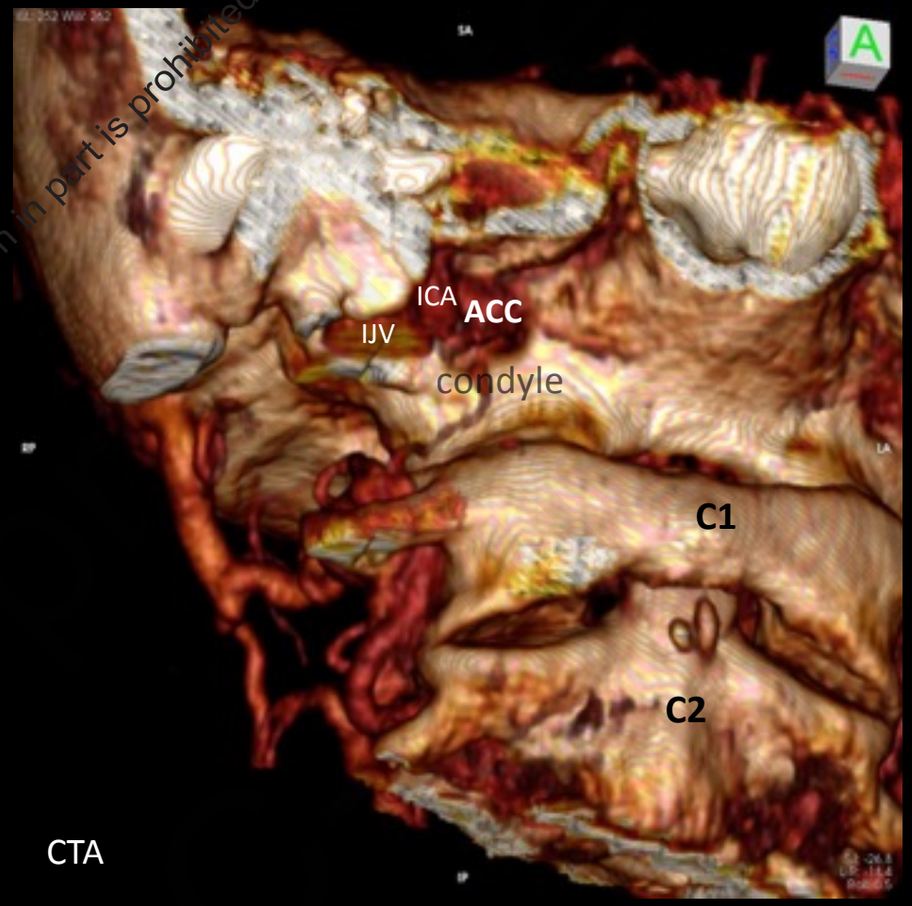

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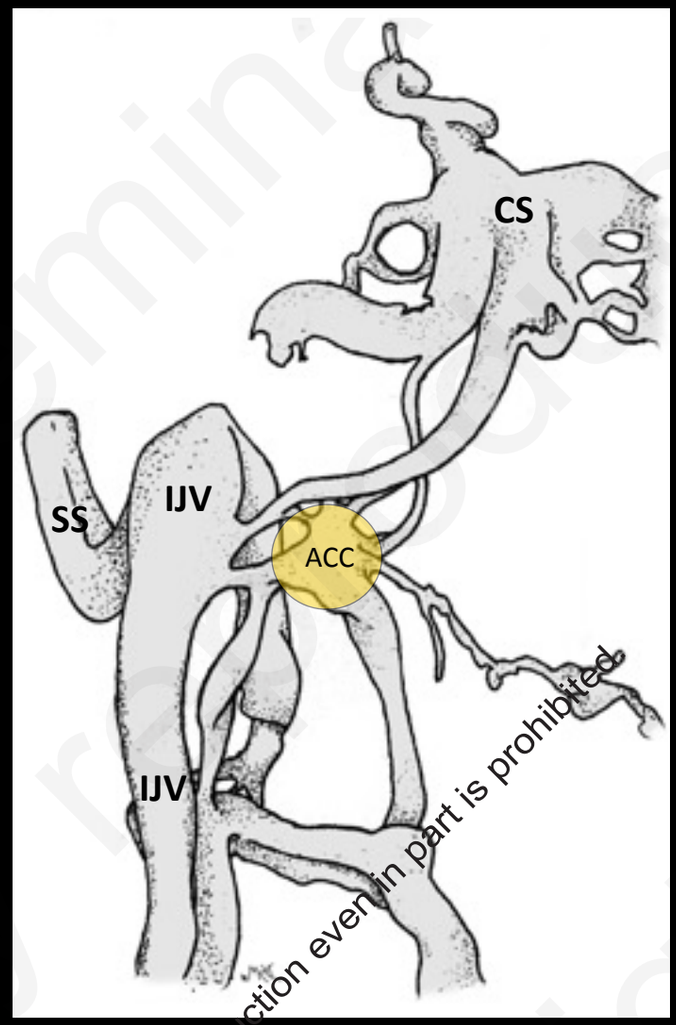
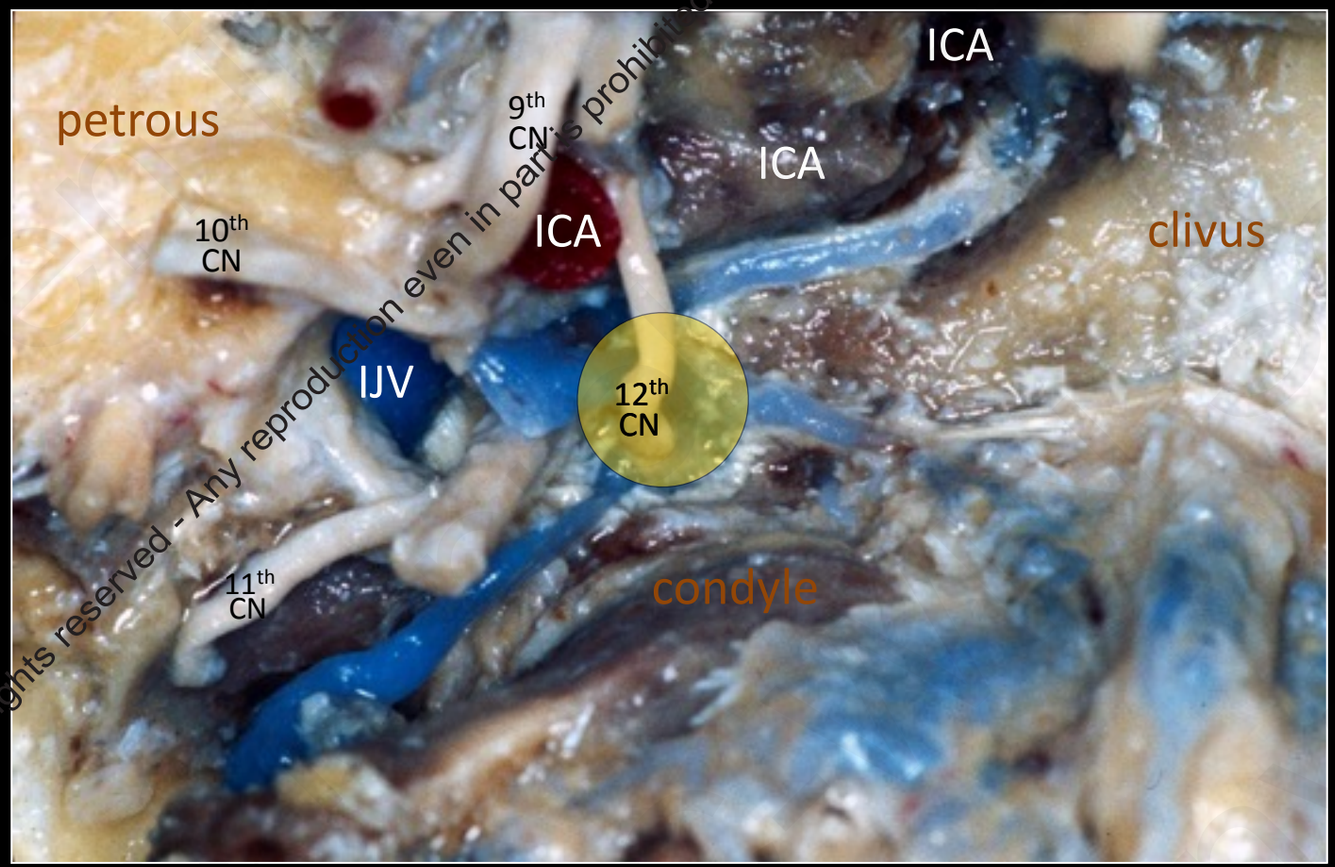
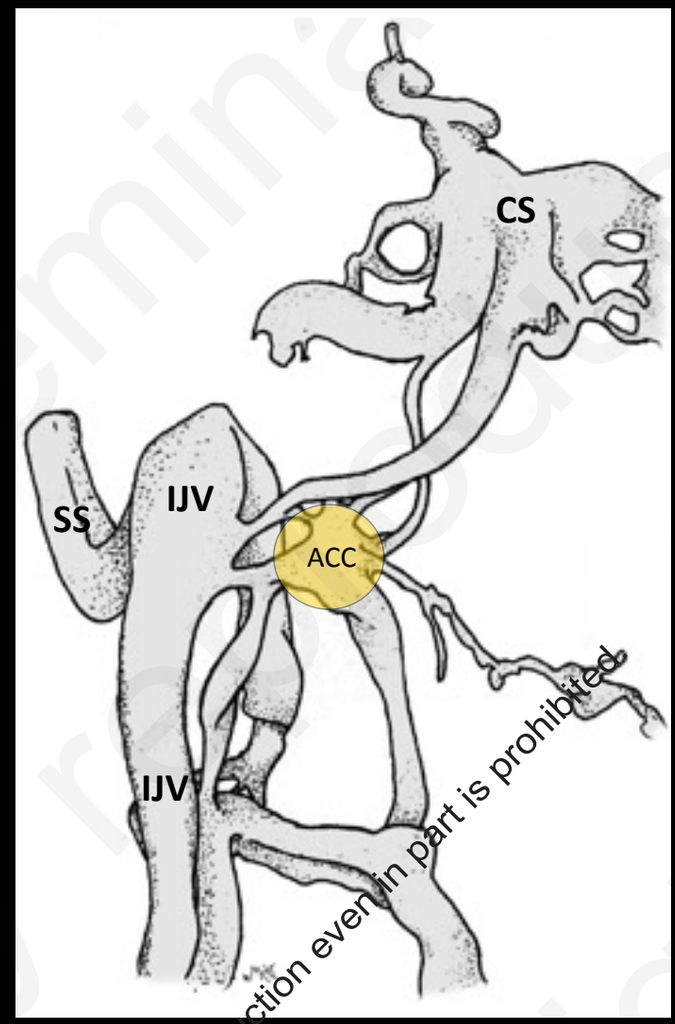


- constant
- located in front of the extra-cranial aperture of the hypoglossal canal, groove

the anterior condylar confluence (ACC)





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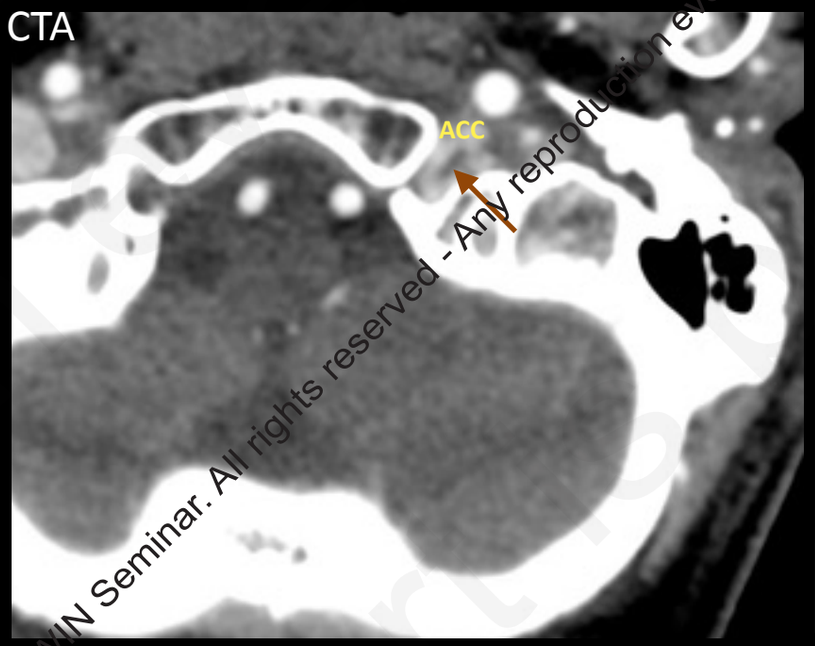

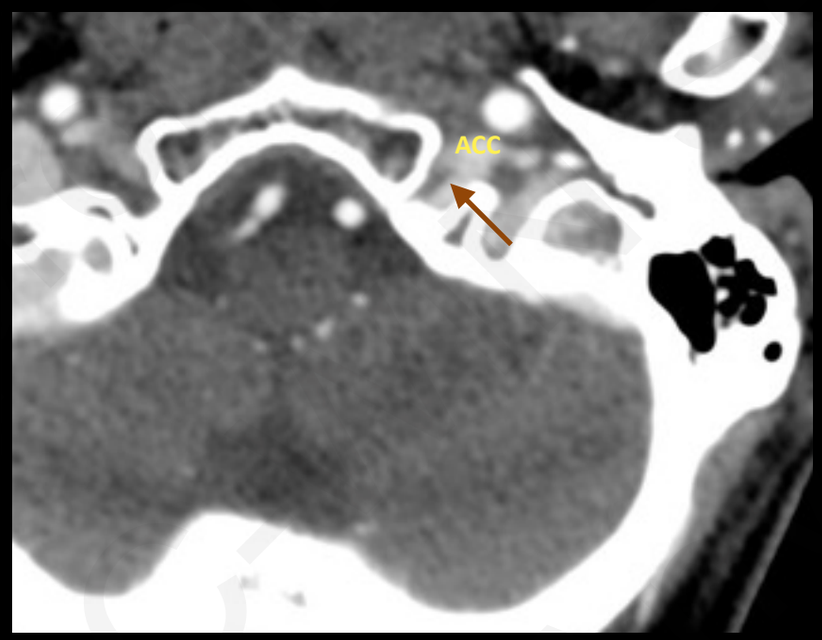

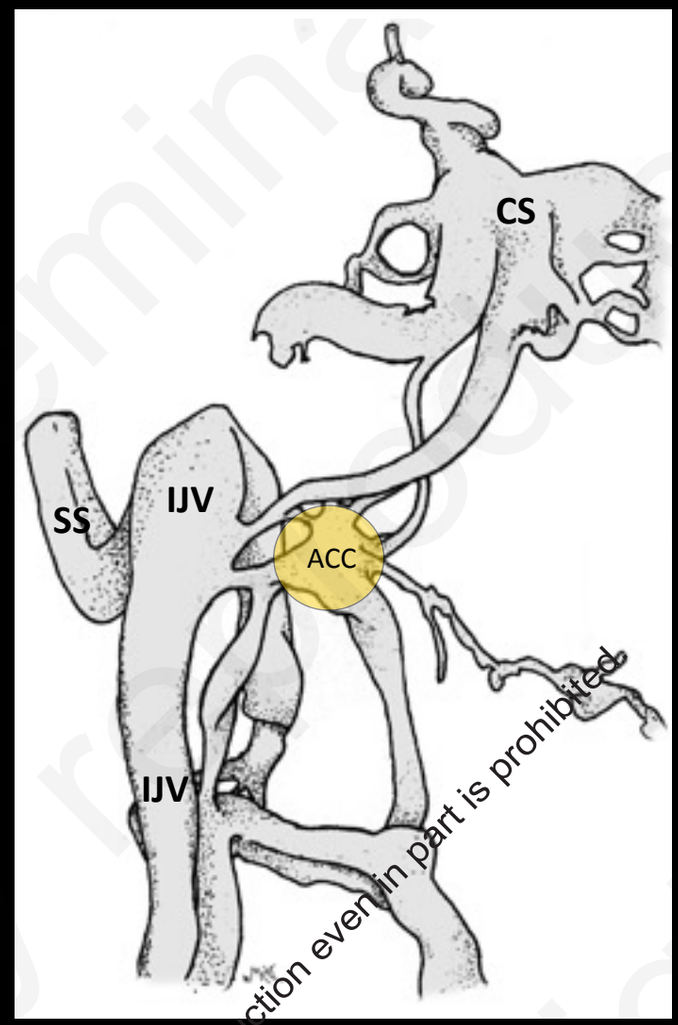

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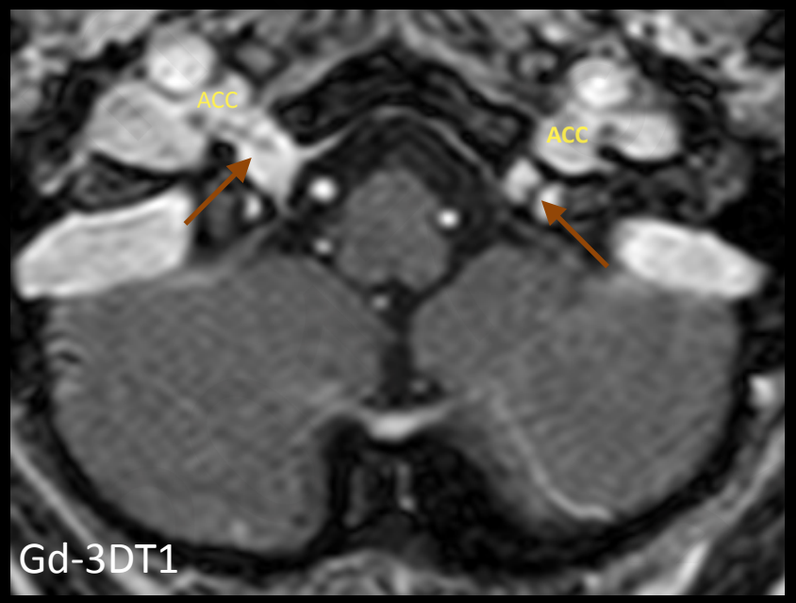

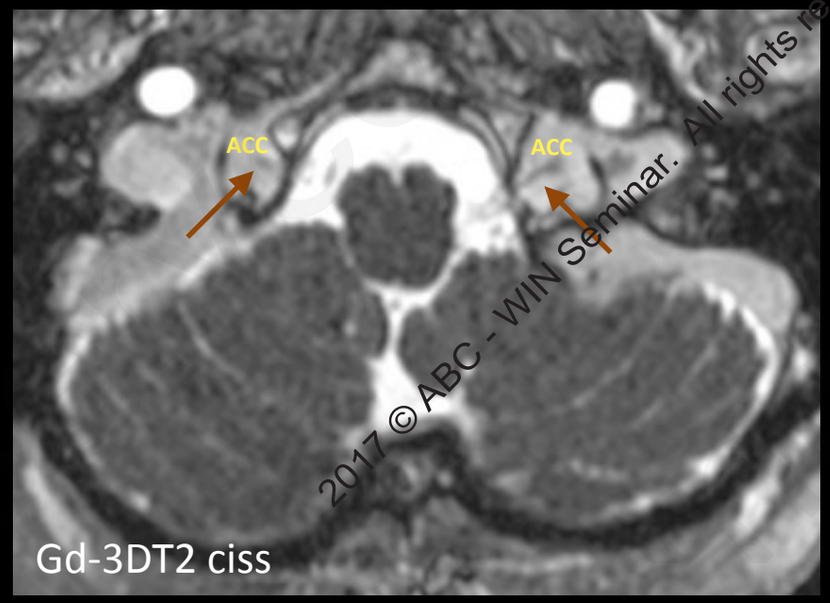

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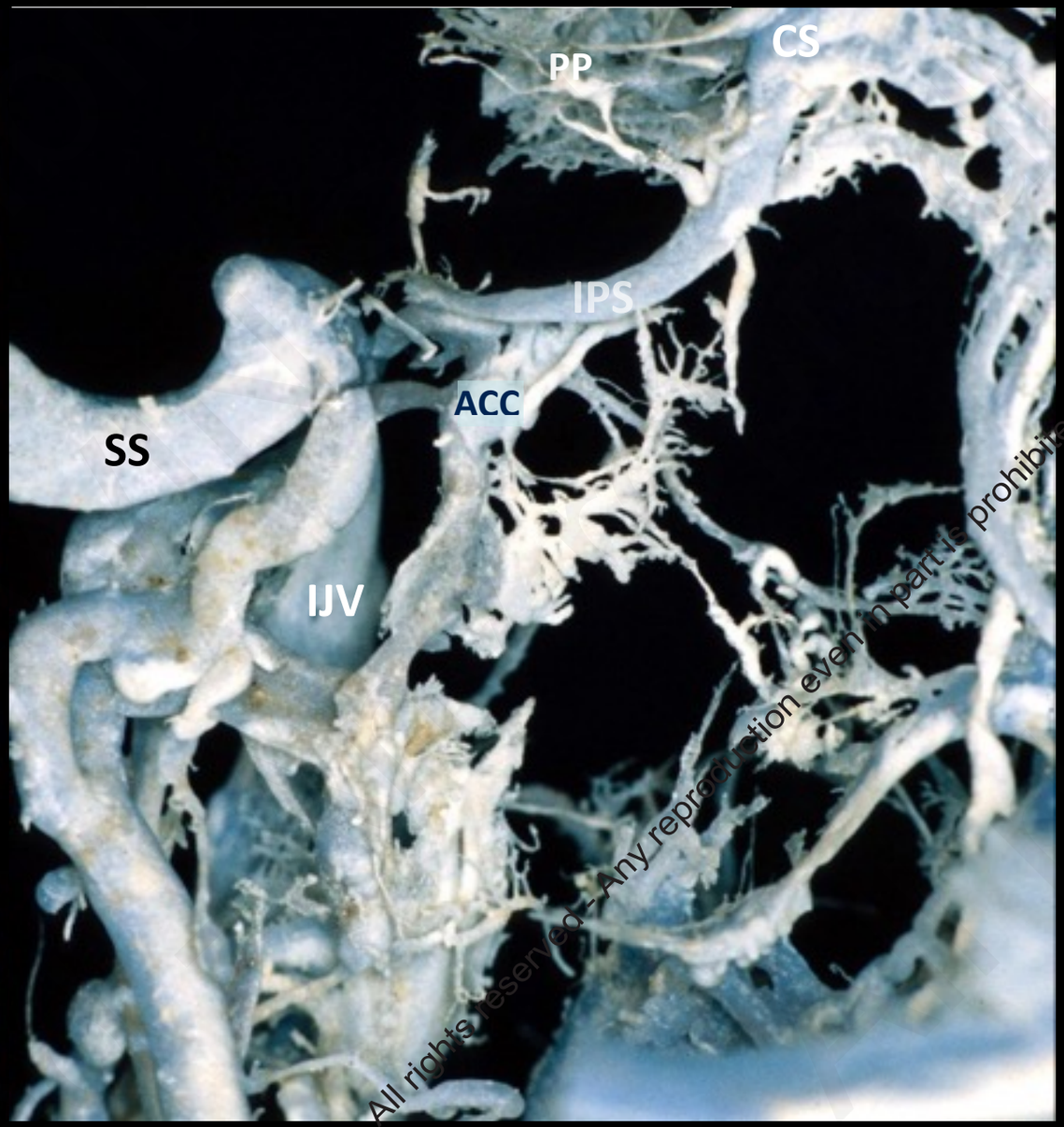

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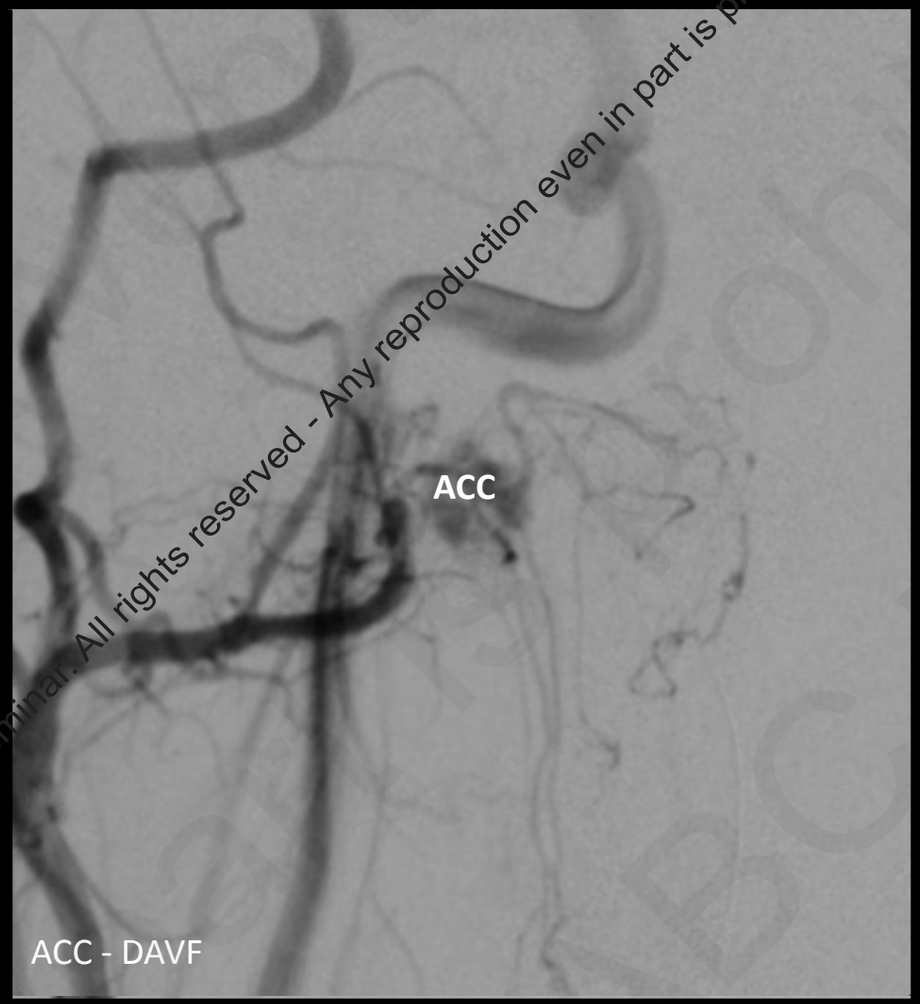
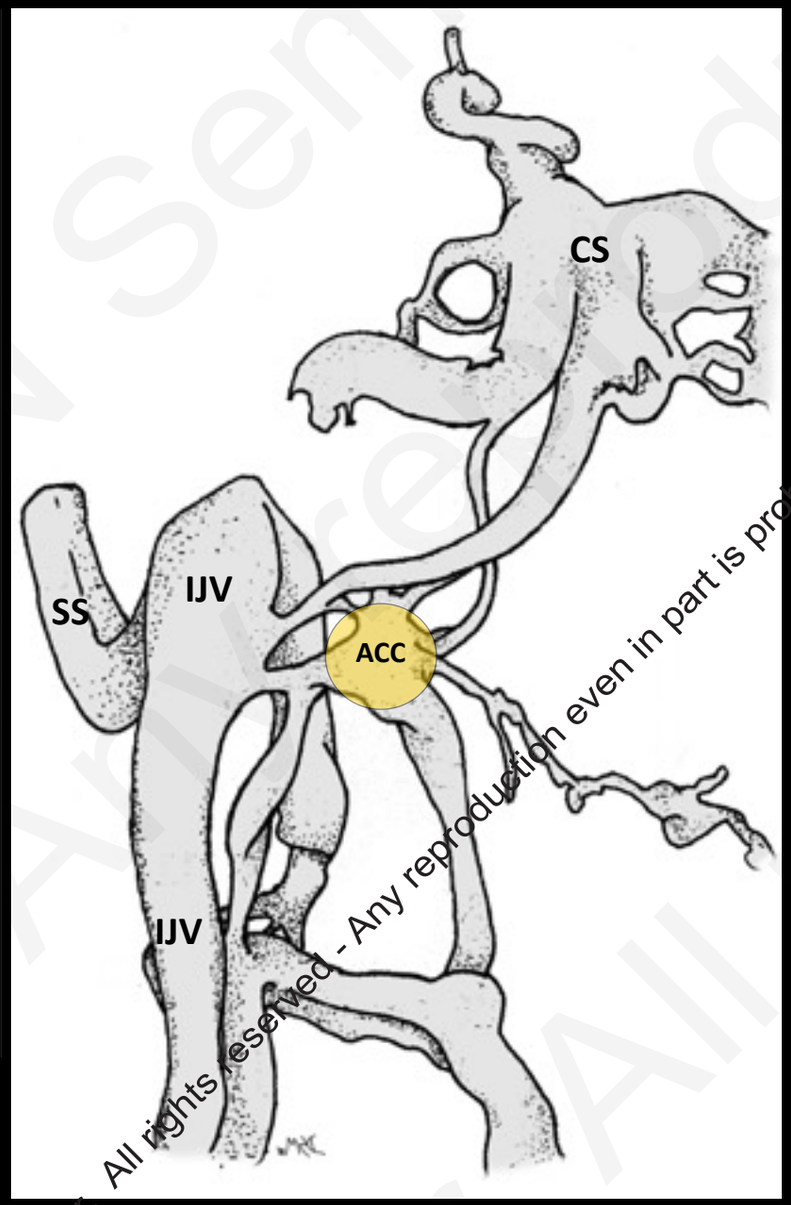


ACC - DAVF



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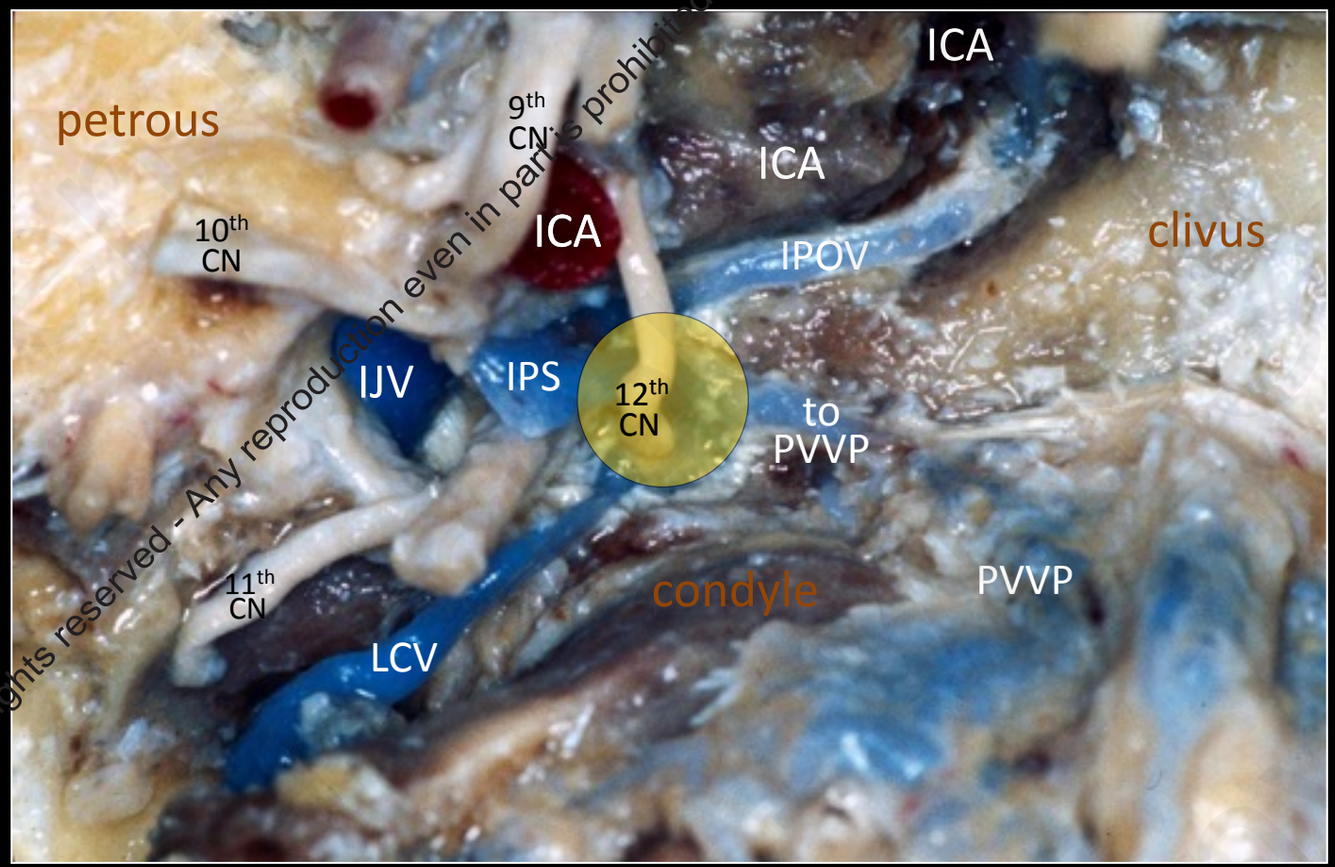
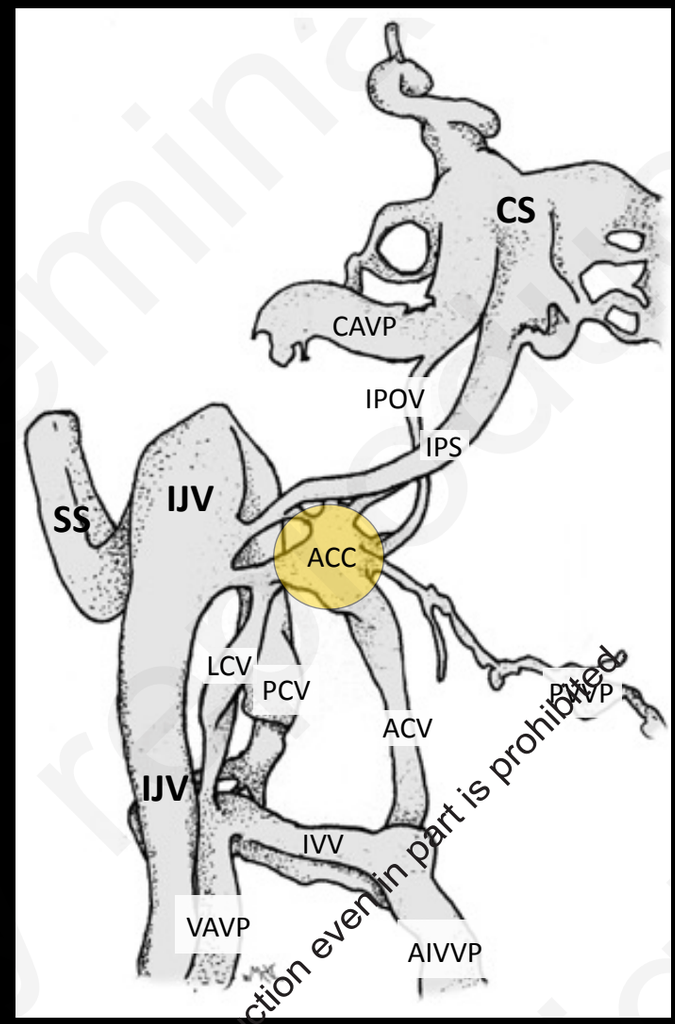


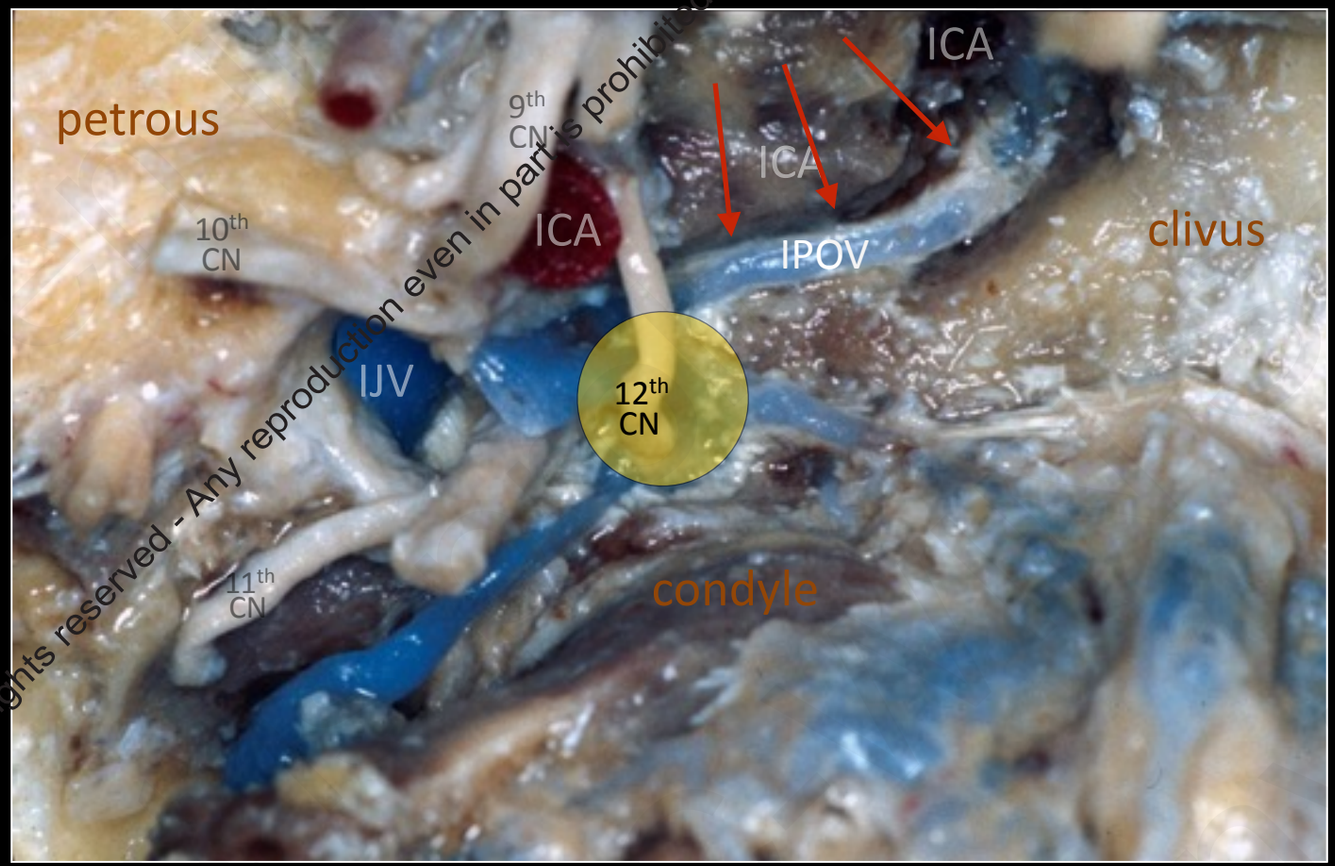


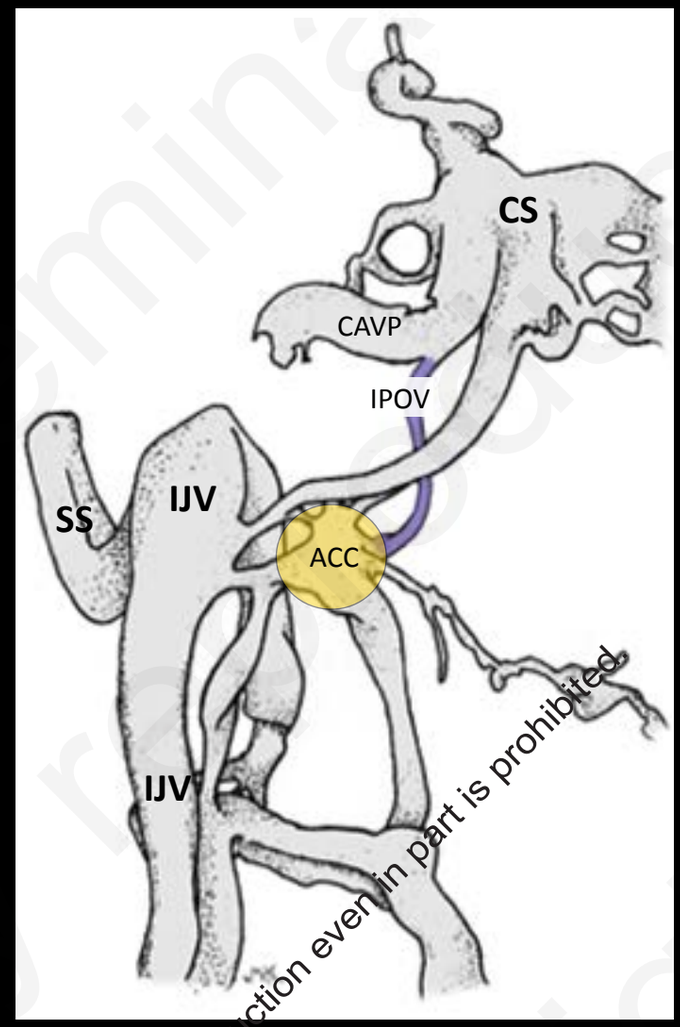
- constant
- located in front of the extra-cranial aperture of the hypoglossal canal
- venous connections:
  ← the inferior petro-occipital vein (IPOV) ← carotid artery venous plexus (CAVP - Rektorzik)
  → IJV
  ← anterior condylar vein (ACV) ← anterior internal vertebral venous plexus
  → lateral condylar vein (LCV) → vertebral artery venous plexus (VAVP)
  → pre vertebral venous plexus (PVVP)
  ← inferior petrosal sinus (IPS)

- important venous crossroad of the cranio-cervical venous junction

the inferior petro-occipital vein (IPOV)

the inferior petro-occipital vein (IPOV)

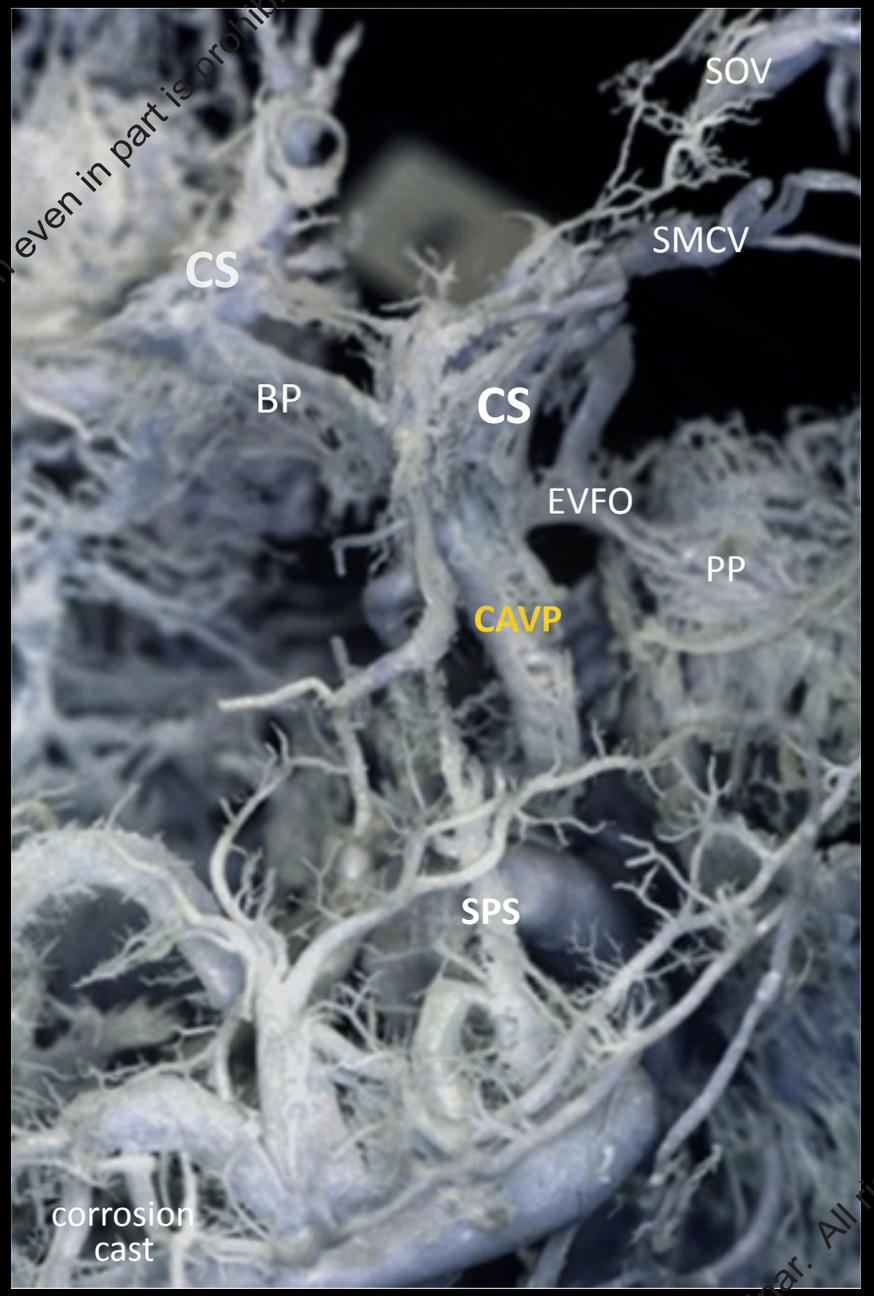


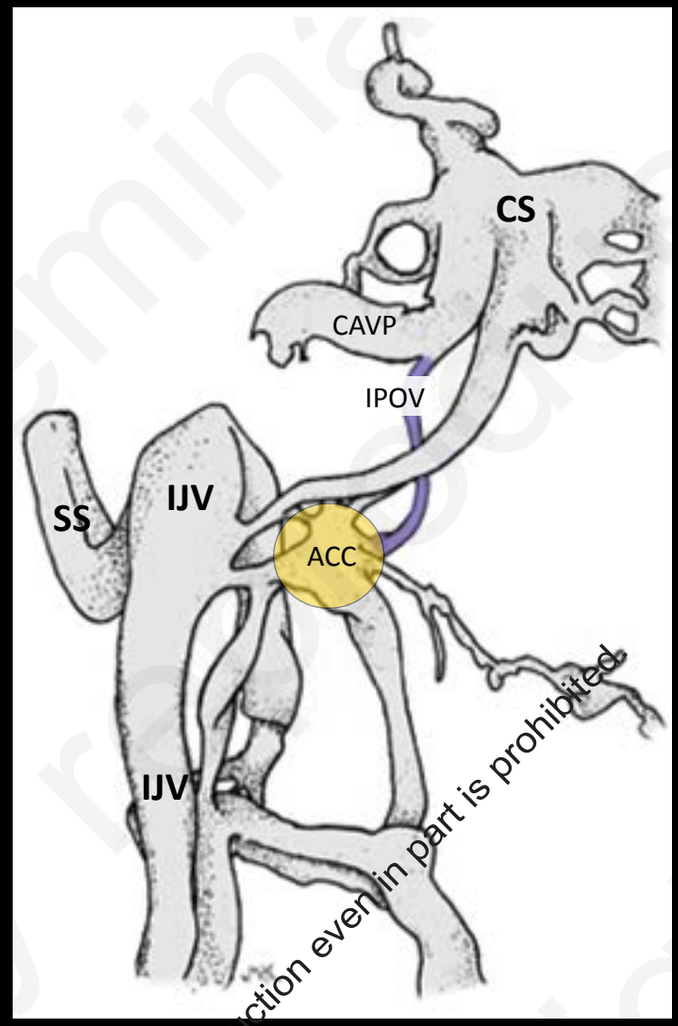


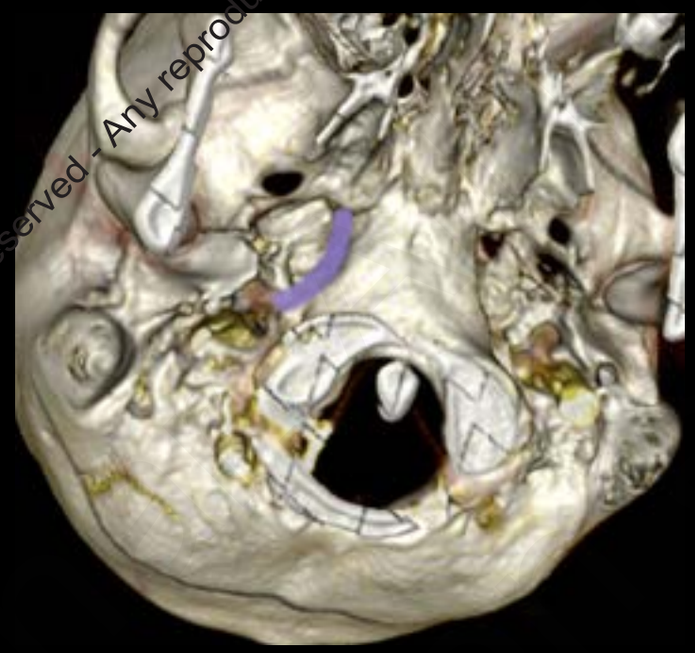
- the inferior petro-occipital vein (IPOV) of Trolard
  - courses along the extra-cranial surface of the petro-occipital suture, contained in fibrous tissue
  - connects the carotid artery venous plexus of Rektorzik (CAVP) to the ACC
  - present most times (can be very thin)

the inferior petro-occipital vein (IPOV)

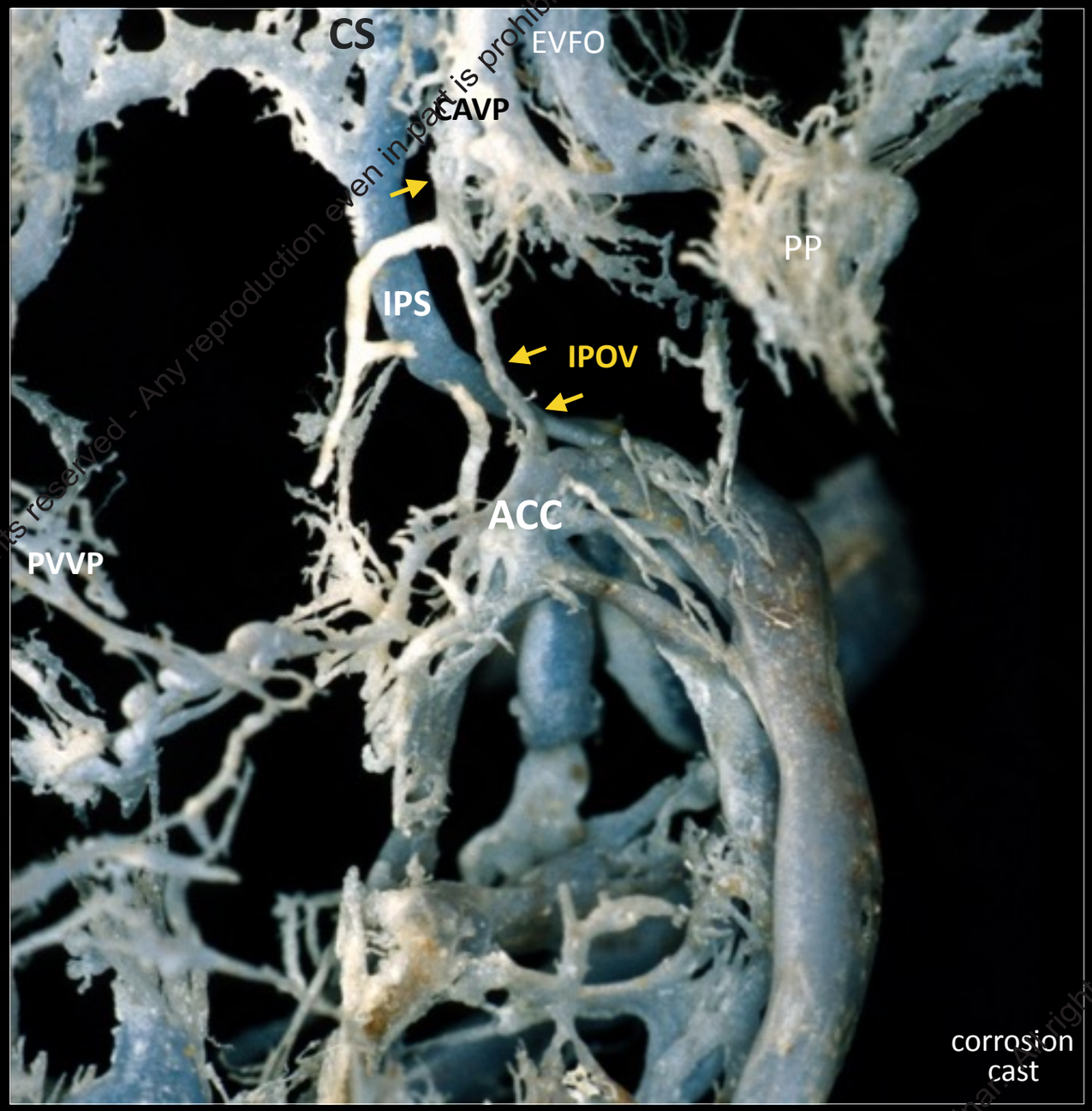
carotid artery venous plexus of Rektorzik - CAVP



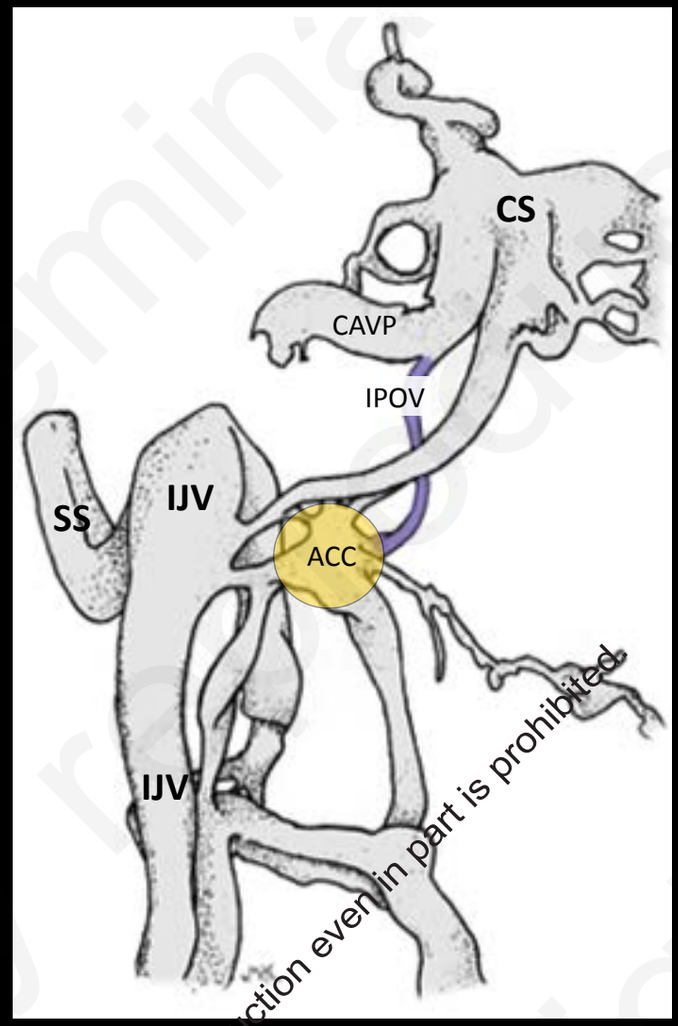




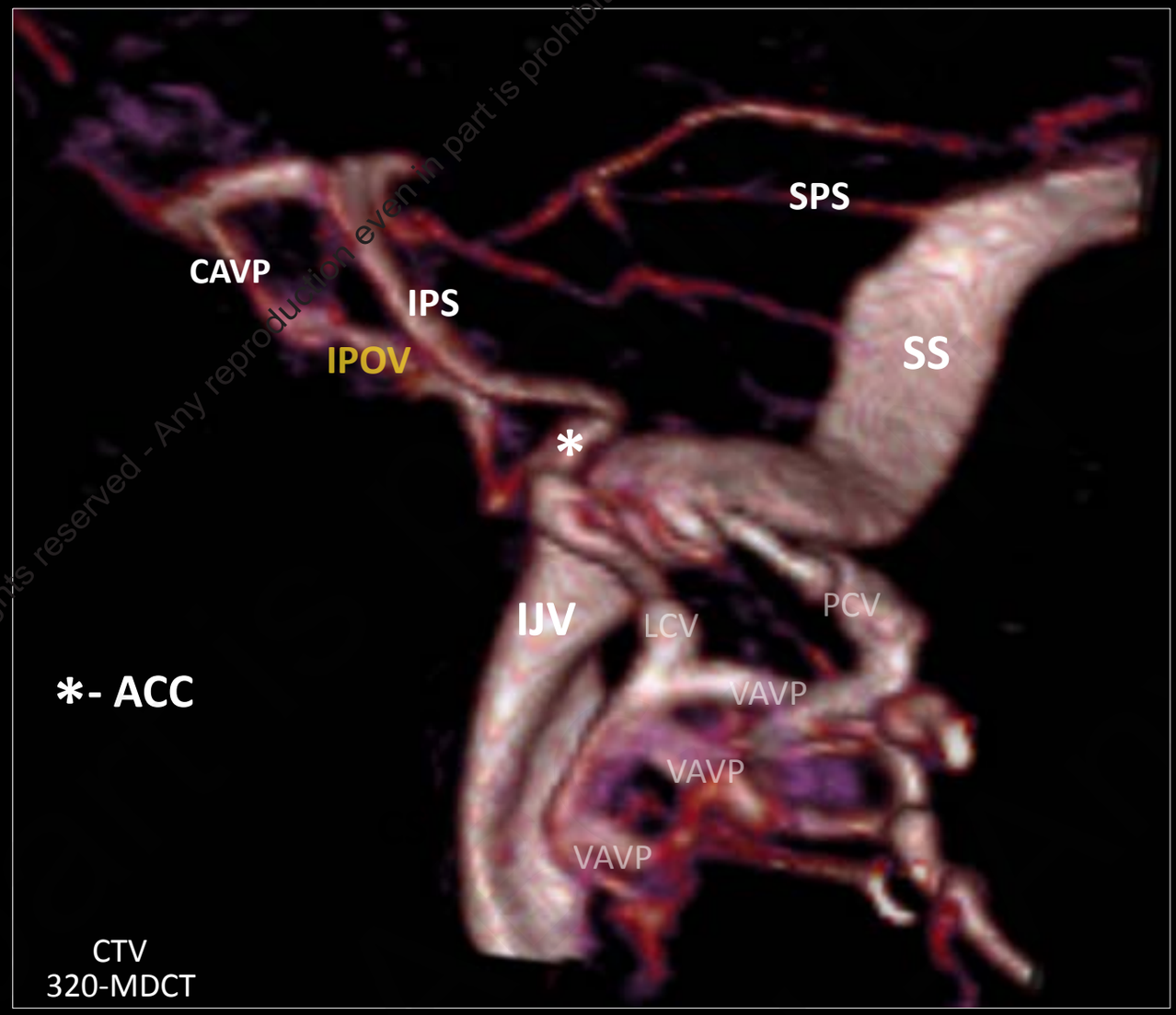
the inferior petro-occipital vein (IPOV)



corrosion cast



the inferior petro-occipital vein (IPOV)



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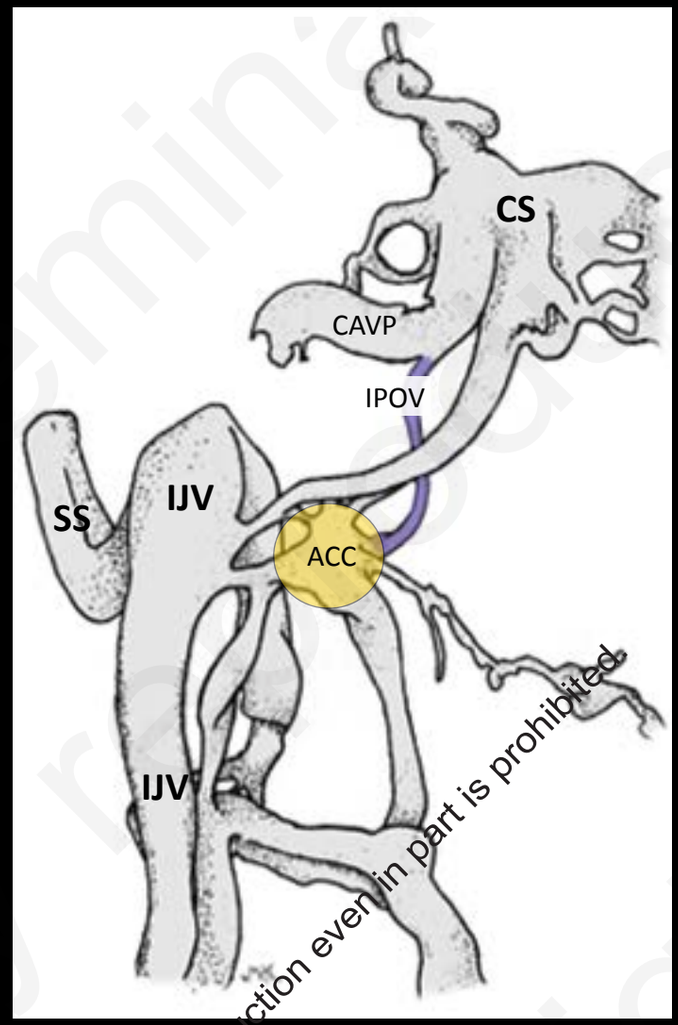

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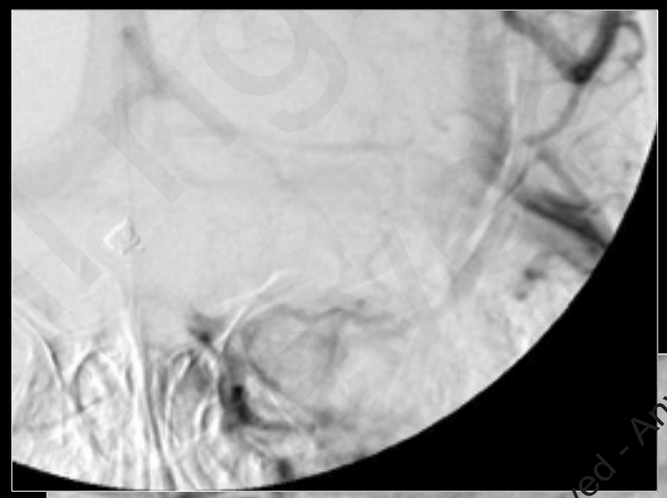

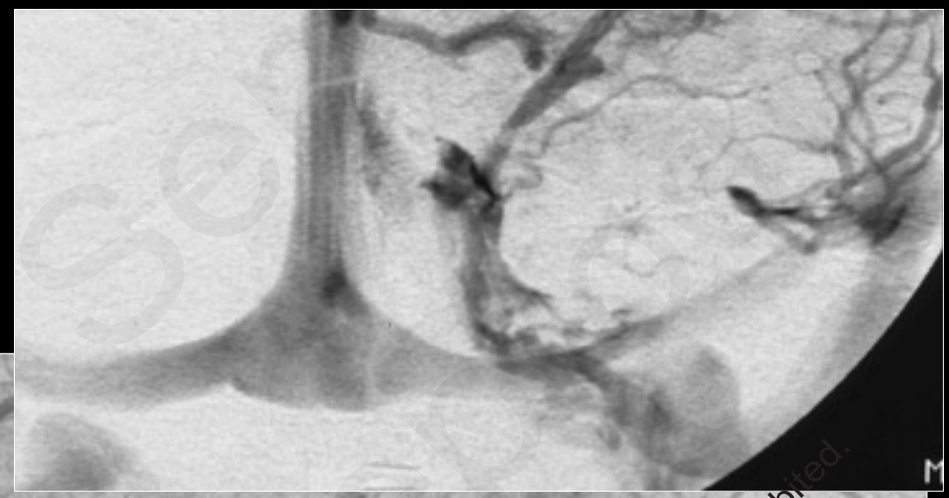

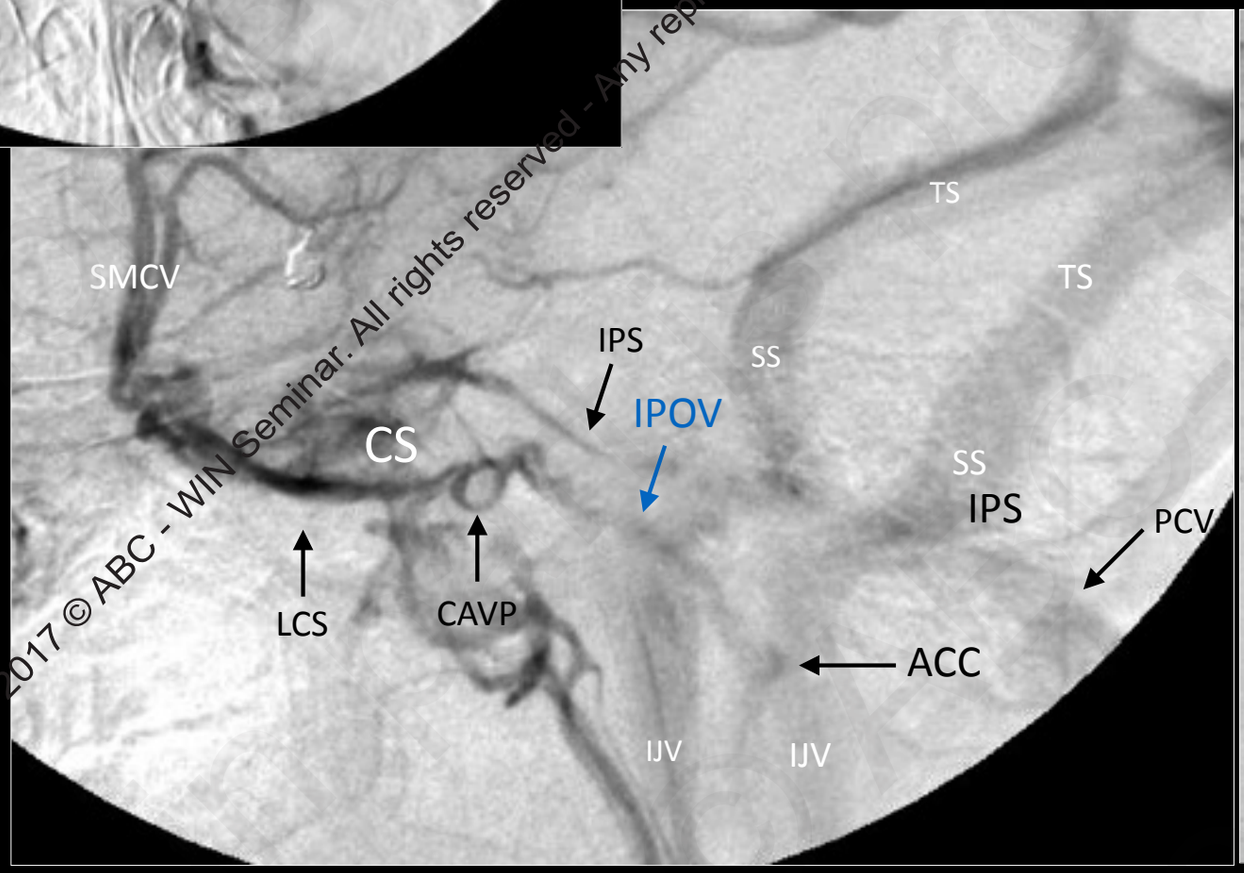

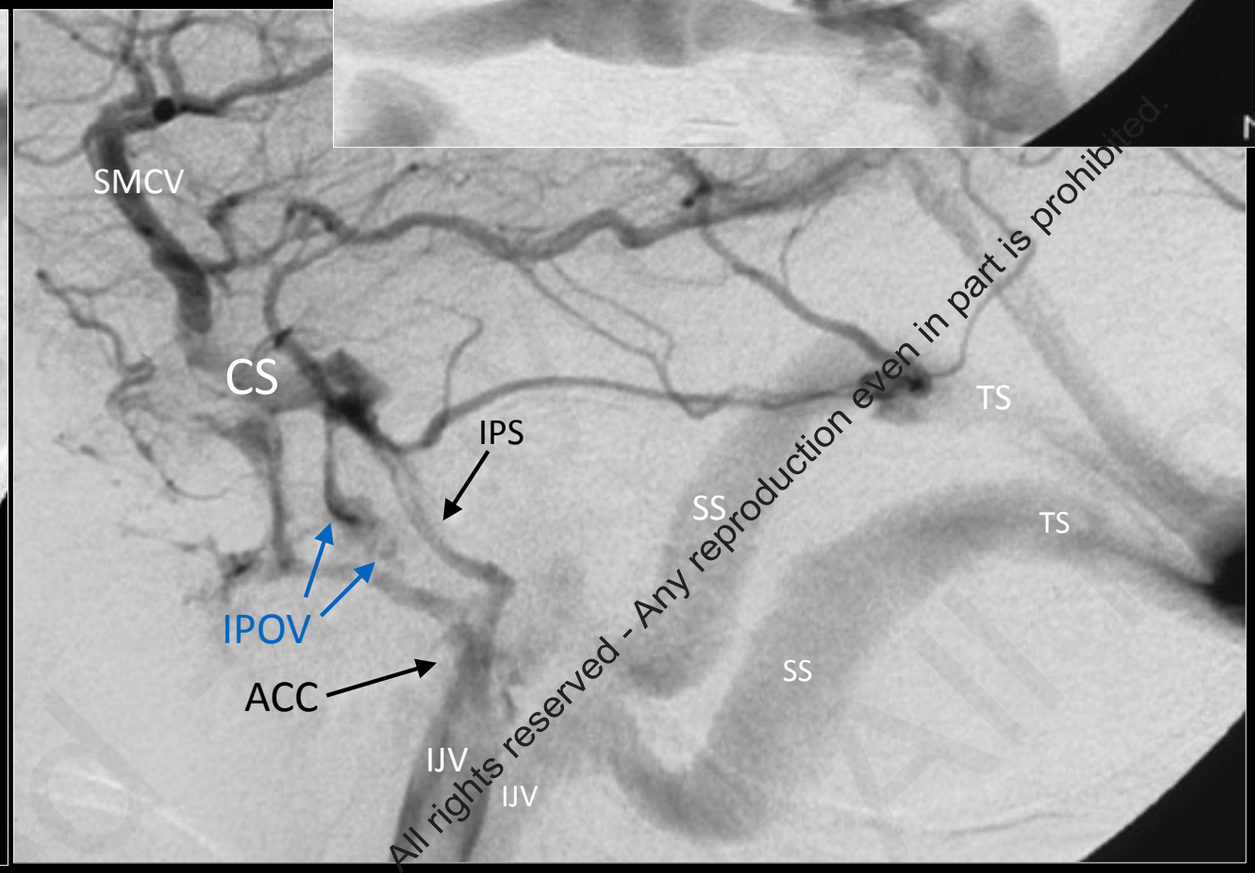

the anterior condylar vein (ACV)

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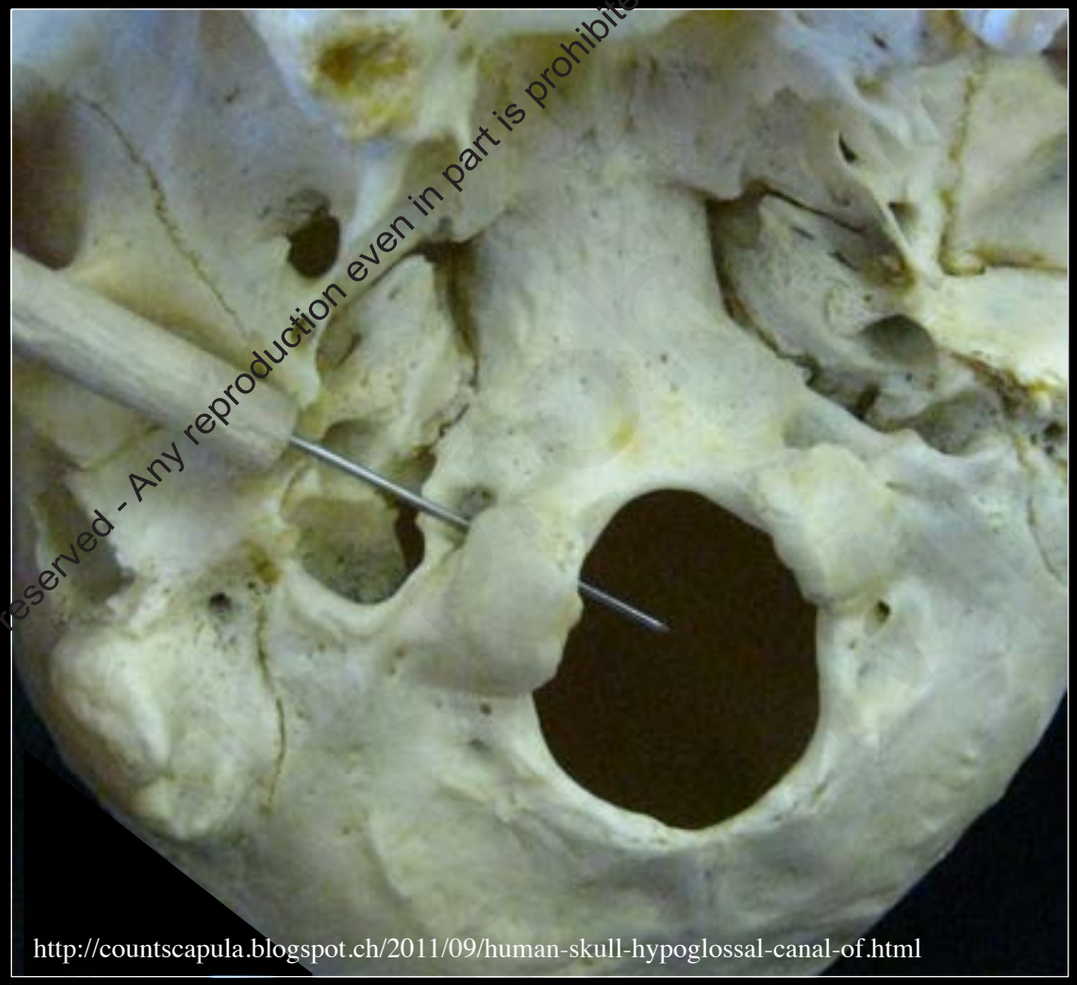
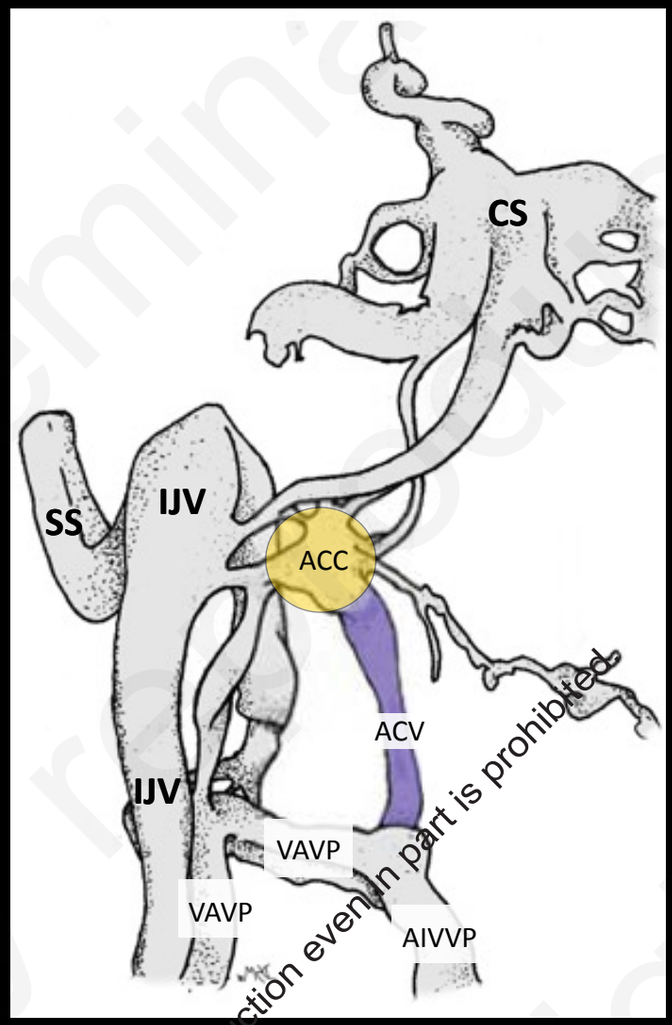


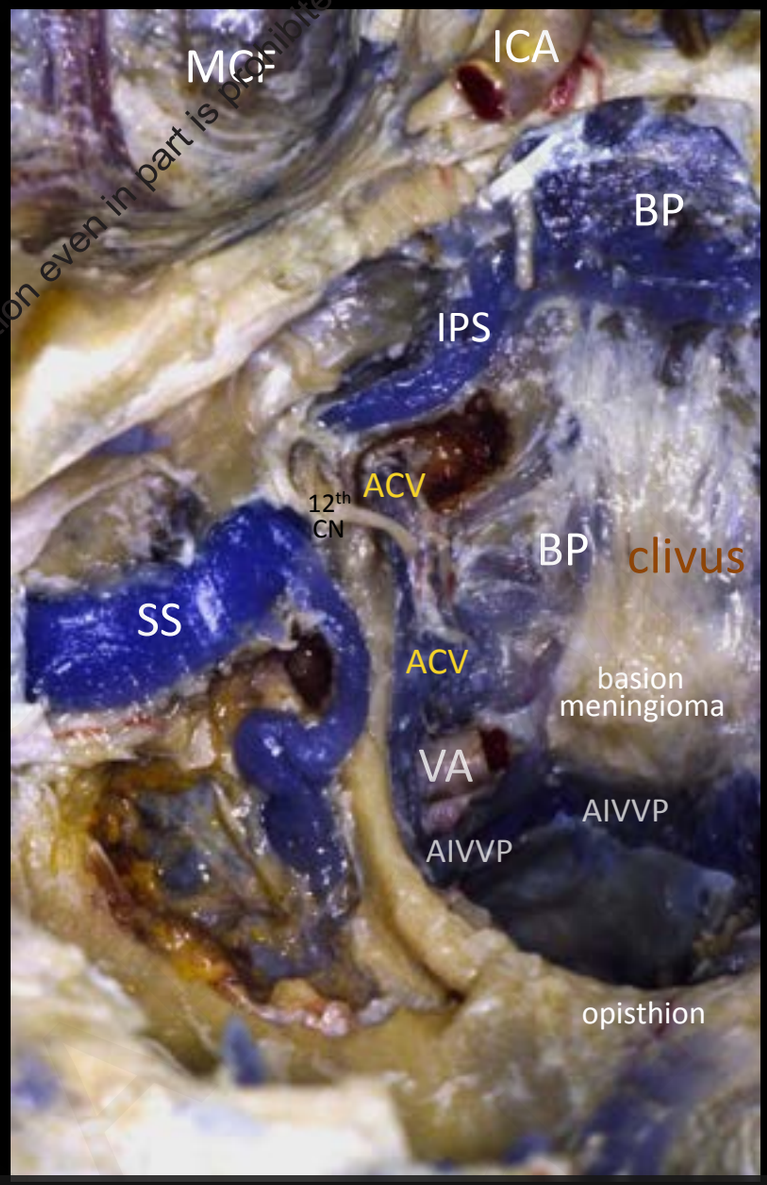
http://countscapula.blogspot.ch/2011/09/human-skull-hypoglossal-canal-of.html

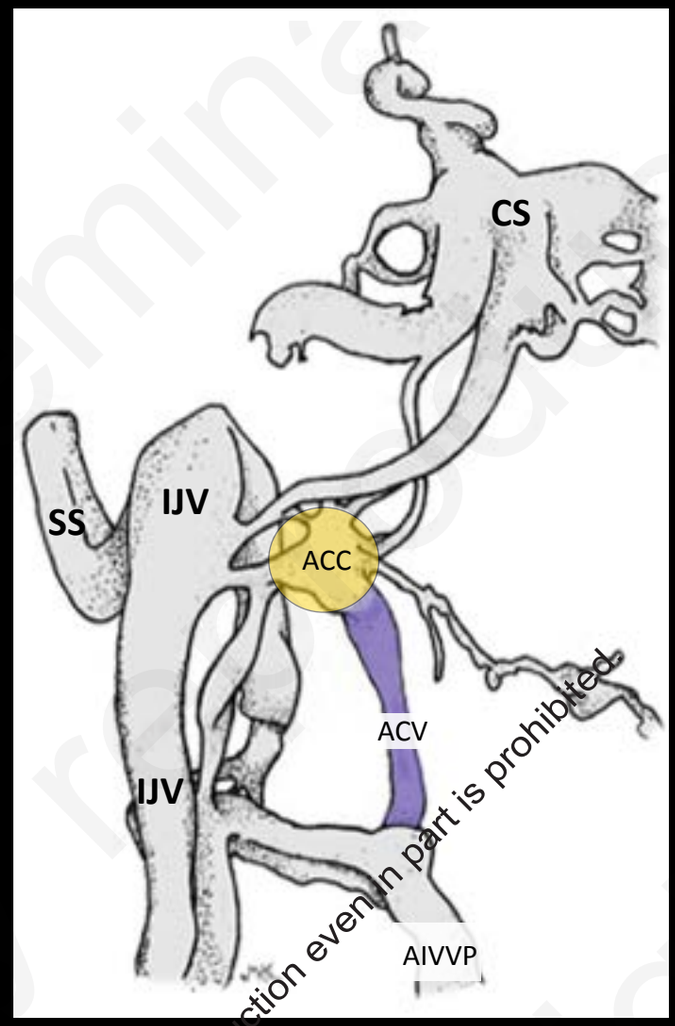


the anterior condylar vein (ACV)

- emissary vein coursing through the anterior condylar canal

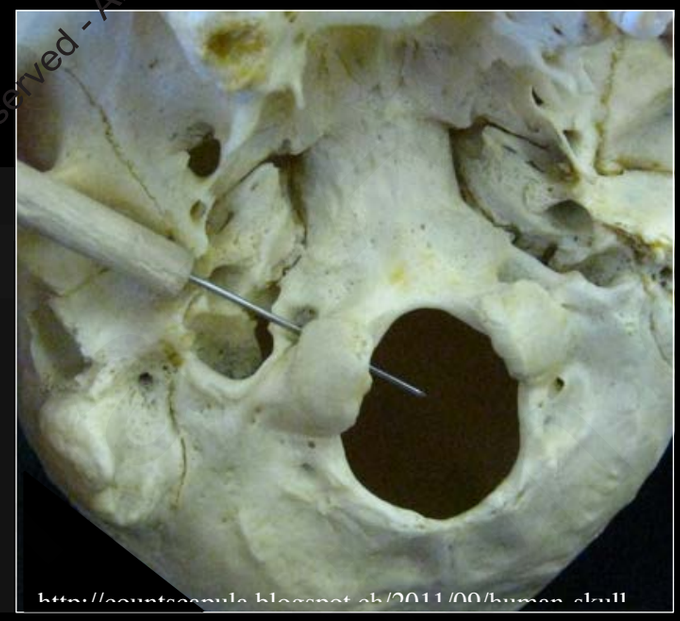
the anterior condylar vein (ACV)





the anterior condylar vein (ACV)

- emissary vein coursing through the anterior condylar canal
- cranial extension of the anterior internal vertebral venous plexus (AIVVP)
- connects extra-cranially with the ACC
- may connect with the basilar plexus (BP) and marginal sinus (MS)
- may be plexiform
- ~ constant



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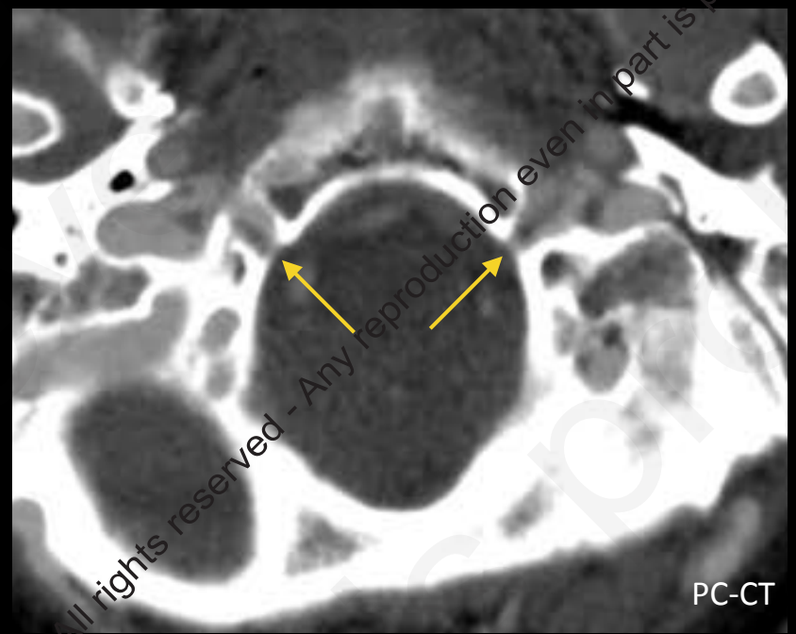
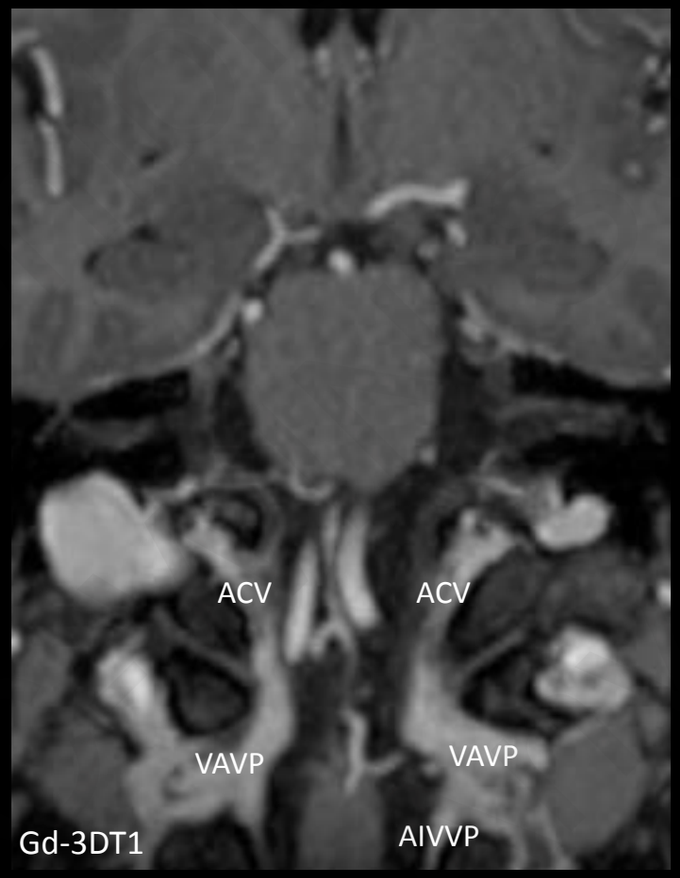
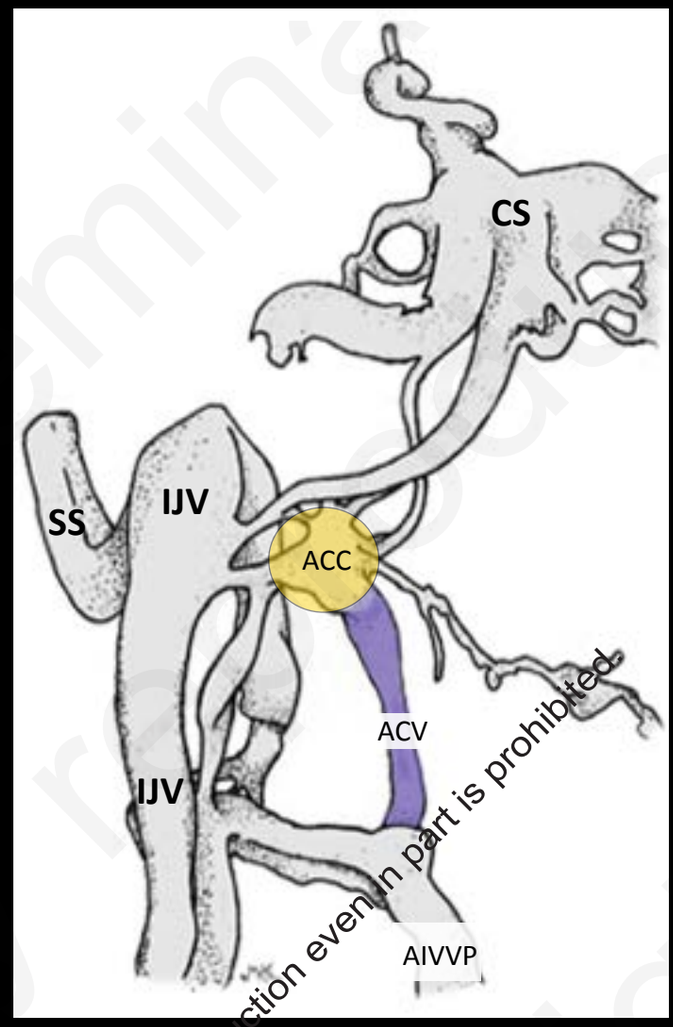
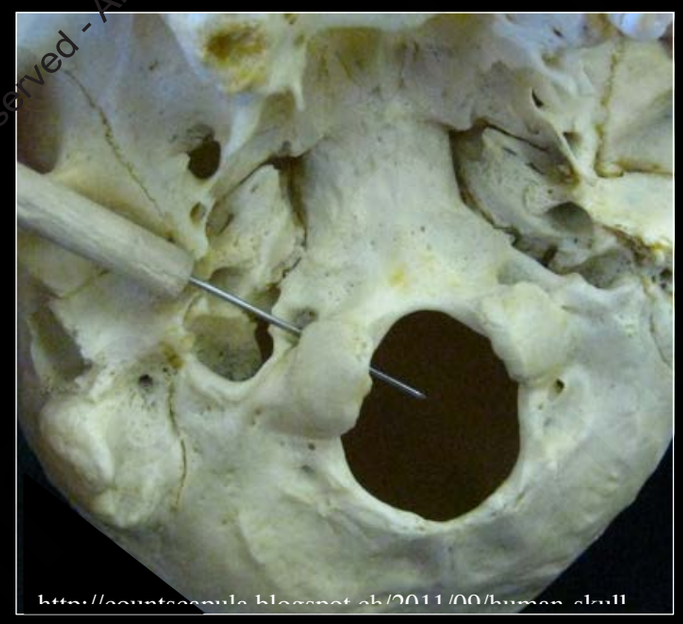
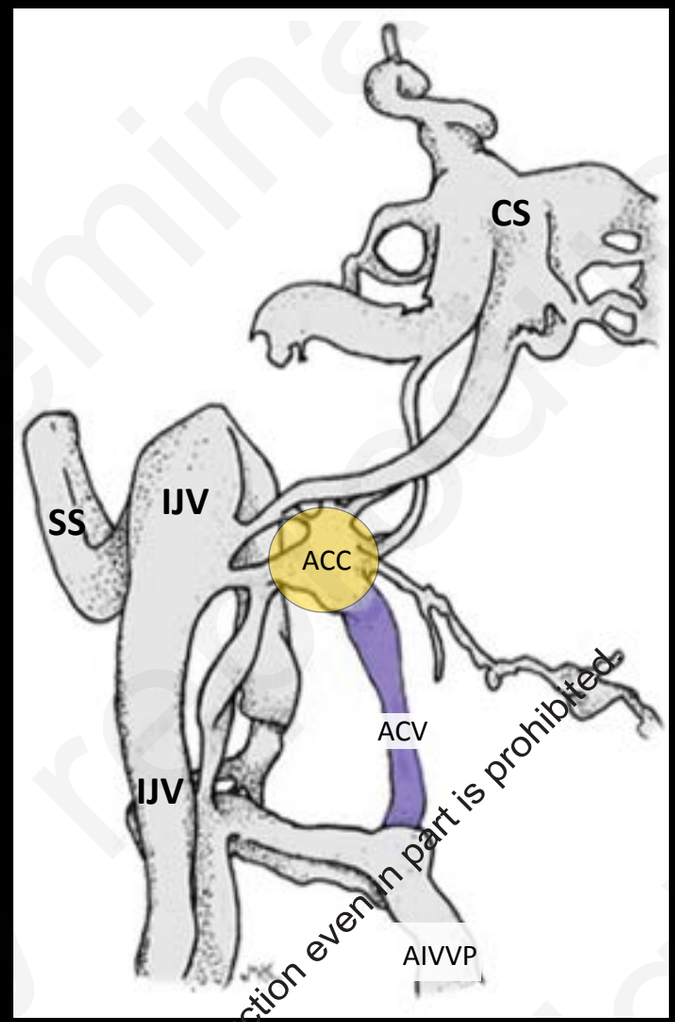


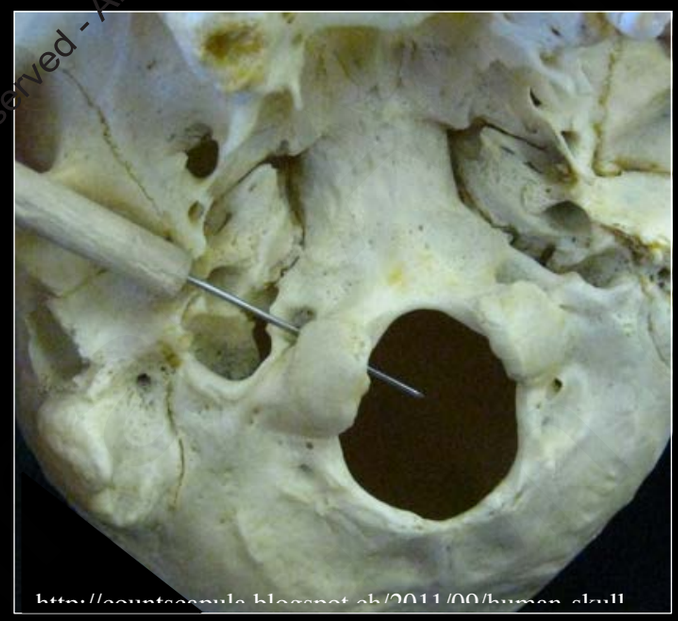






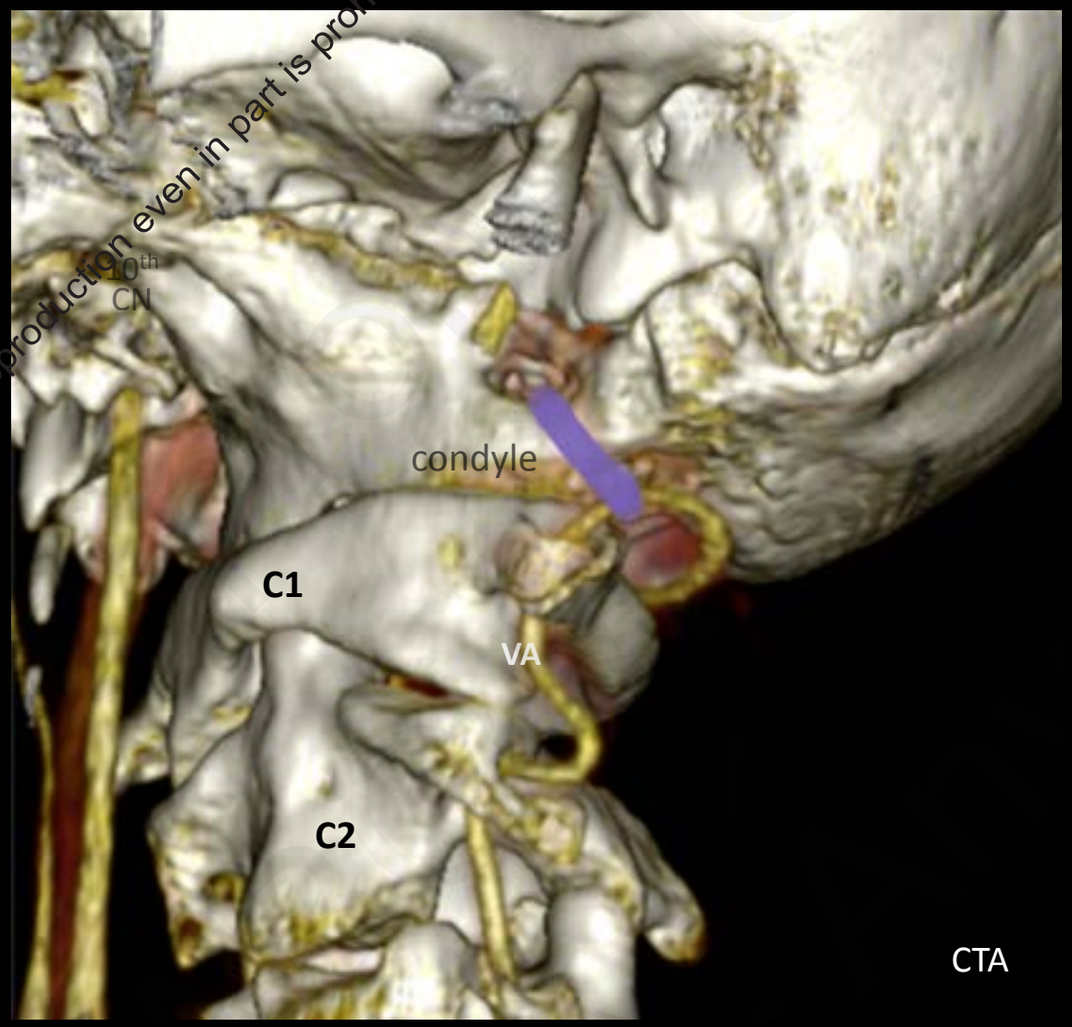
the anterior condylar vein (ACV)

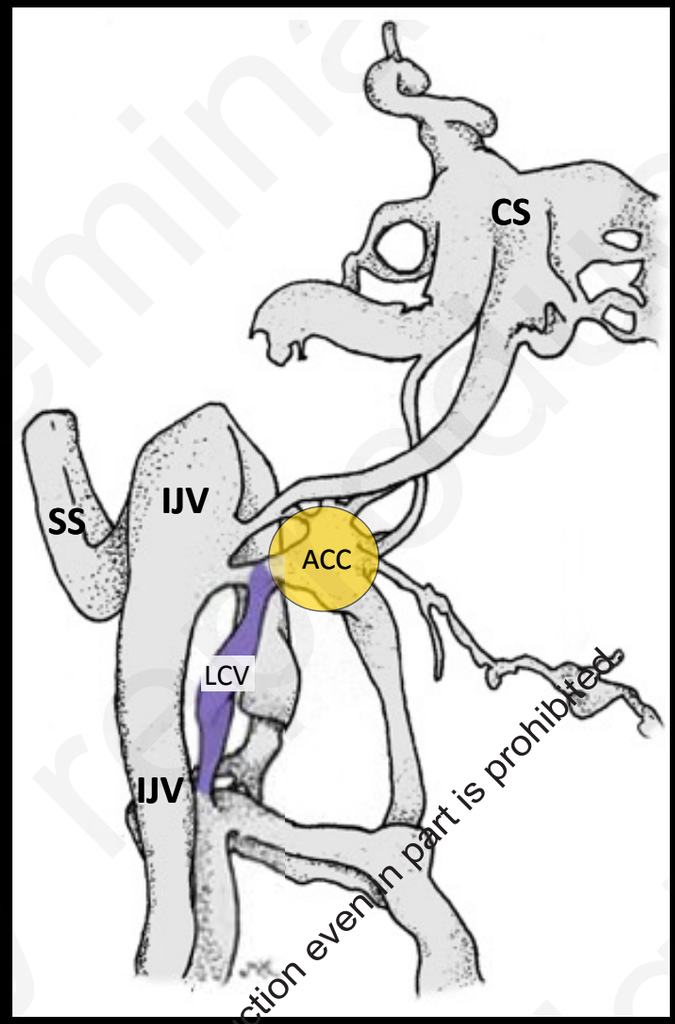




the lateral condylar vein (LCV)

the lateral condylar vein (ACV)



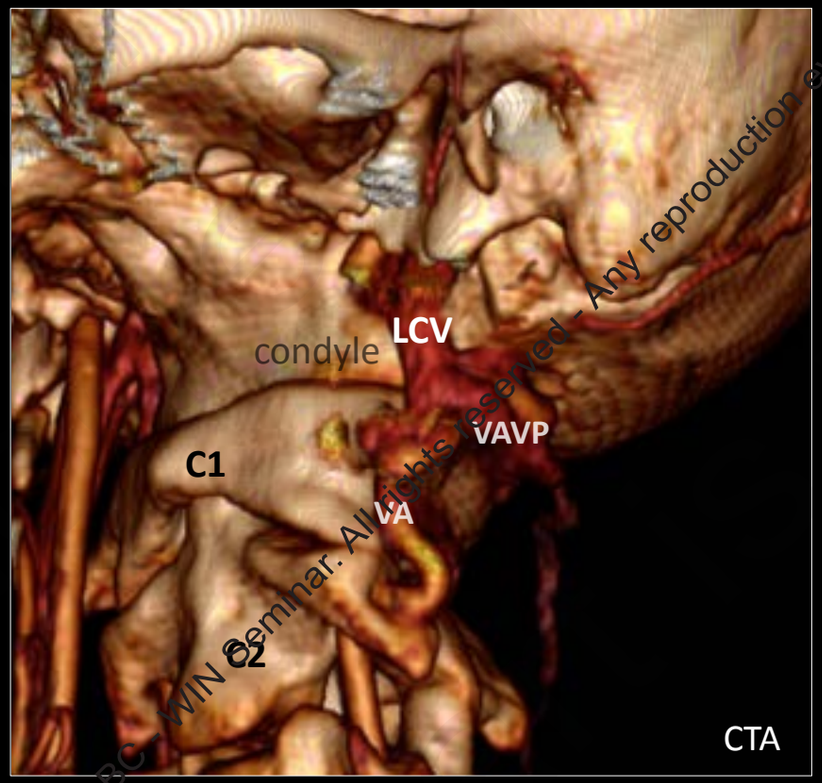


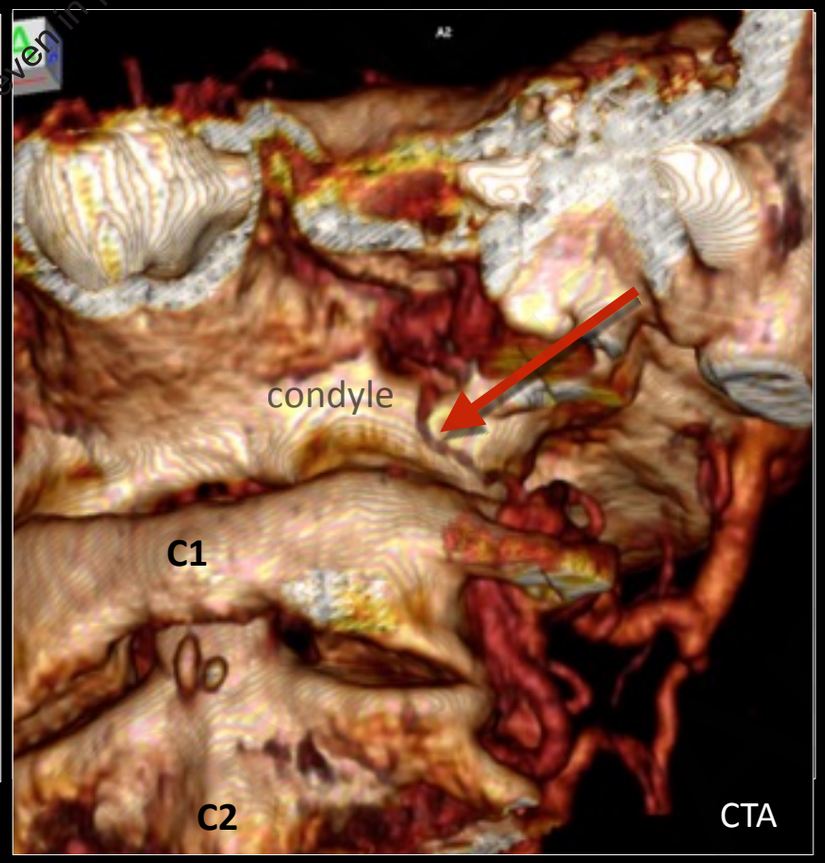
CTA

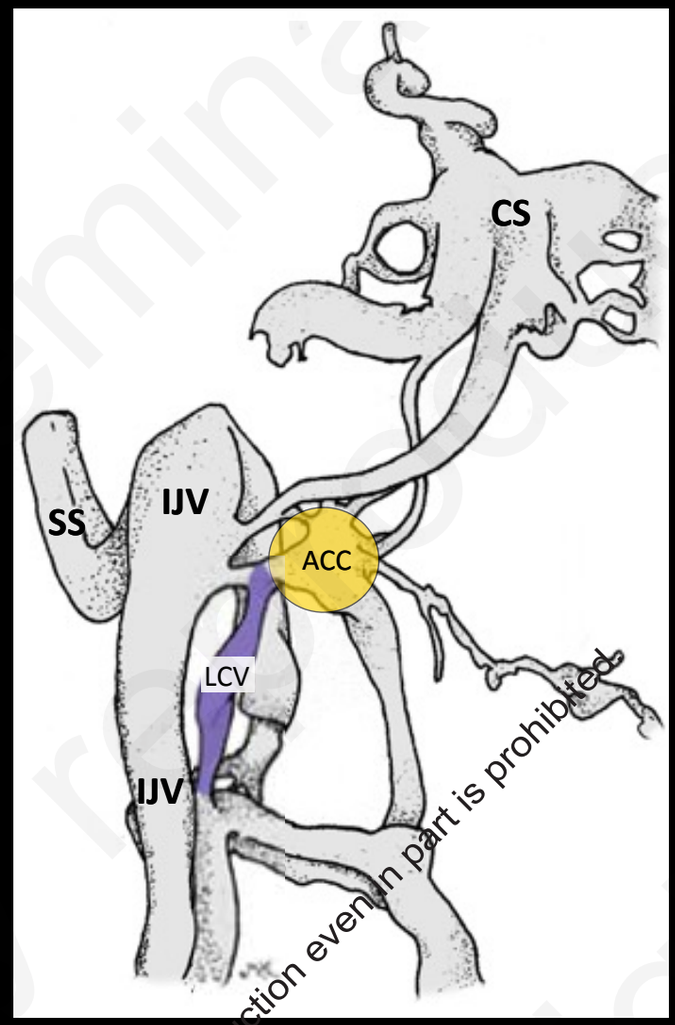
the lateral condylar vein (LCV)

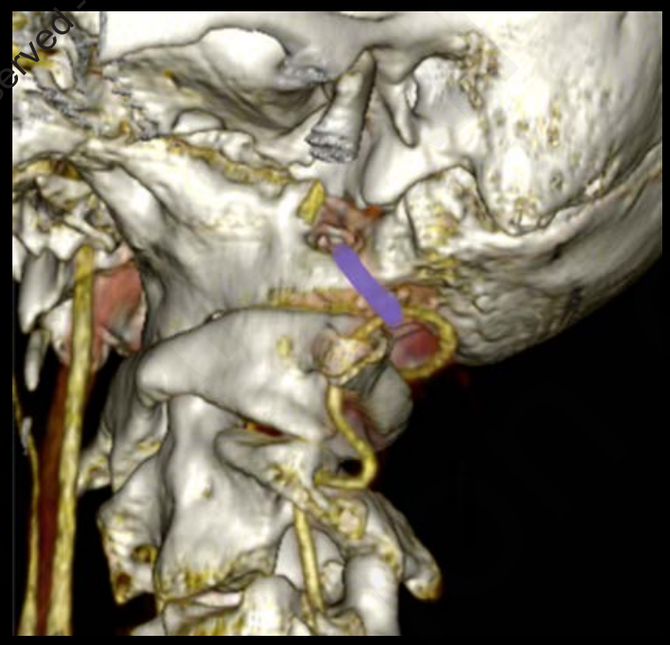
- originates from an anastomosis between the ACC and the IJV
- → along the lateral surface of the occipital condyle → anterior genou of the VAVP
- may course inside an osseous in the occipital condyle
- present ~ 80% of the times

the lateral condylar vein (ACV)

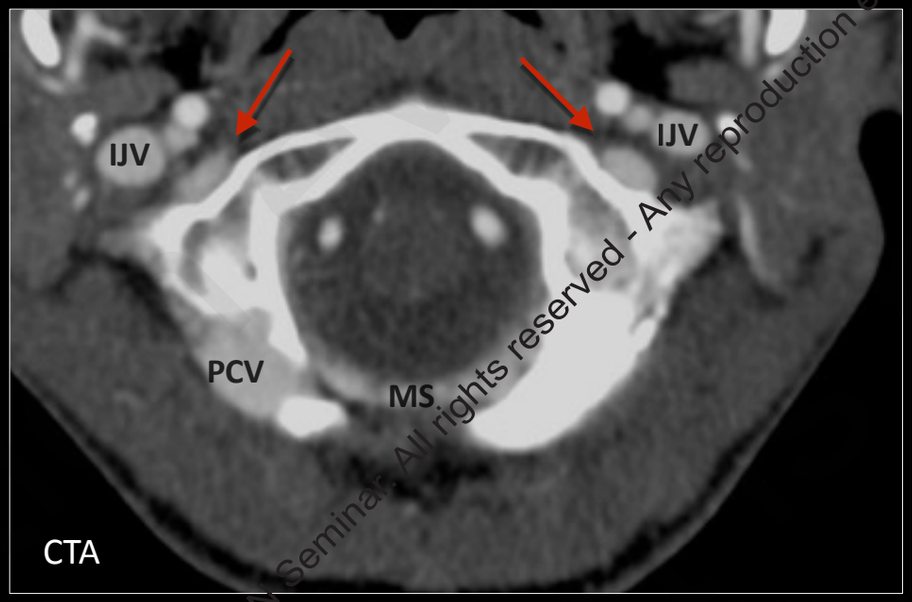


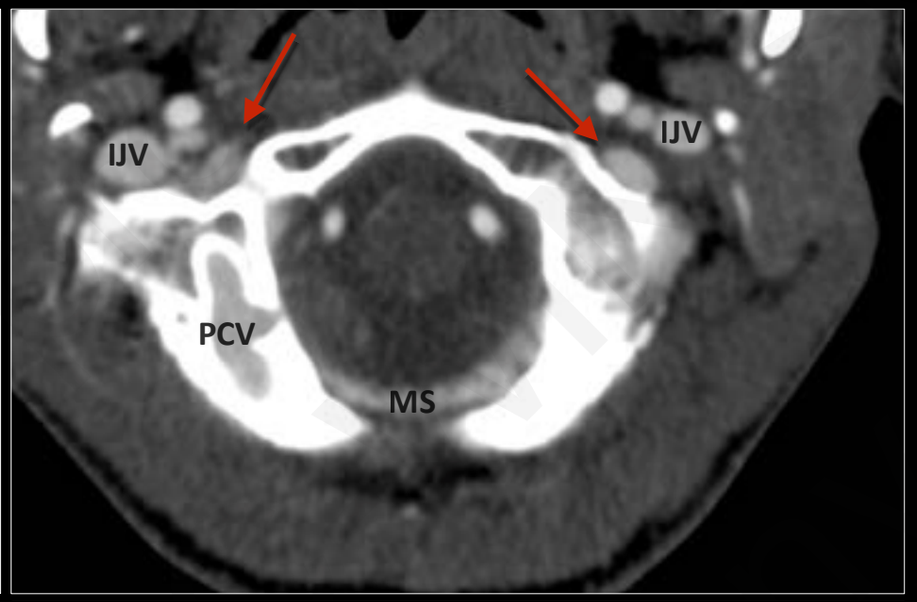


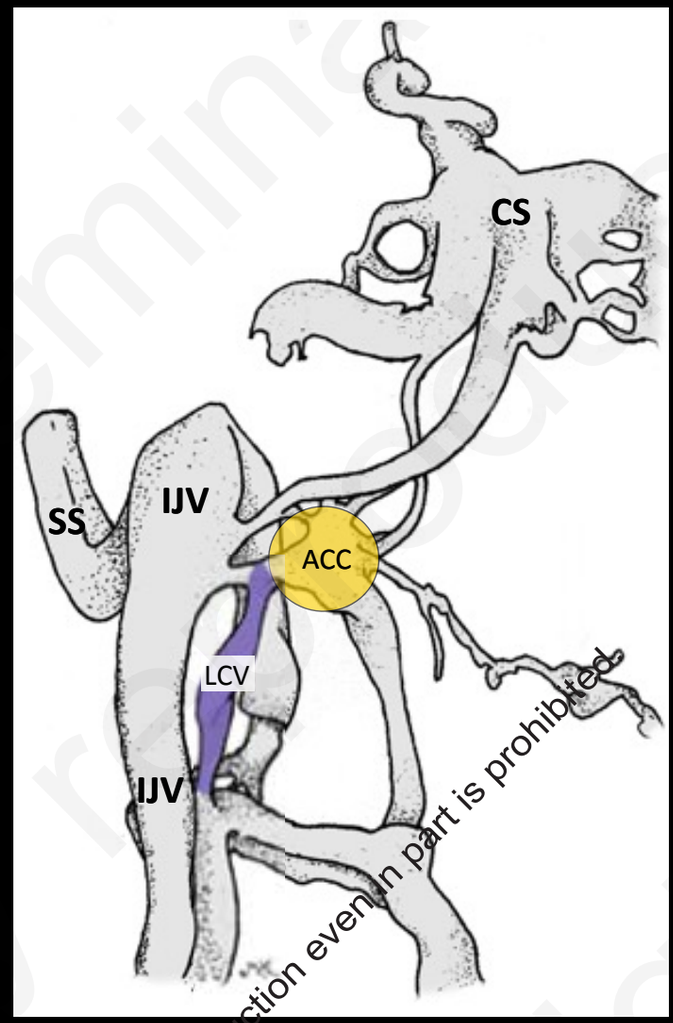


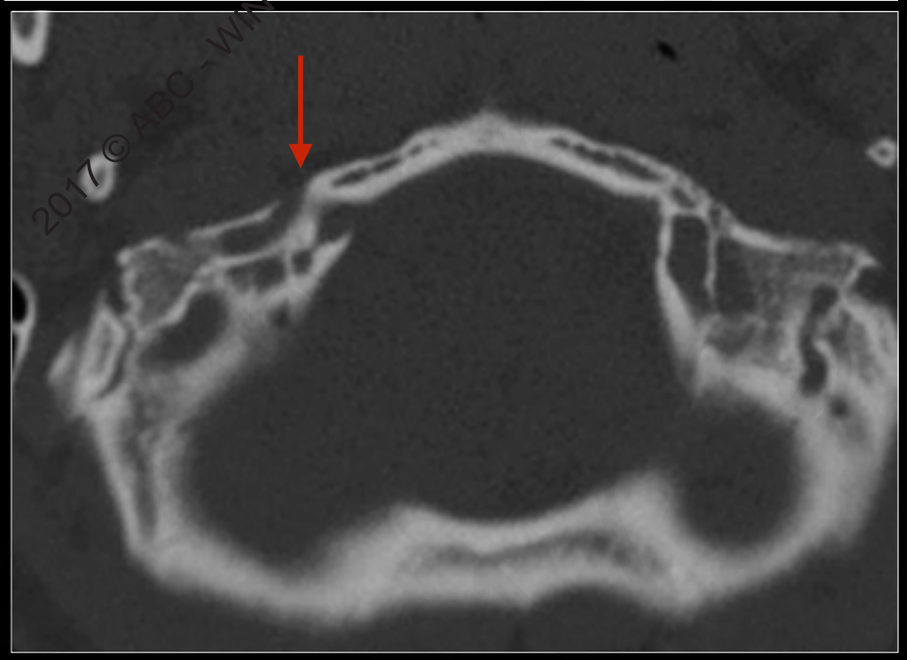


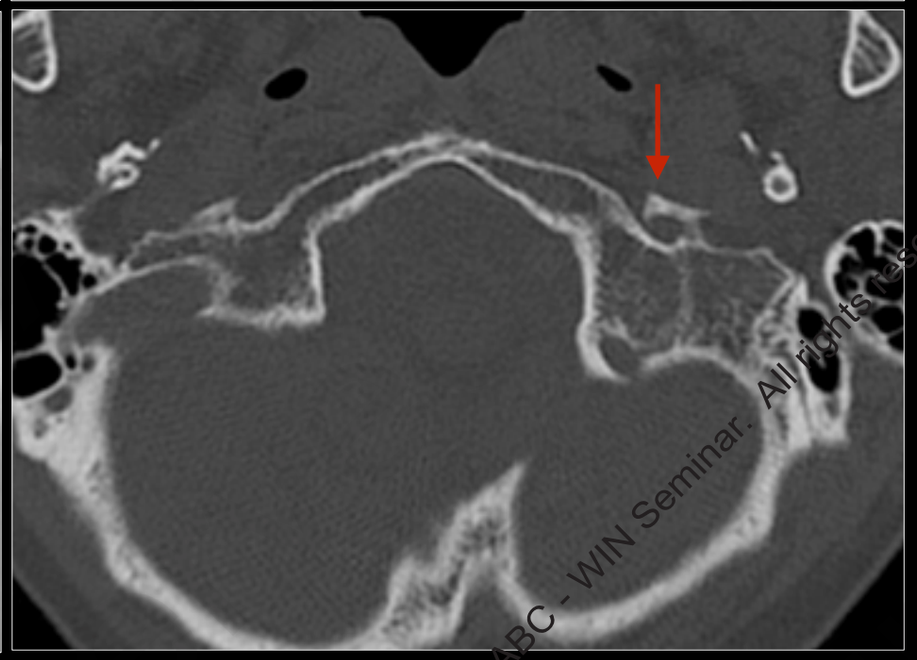
the lateral condylar vein (ACV)











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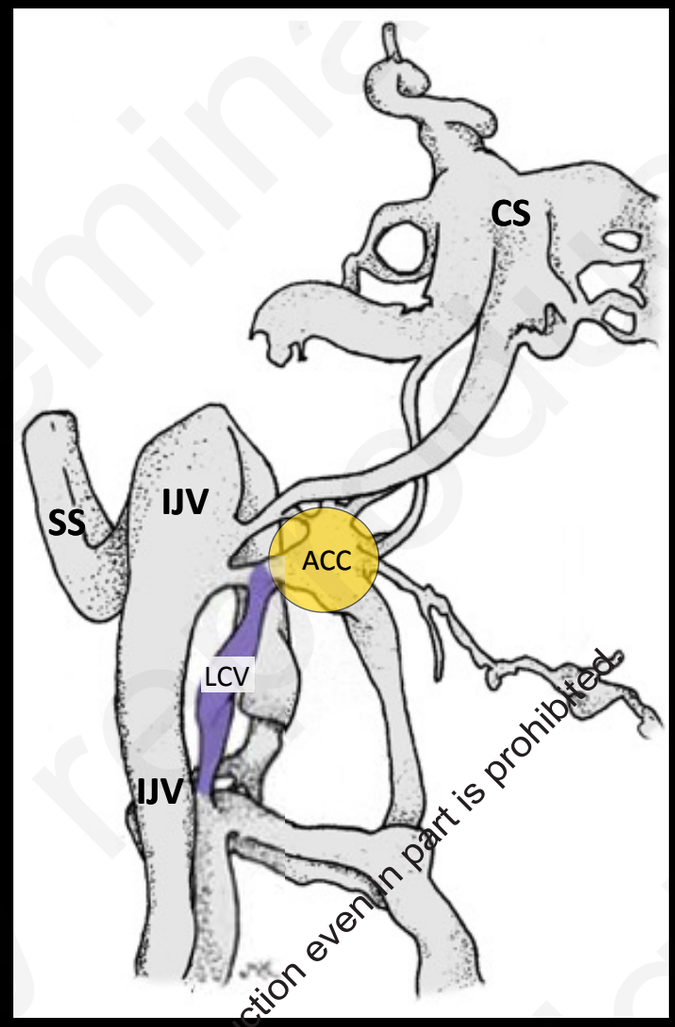
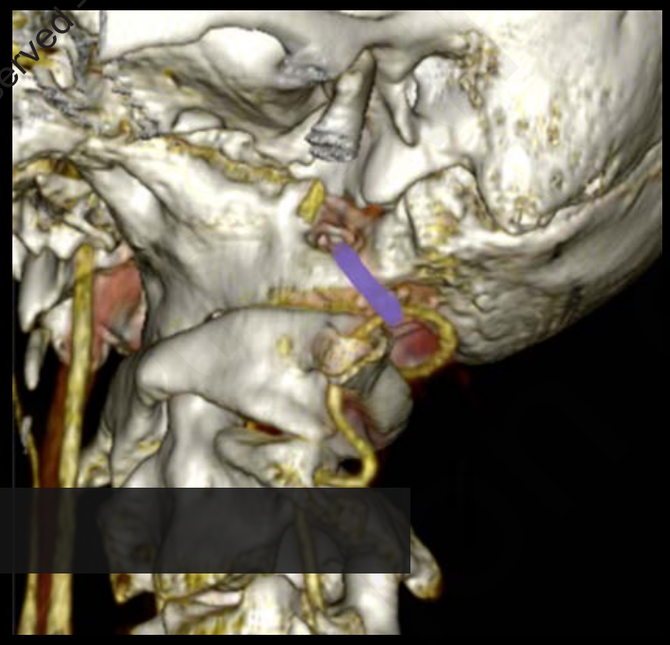
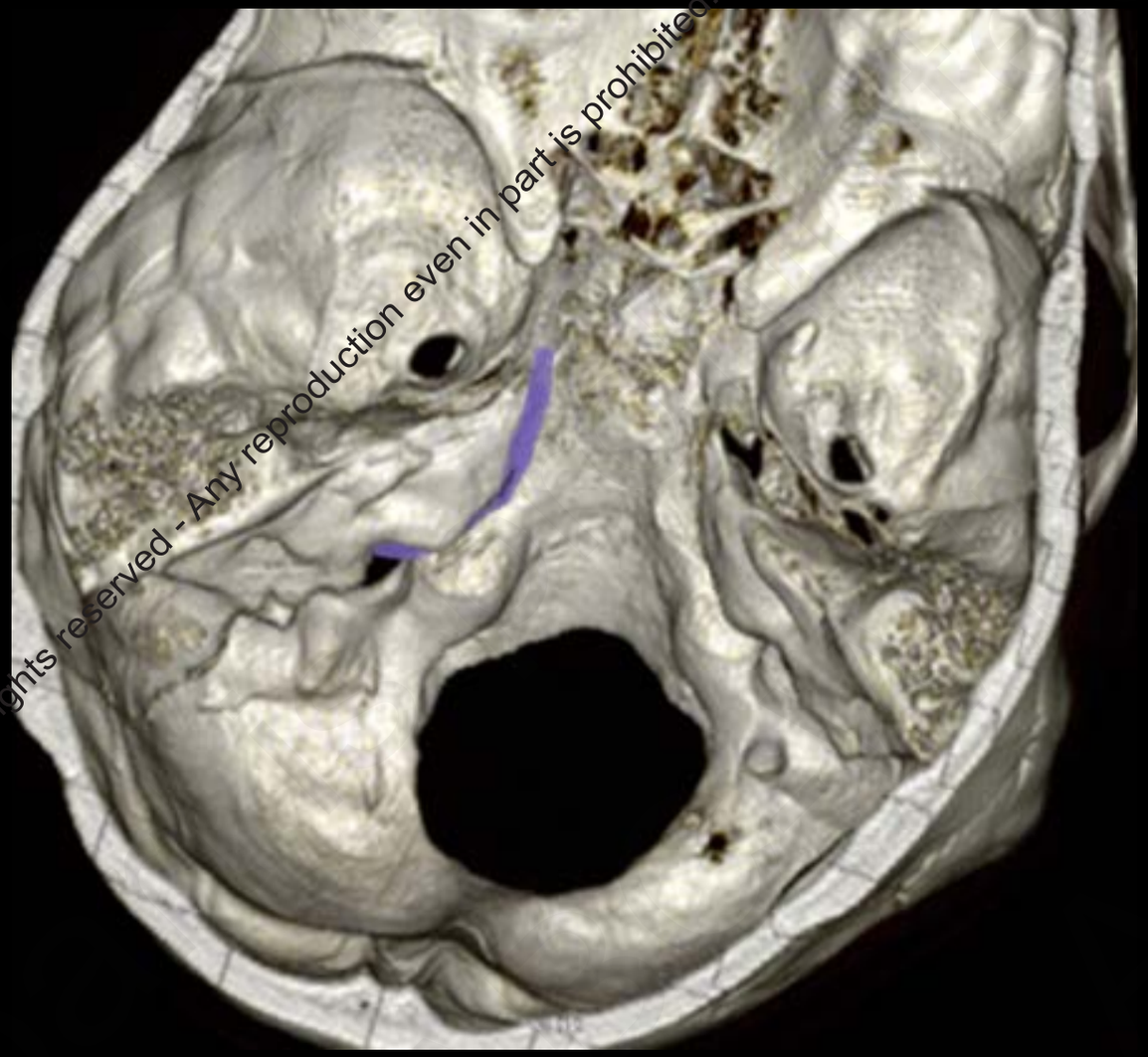


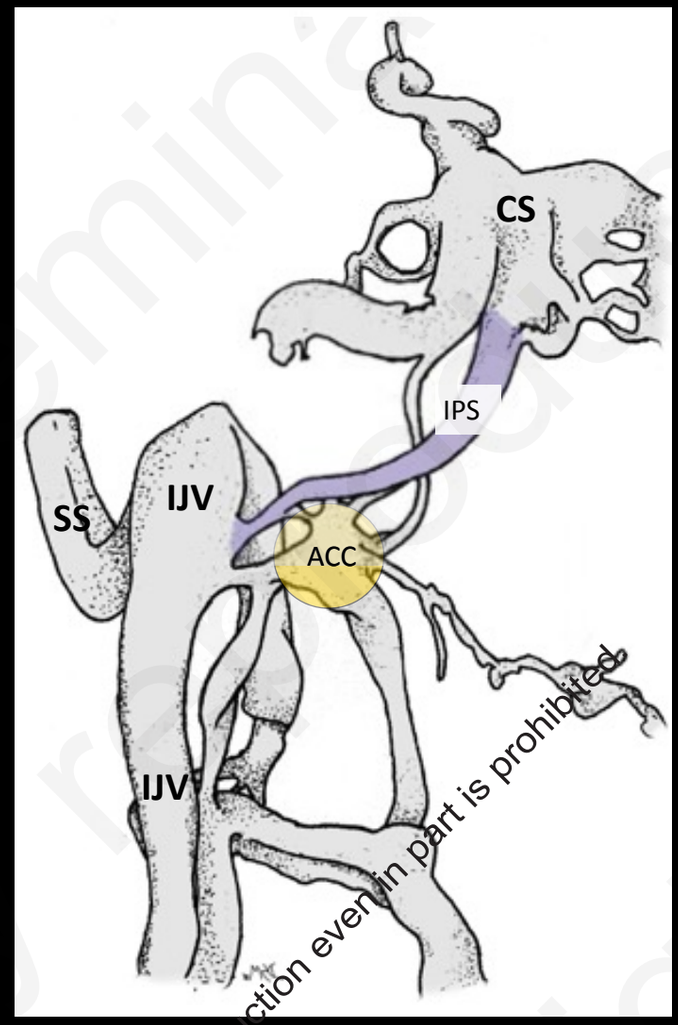


inverse proportionality relation between the LCV and PCV

the inferior petrosal sinus (IPS)

the inferior petrosal sinus (IPS)

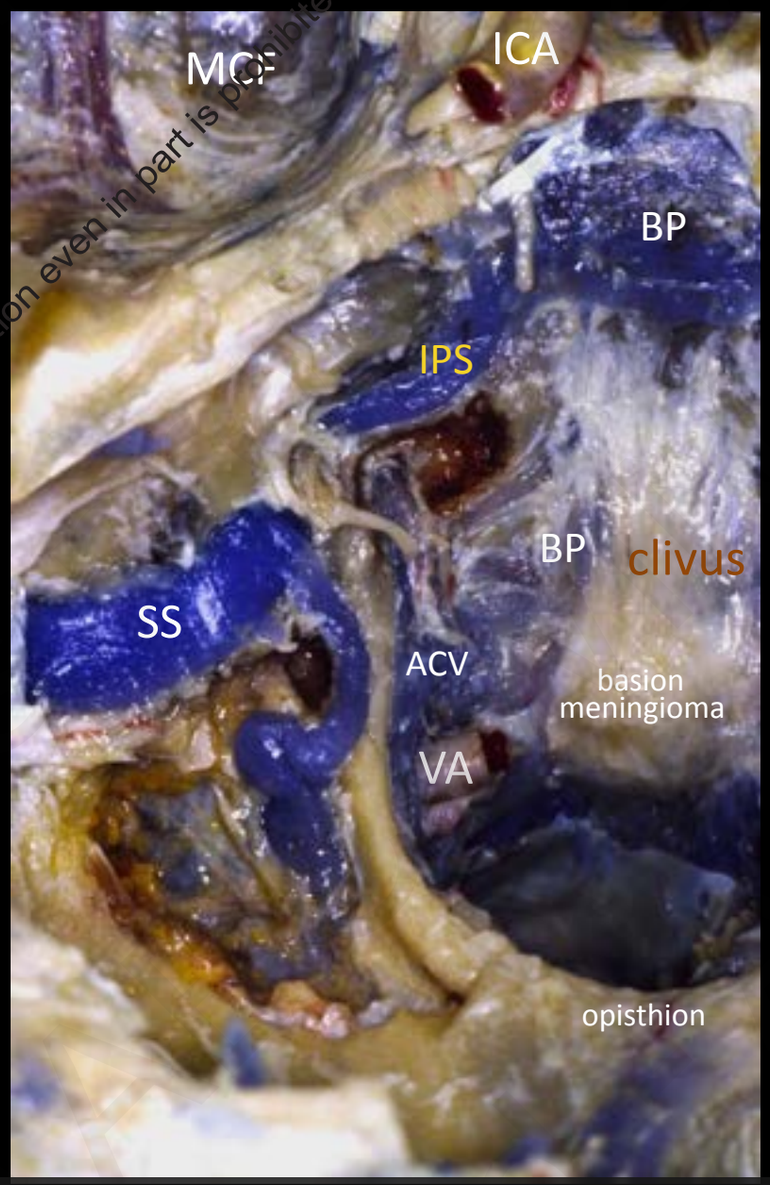


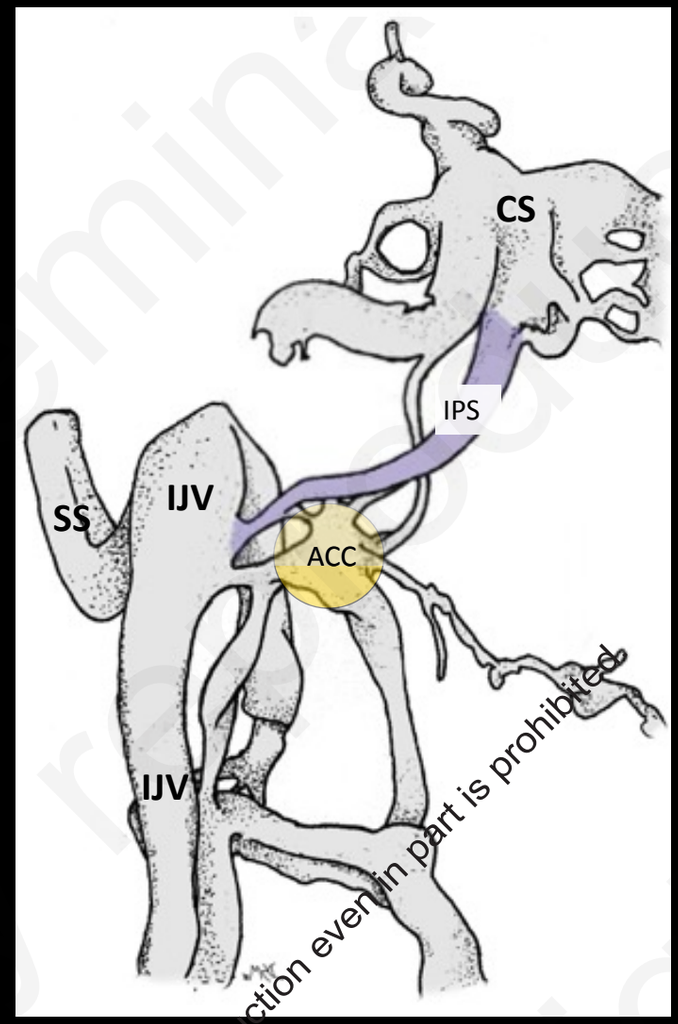


the inferior petrosal sinus (IPS)

- courses along the petro-occipital fissure to the jugular foramen (pars nervosa)

the inferior petrosal sinus (IPS)





the inferior petrosal sinus (IPS)

- courses along the petro-occipital fissure to the jugular foramen (pars nervosa)
- major efferent pathway of the cavernous sinus (CS) (postero-inferior)
- classic: → the IJV often extracranially, up to several cm below the jugular foramen
- connections (en passant or terminal) to the anterior condylar confluence (ACC)
- connected to the basilar plexus medially
- may course within a bony canal
- constant

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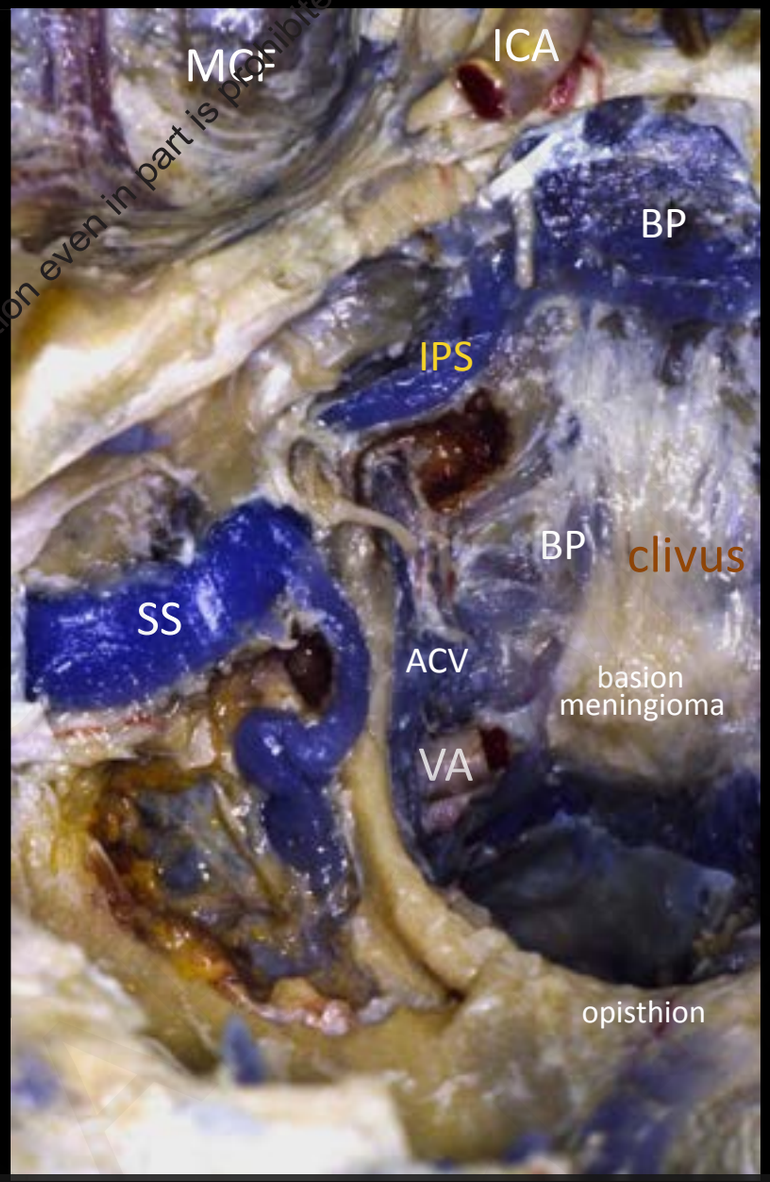

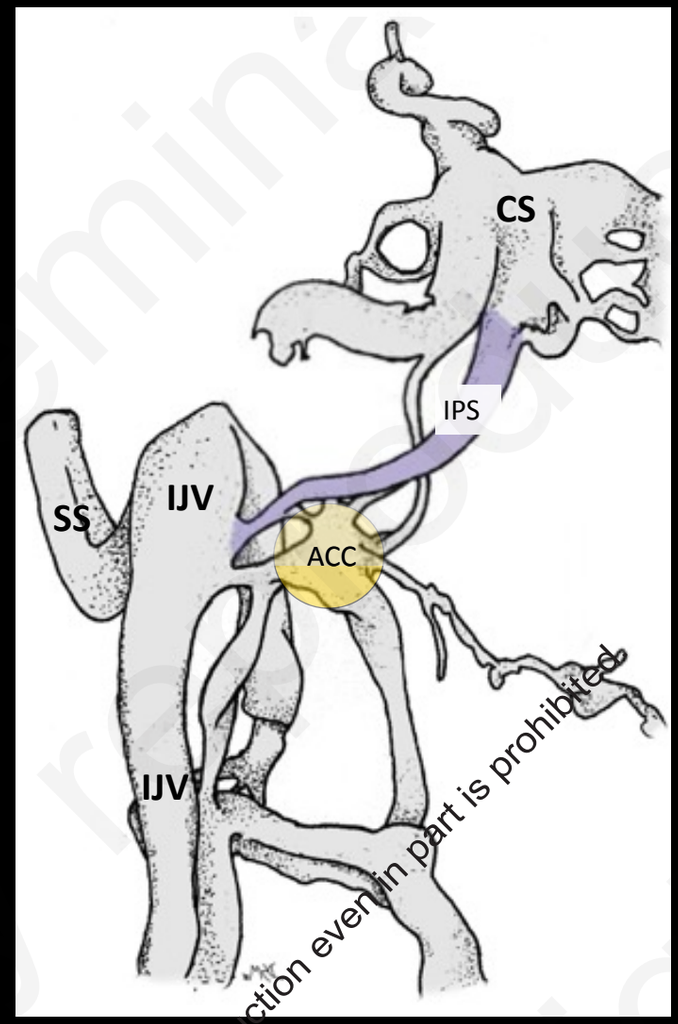

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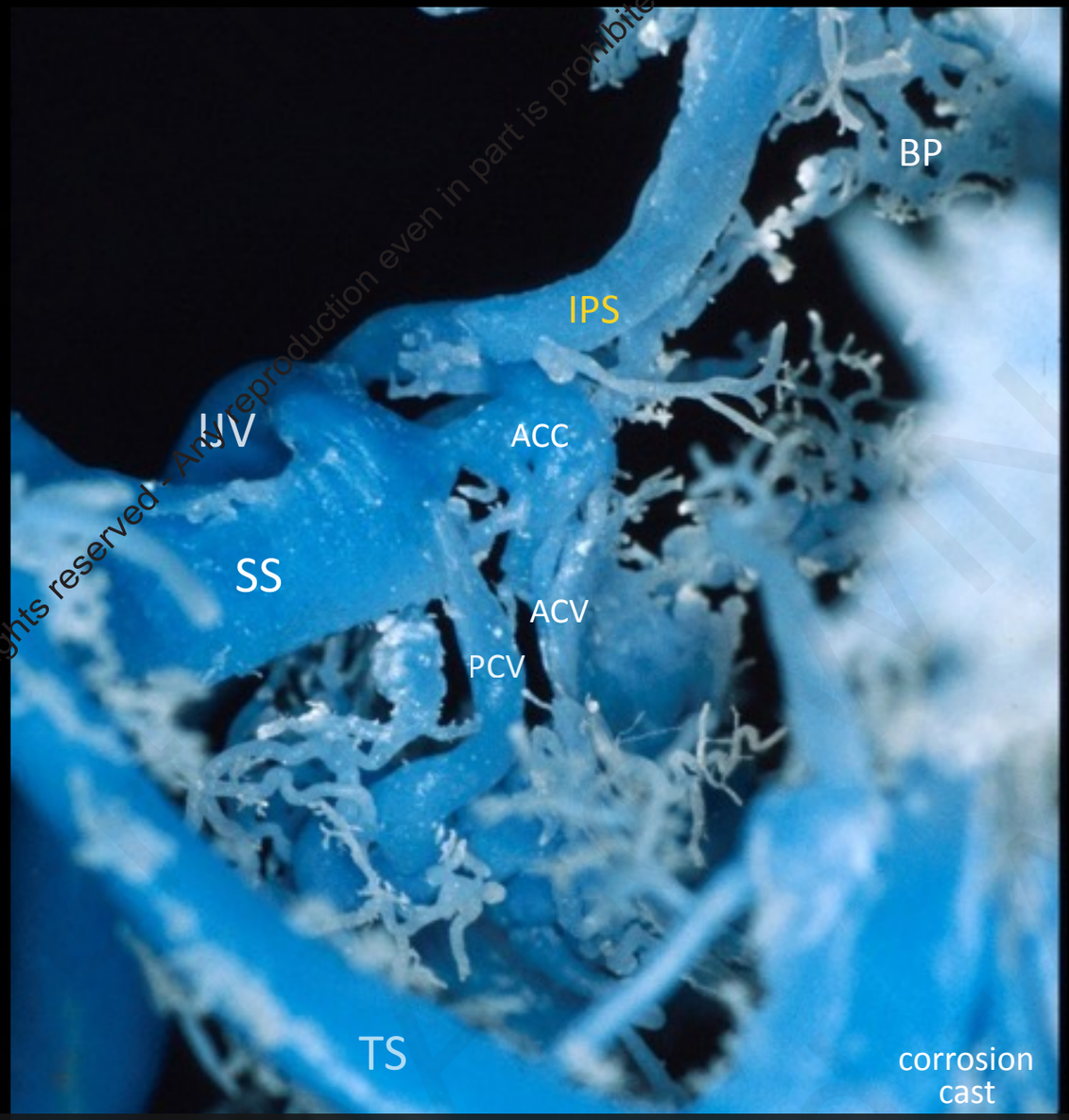

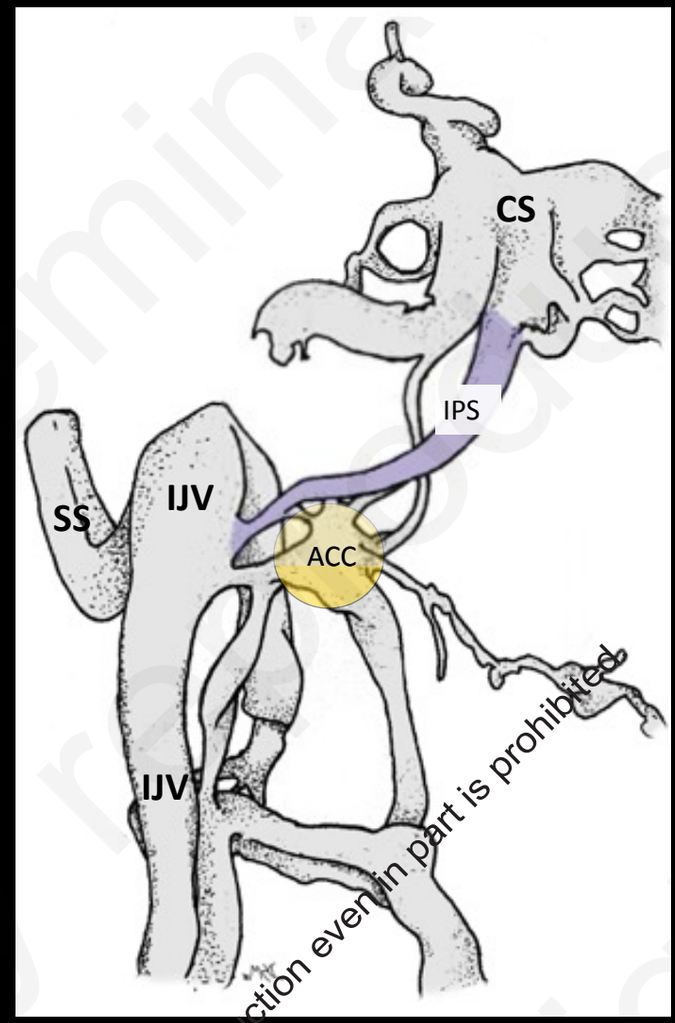

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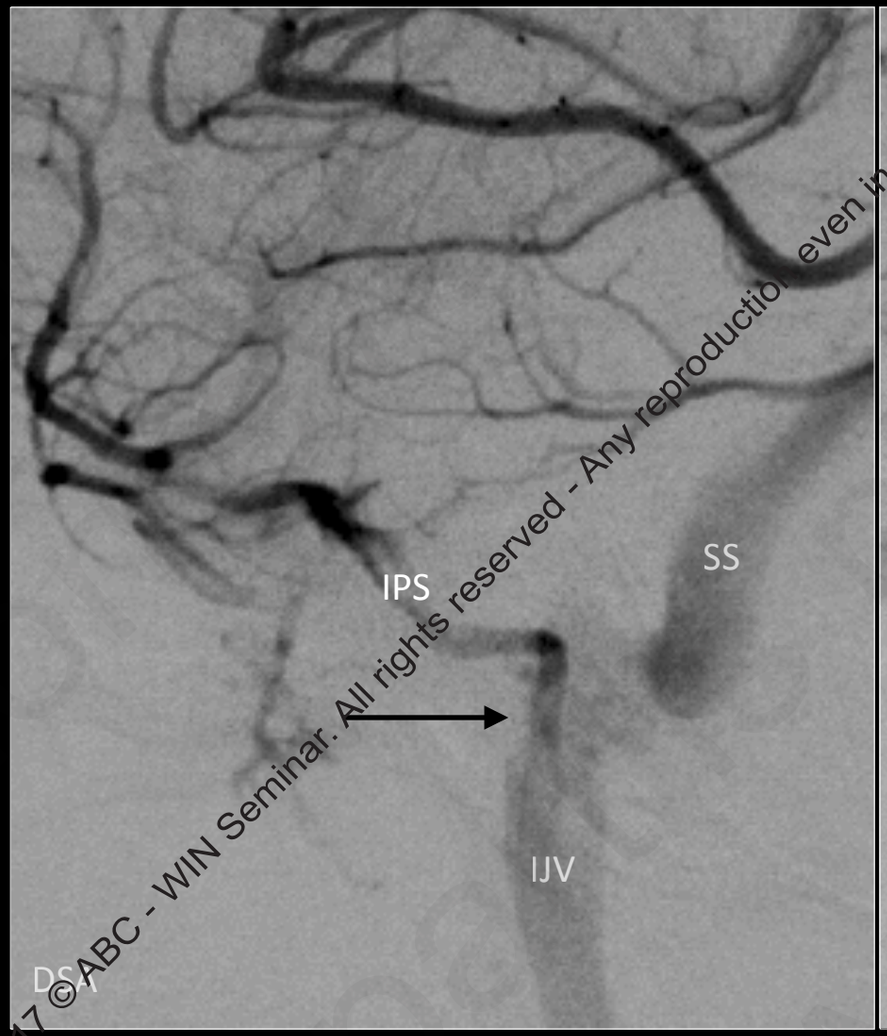

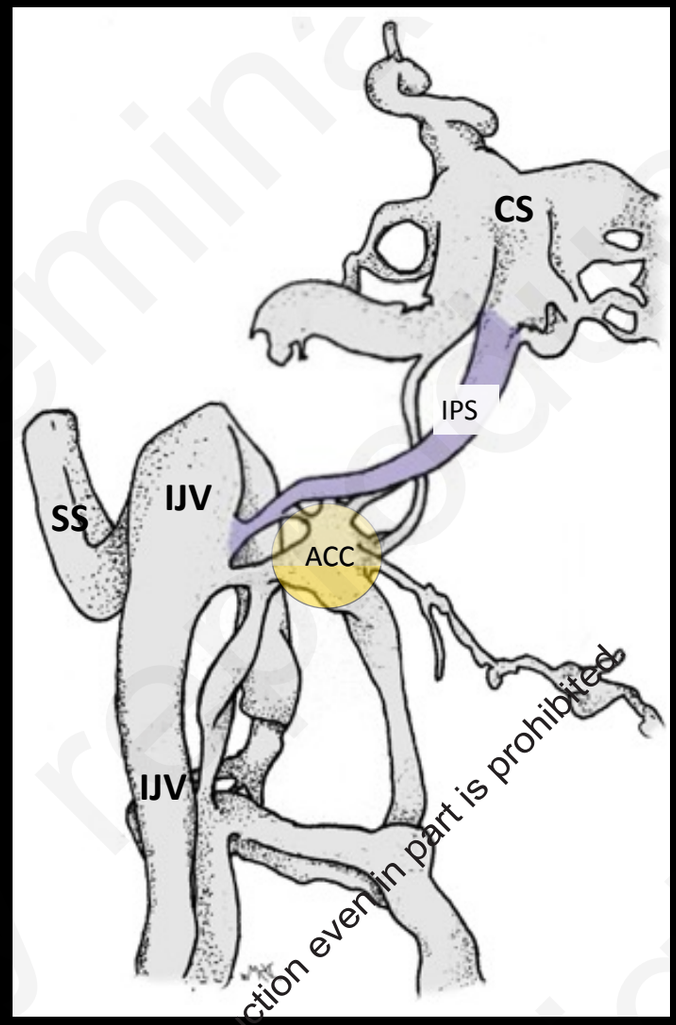

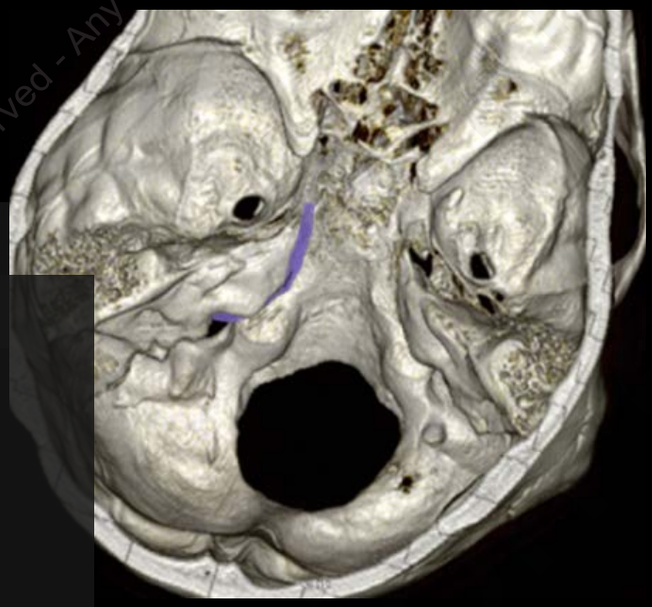

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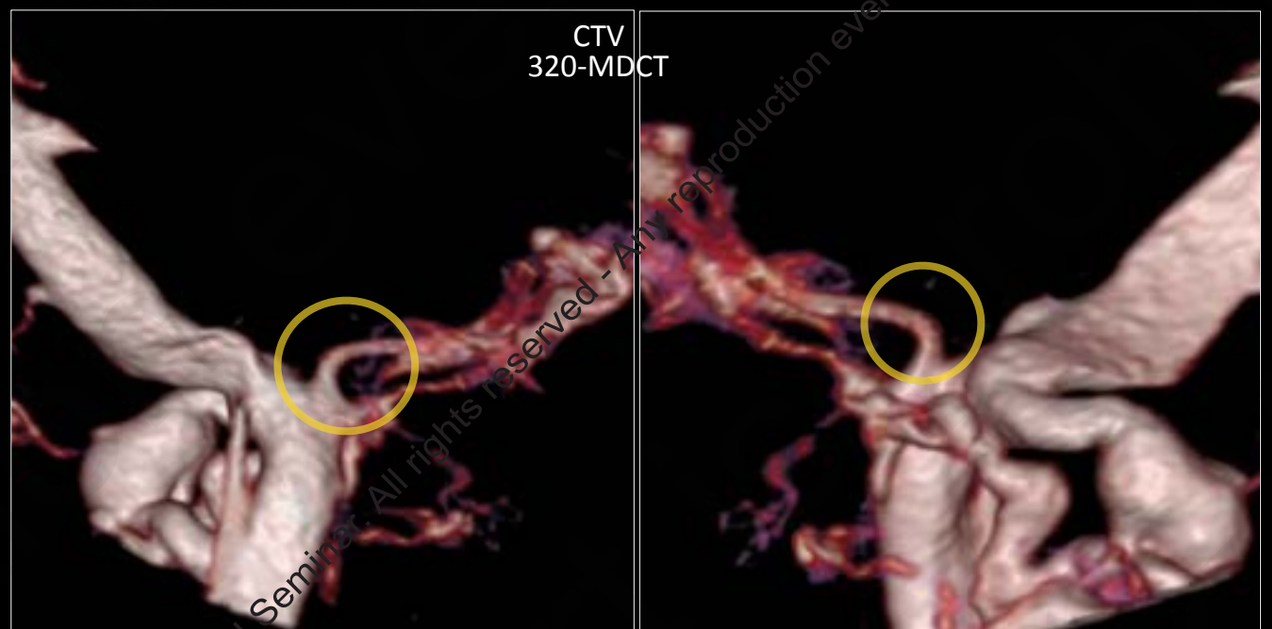
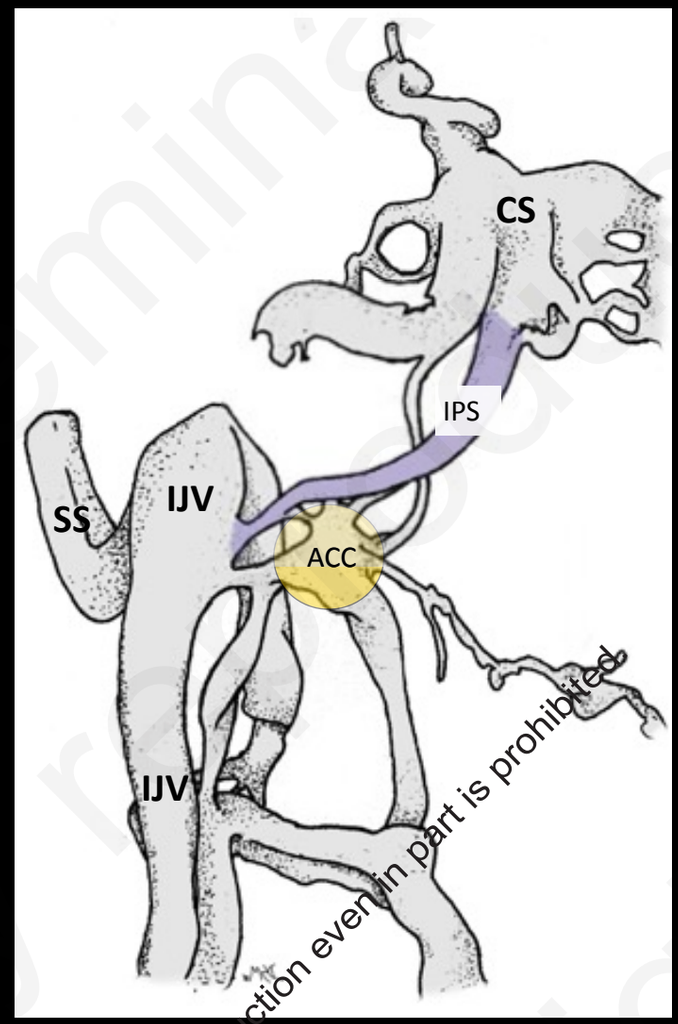
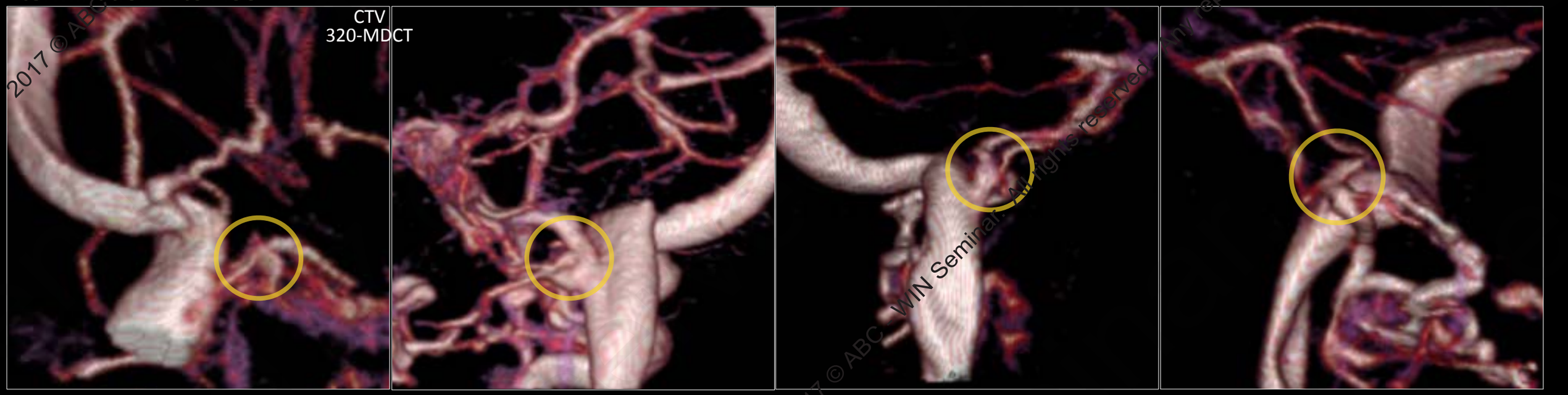
the inferior petrosal sinus (IPS)

termination into IJV



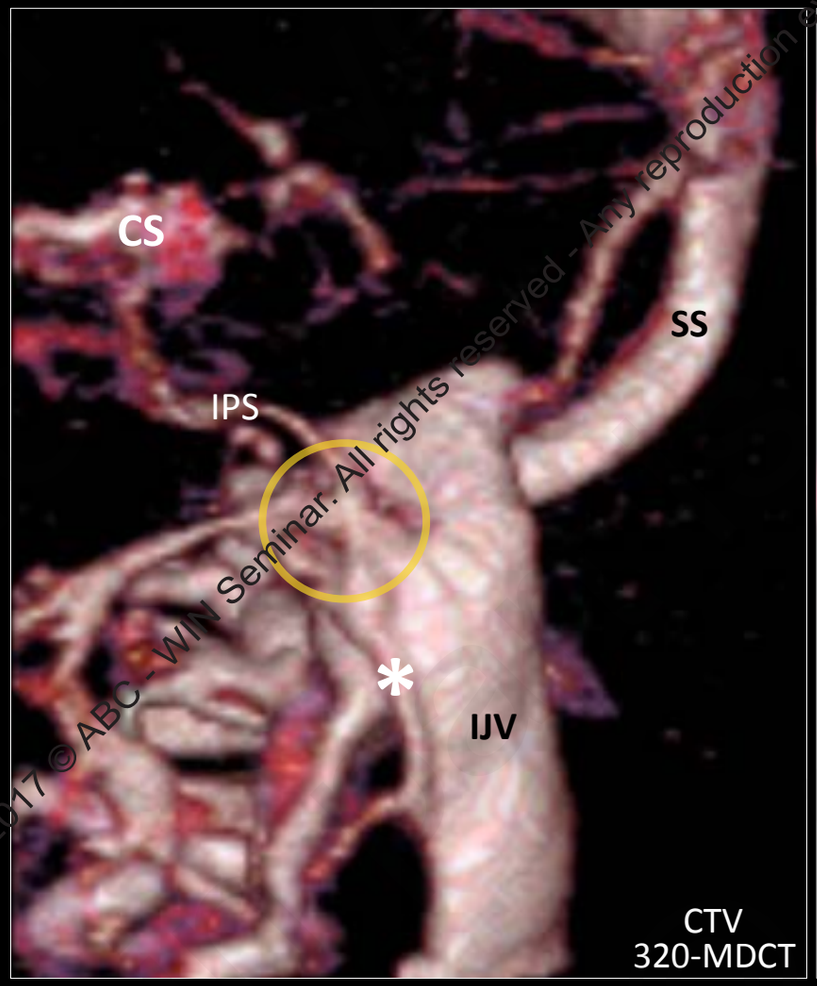


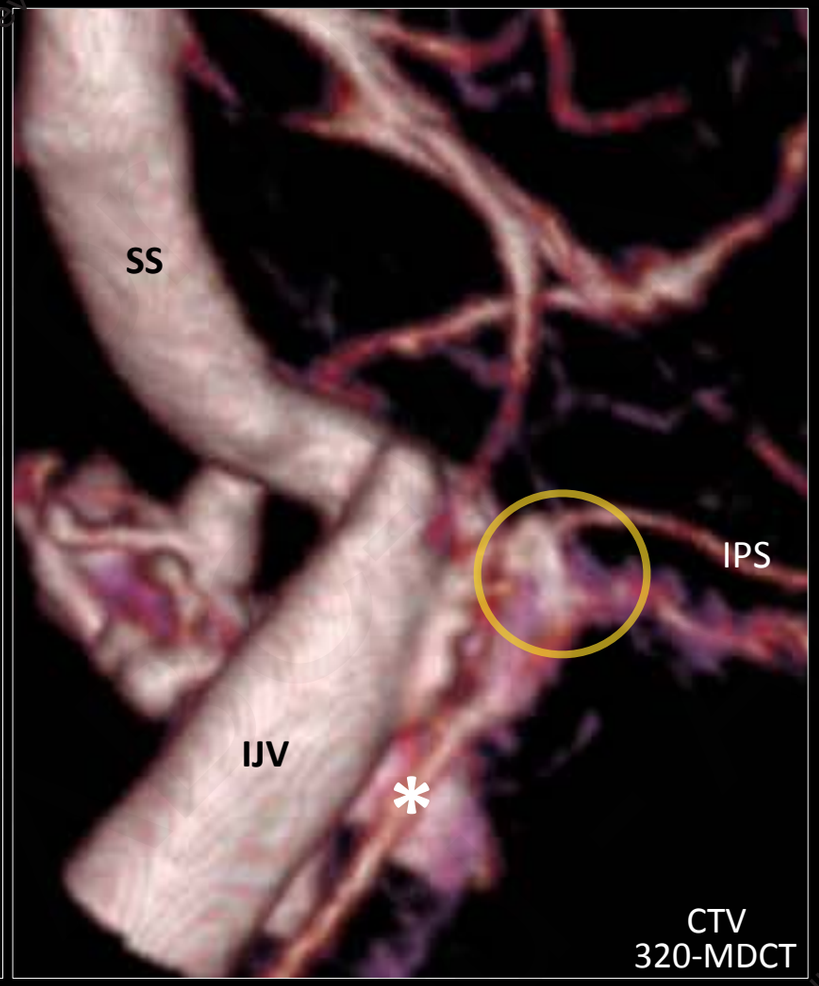
termination into ACC

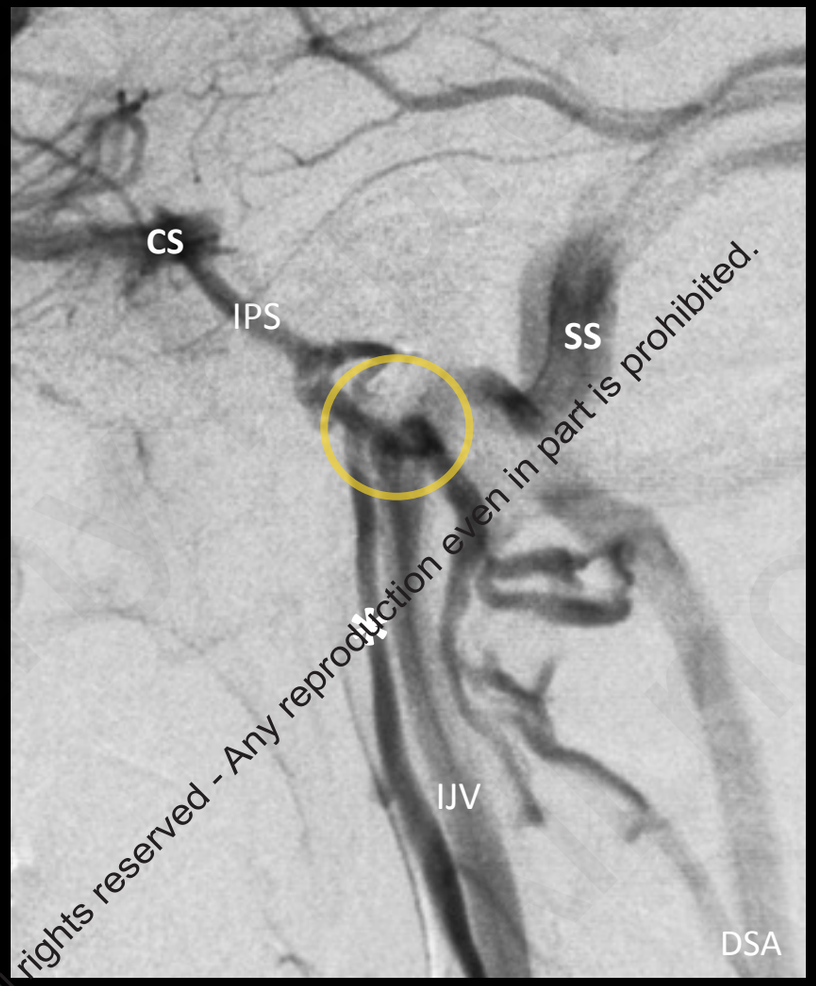


the inferior petrosal sinus (IPS)

termination of the IJV : cervical IPS or IJV duplication?







* - cervical IPS versus duplicated IJV ?

the posterior condylar vein (PCV)

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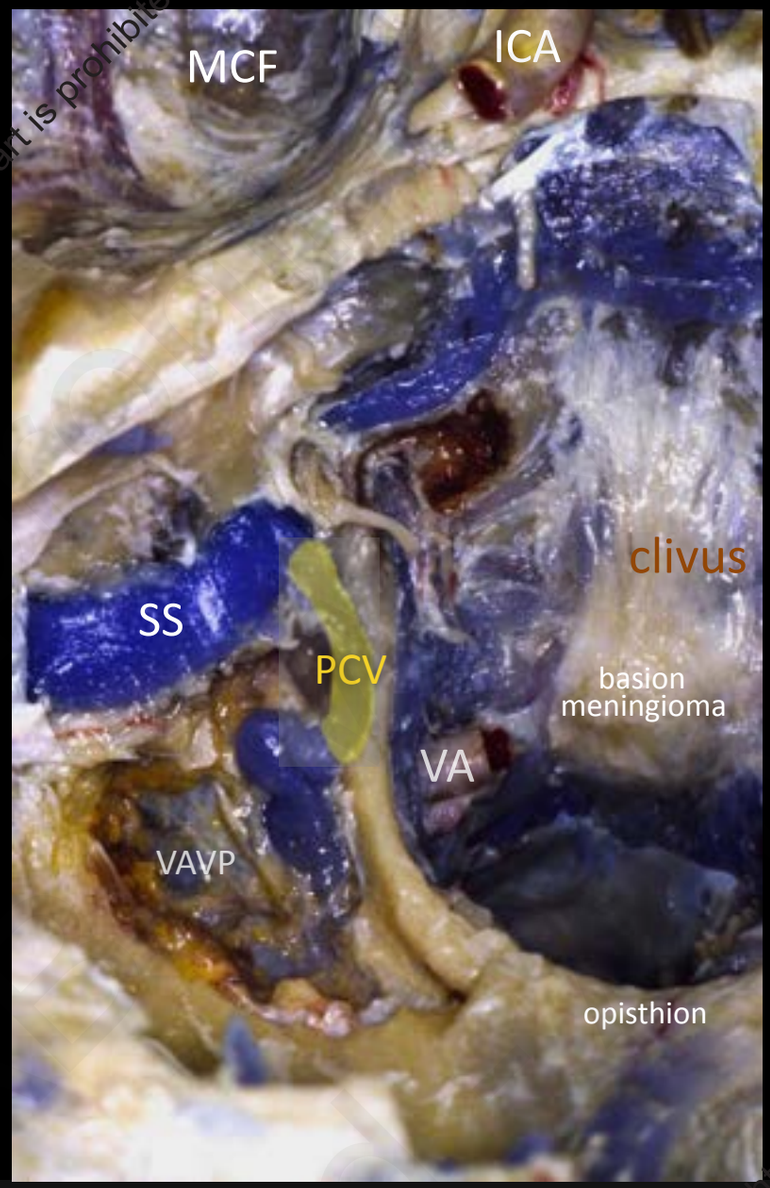
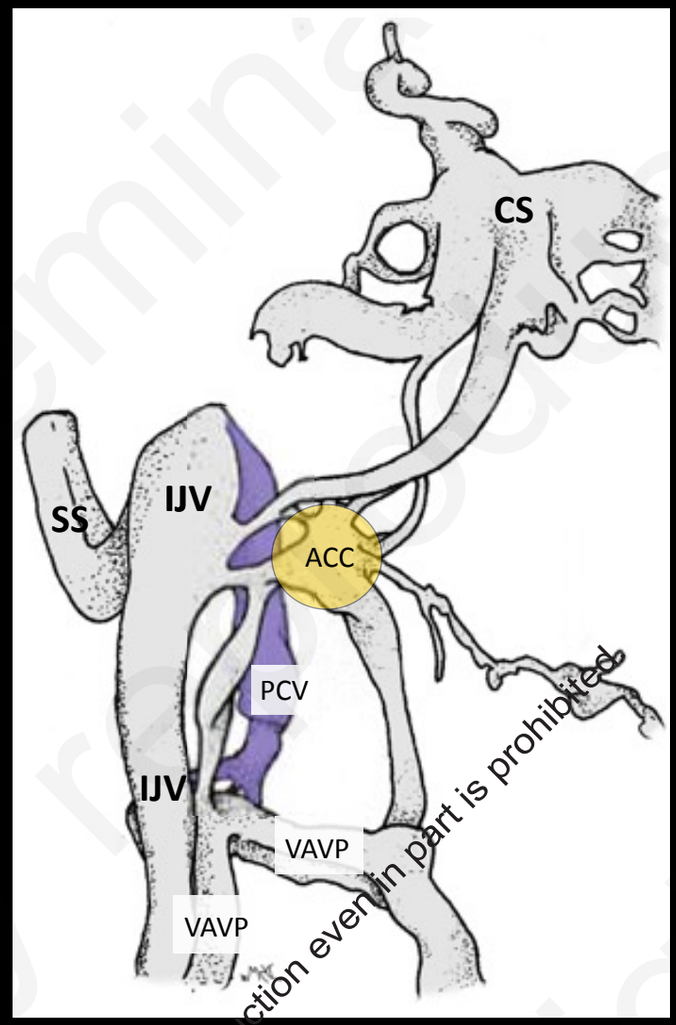


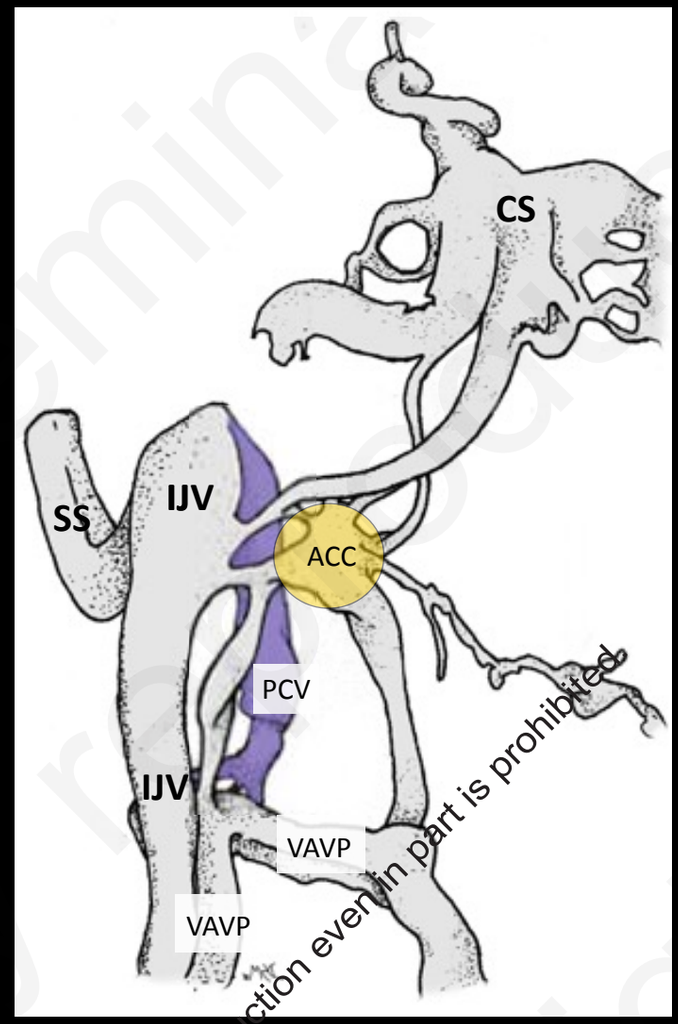


the posterior condylar vein (PCV)

- emissary vein coursing in the posterior condylar canal
- present ~ 80%
  ← junction sigmoid sinus (SS) / bulb jugular vein
  → posterior genou vertebral artery venous plexus (VAVP) / deep cervical vein (DCV)

the posterior condylar vein (PCV)

CTV
320-MDCT



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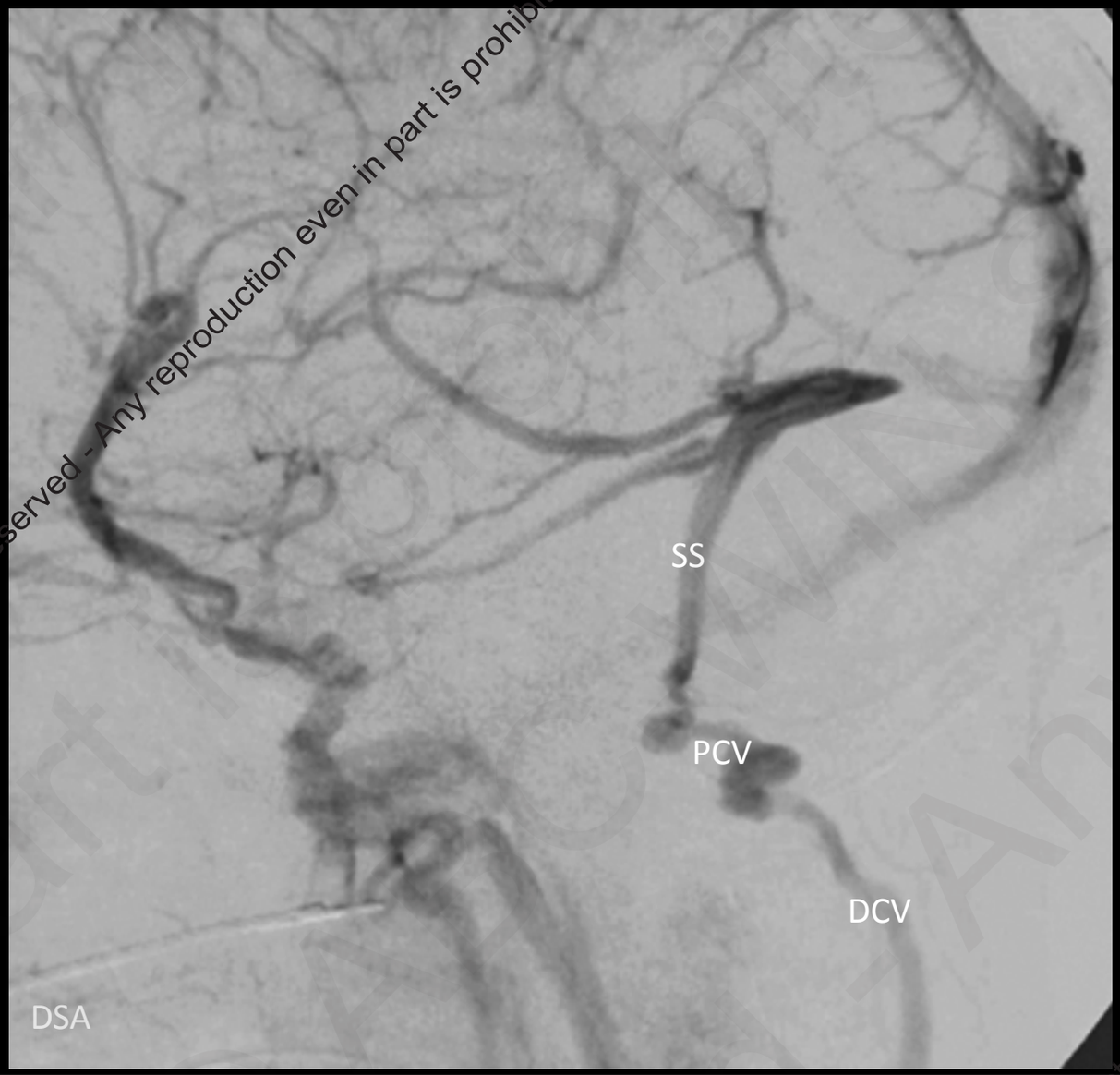

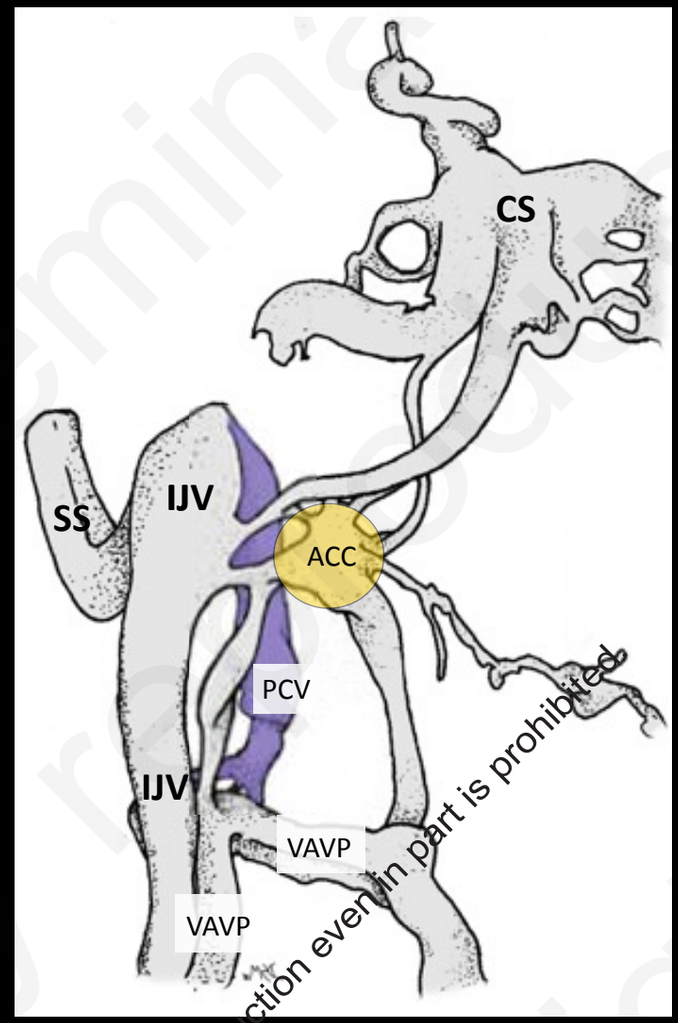

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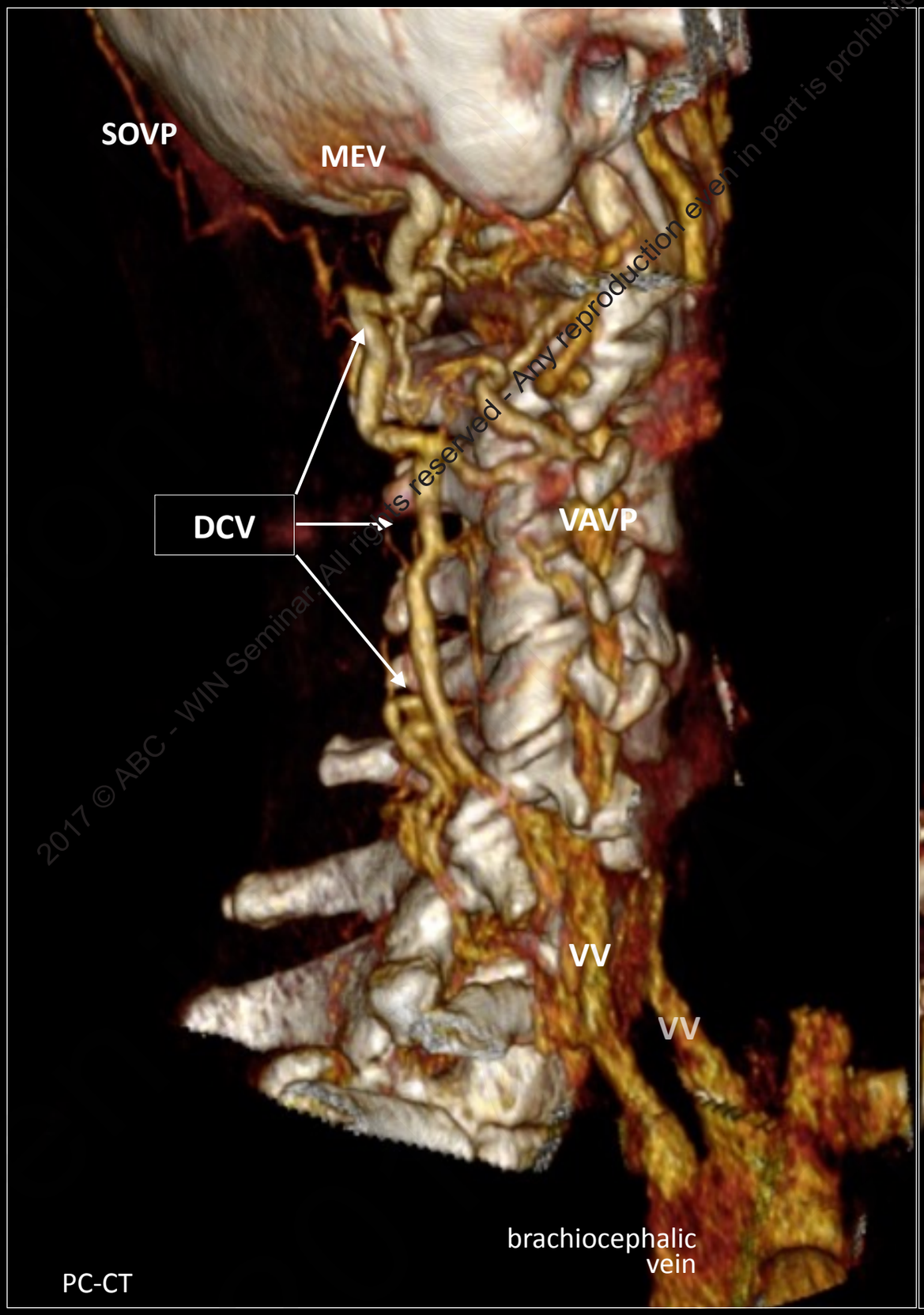
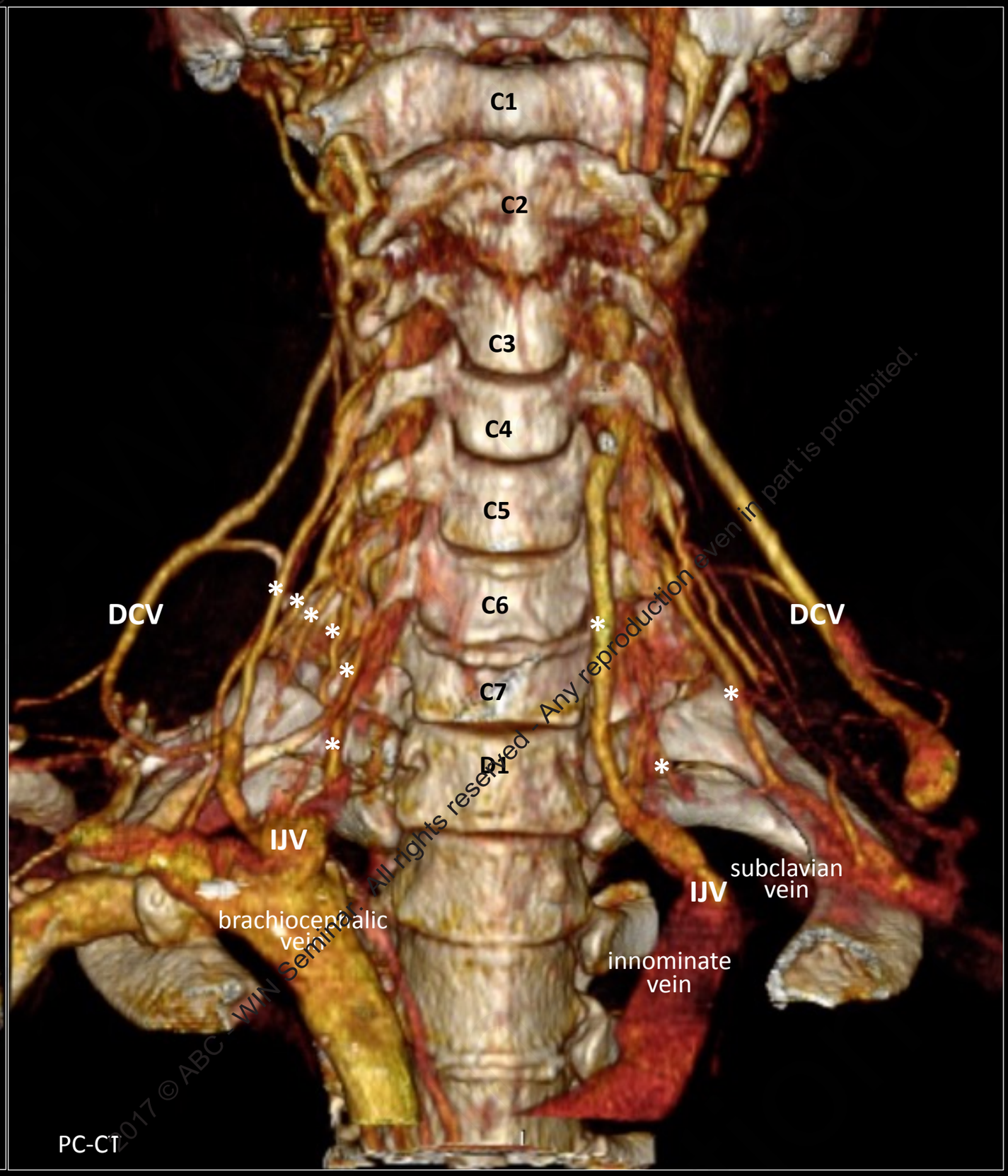
the PCV may represent the only drainage pathway of the SS in case of distal SS aplasia

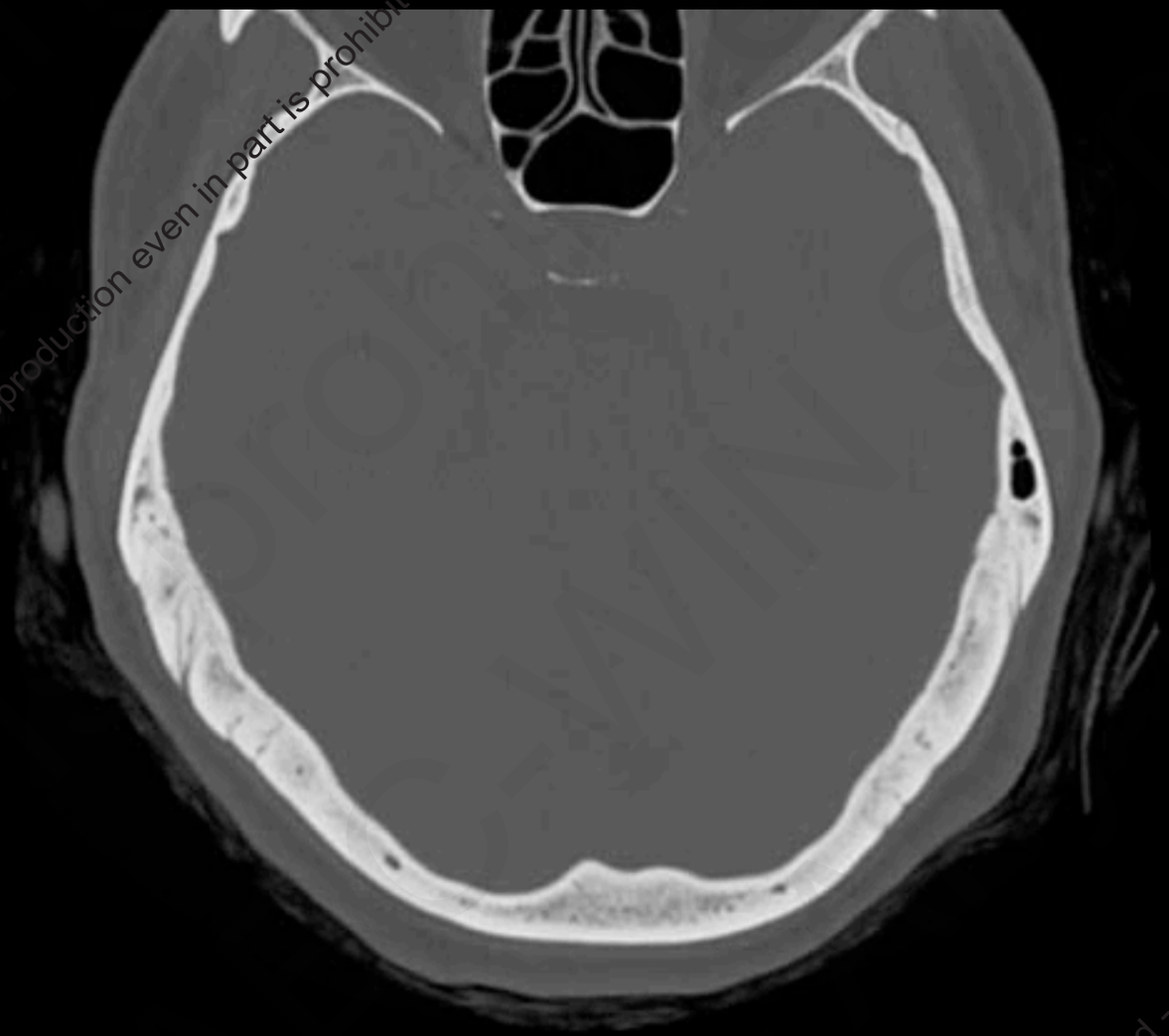
the external vertebral venous system (EVVS)





the mastoid emissary (MEV)

the mastoid emissary vein (ACV)



the mastoid emissary vein (MEV)

- originates from the sigmoid sinus (SS) in the posterior mastoid bone
- → occipito-mastoid suture → variable exit: mastoid, occipitomastoid suture or occipital squama
- → posterior genou of the vertebral artery venous plexus (VAVP), deep cervical vein (DCV) or external jugular vein
- present ~ 60-90 % of the times

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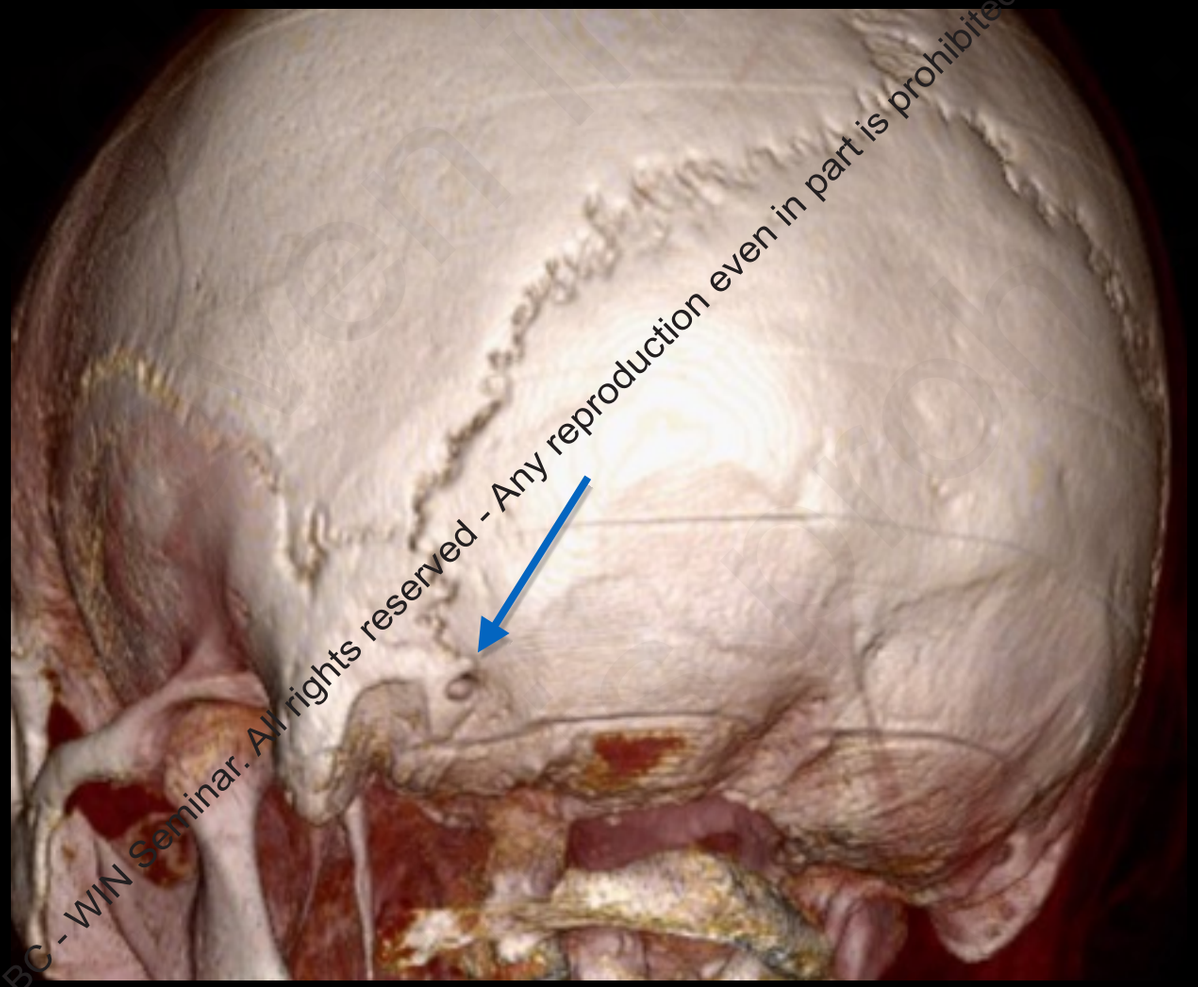

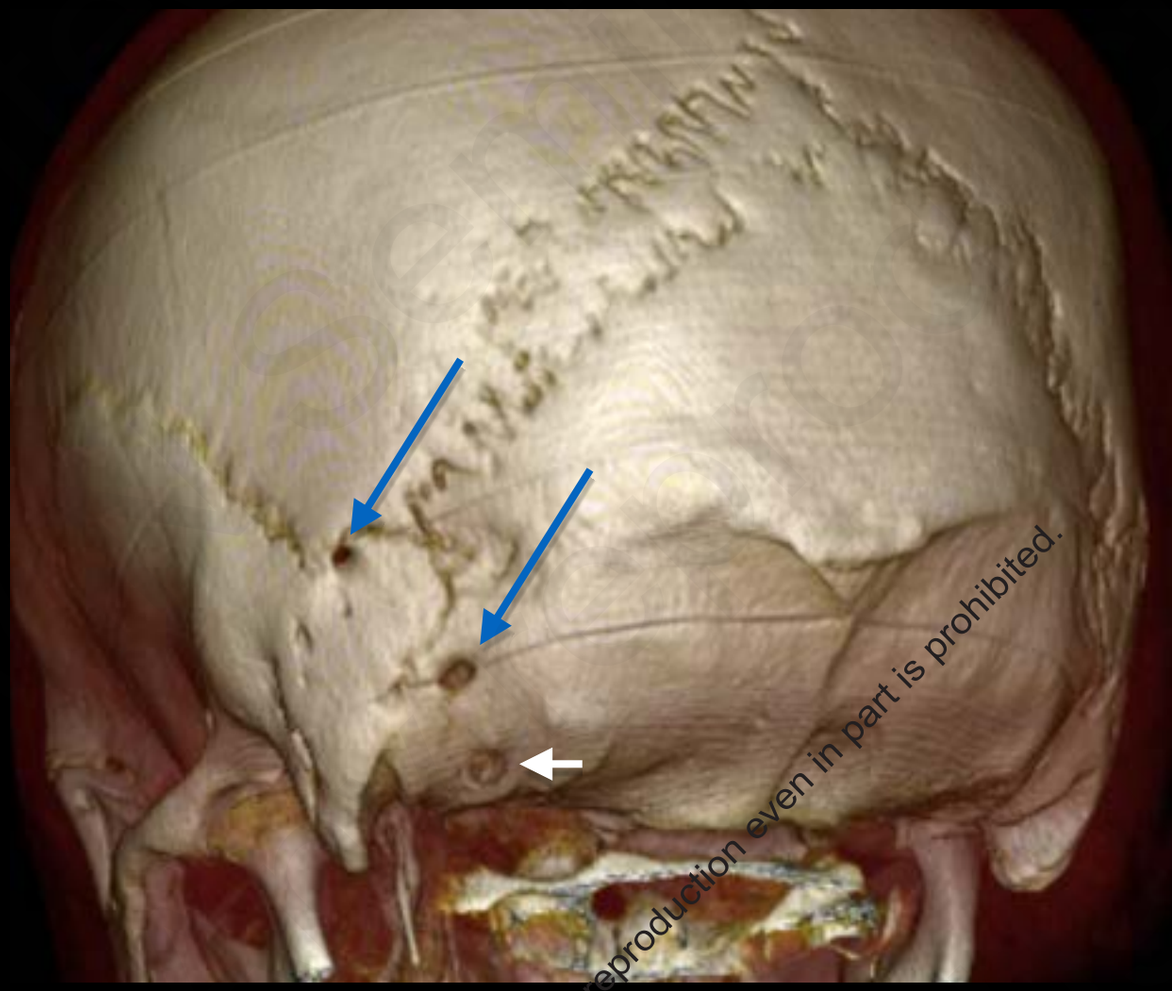

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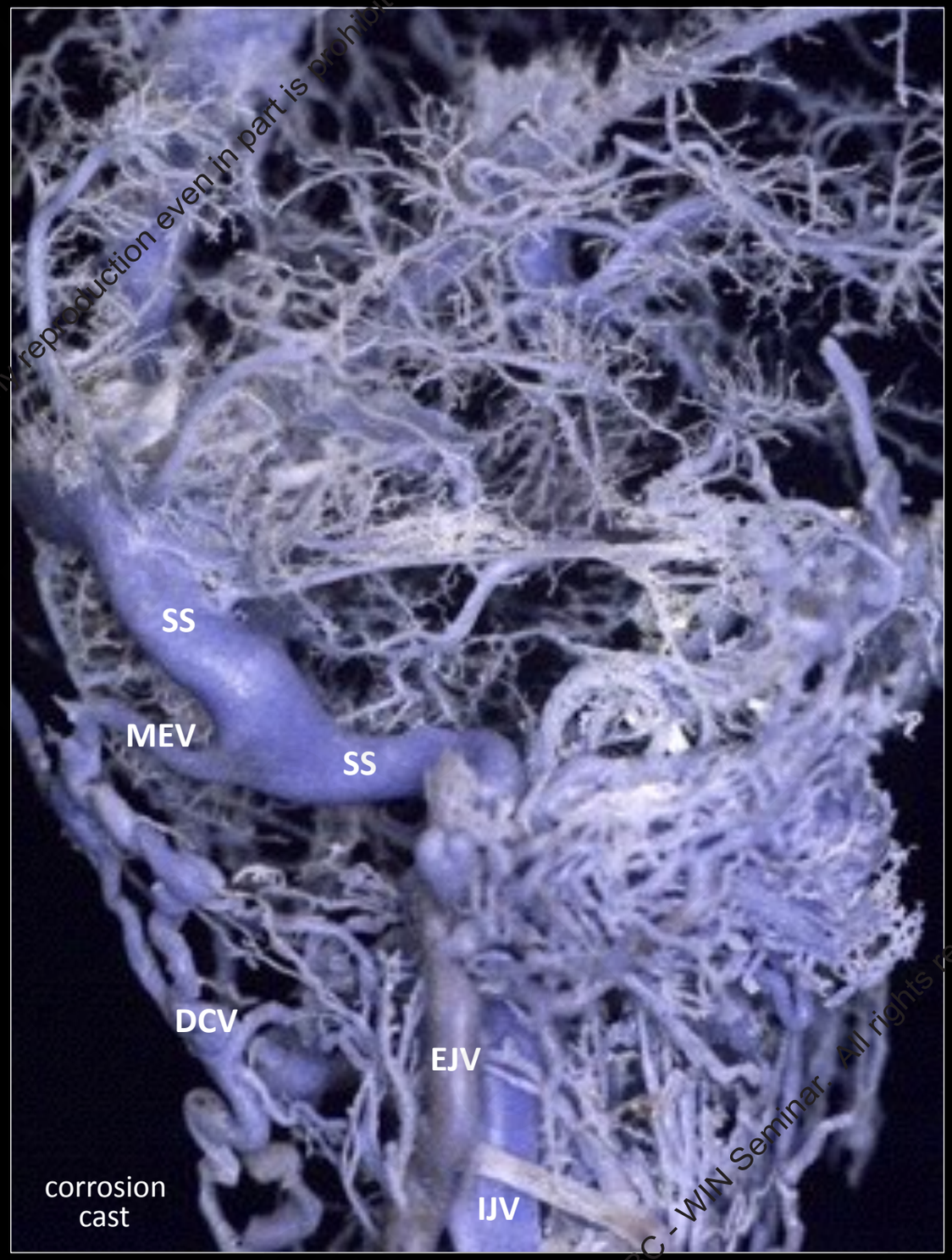

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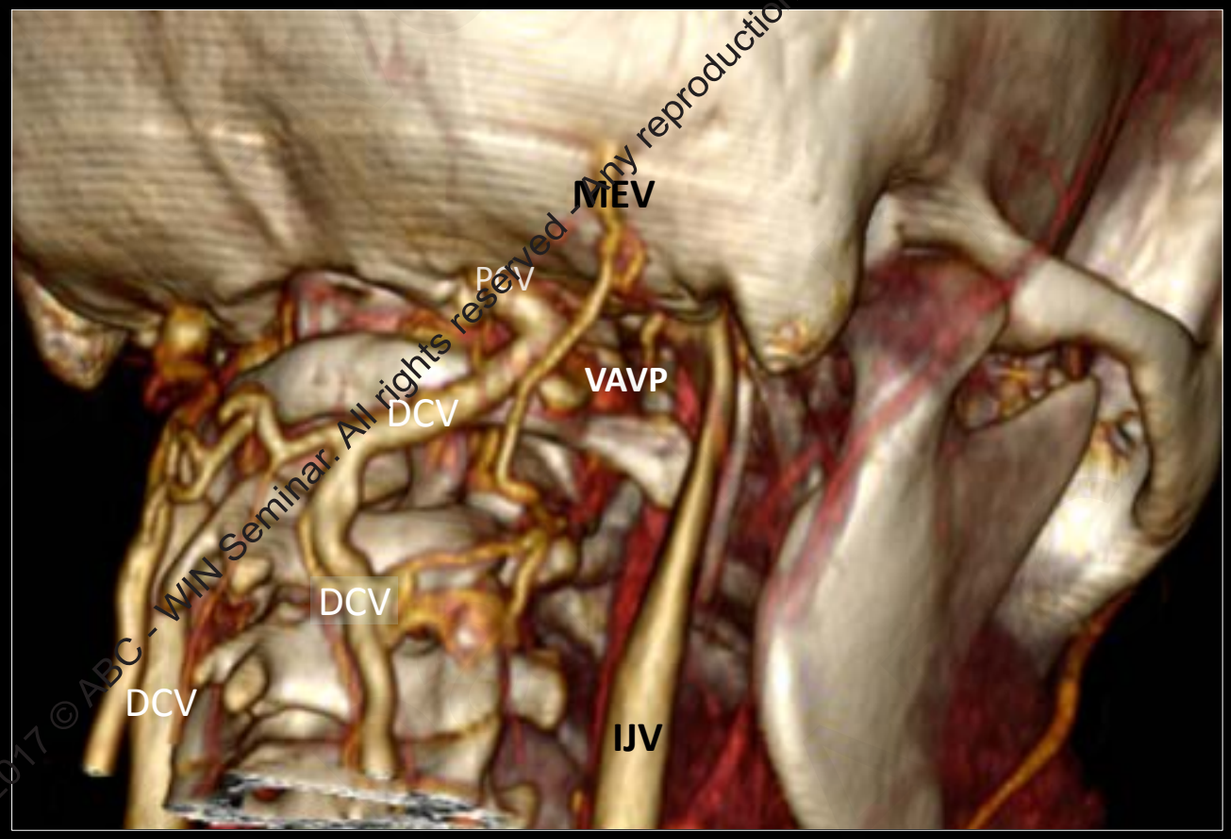

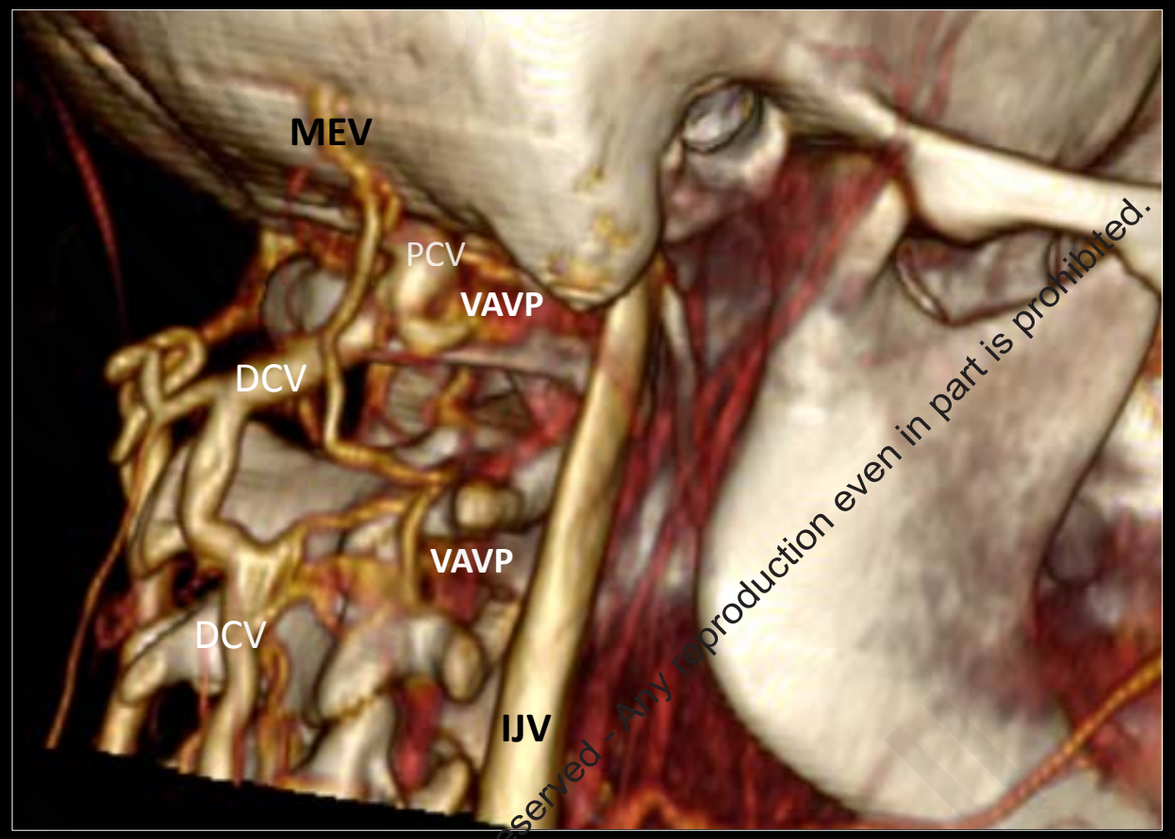

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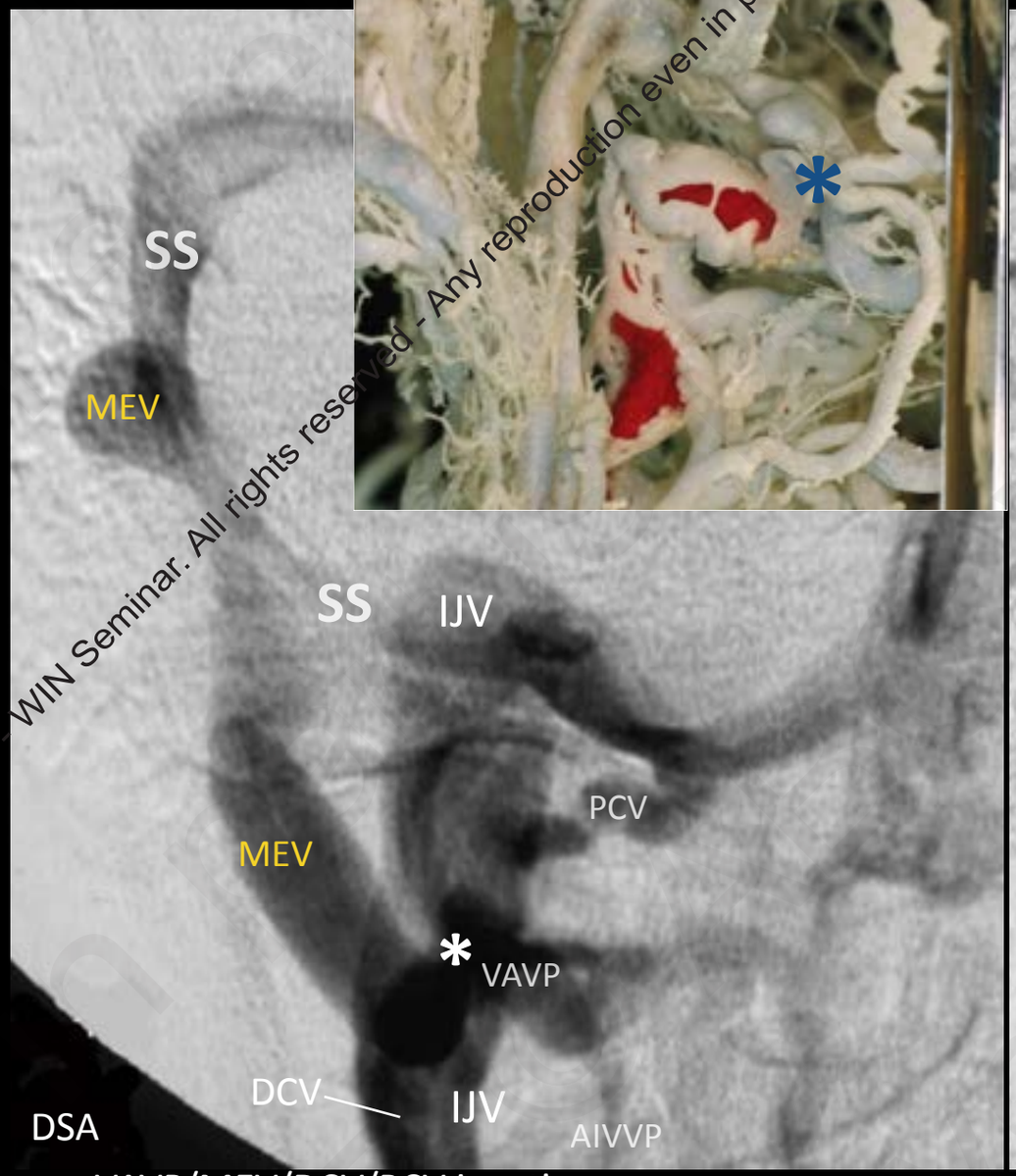

* - VAVP/MEV/DCV/PCV junction

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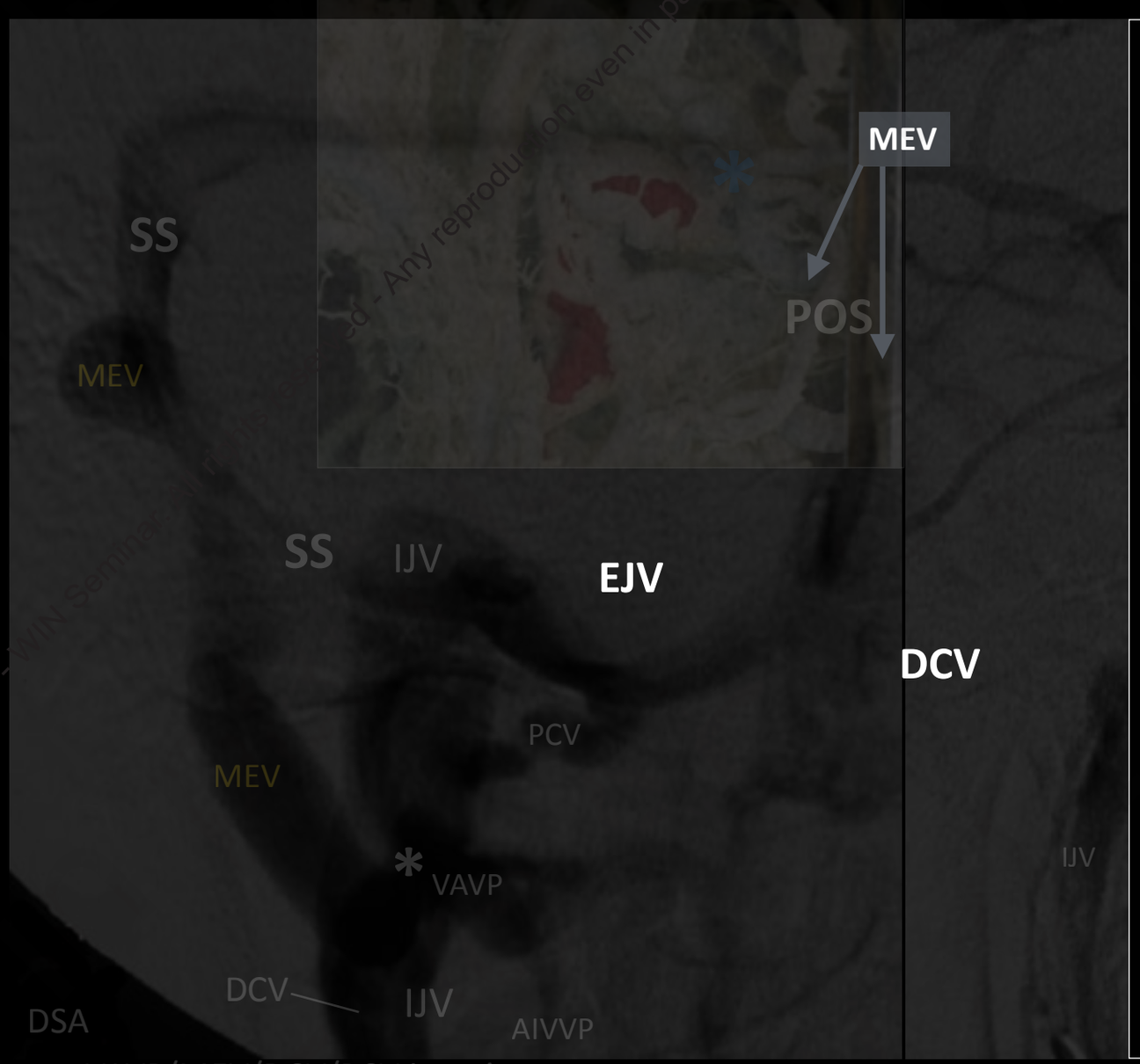

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the marginal sinus (MS)

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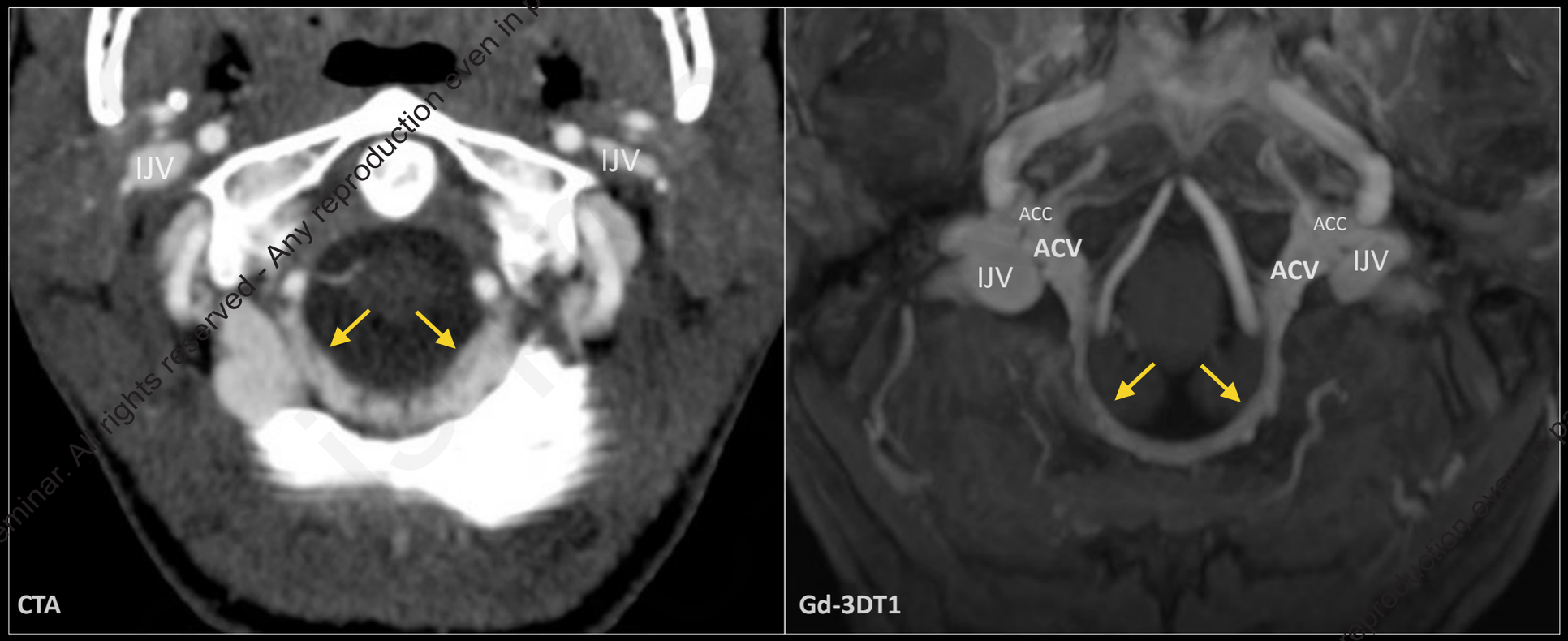

the marginal sinus (MS)

- circular sinus lying in the dura mater disposed around the margin of the foramen magnum
- more developed posteriorly

← persistent occipital sinus	→ anterior condylar veins
← diploic veins of the occipital squama	→ origin of the vertebral artery venous plexus (VAV) at C0/C1
← posterior fossa veins	→ basilar plexus

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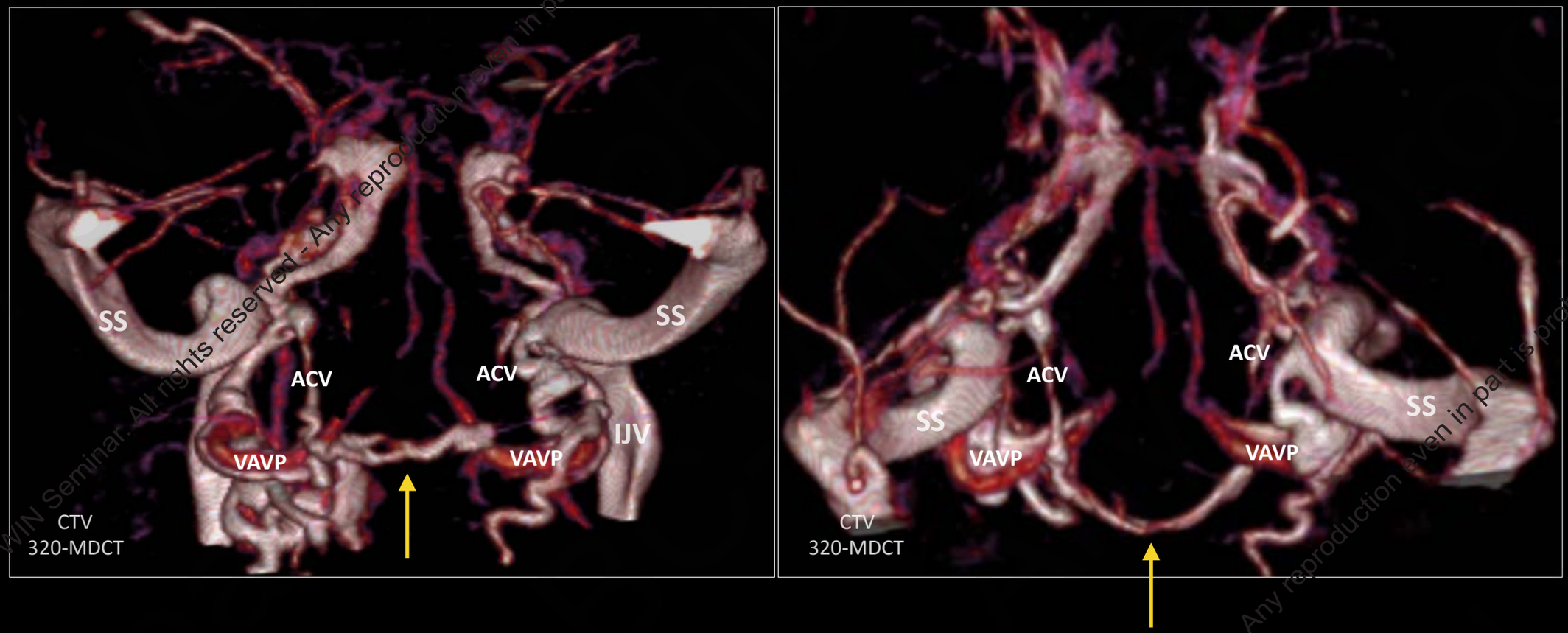

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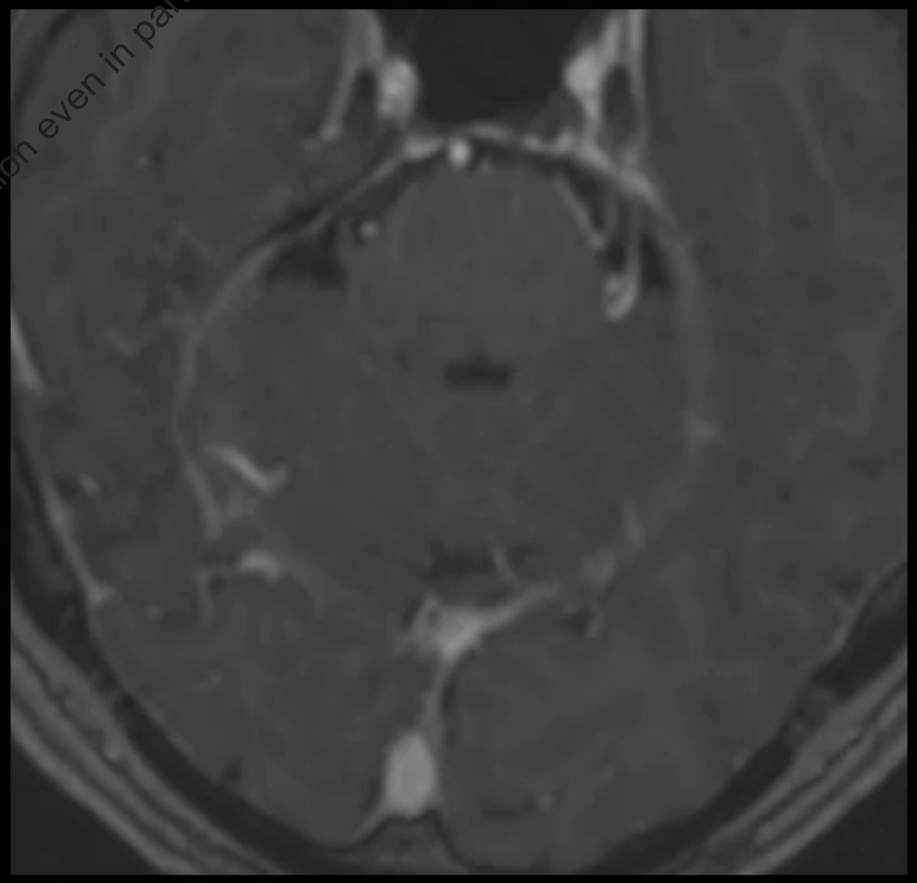

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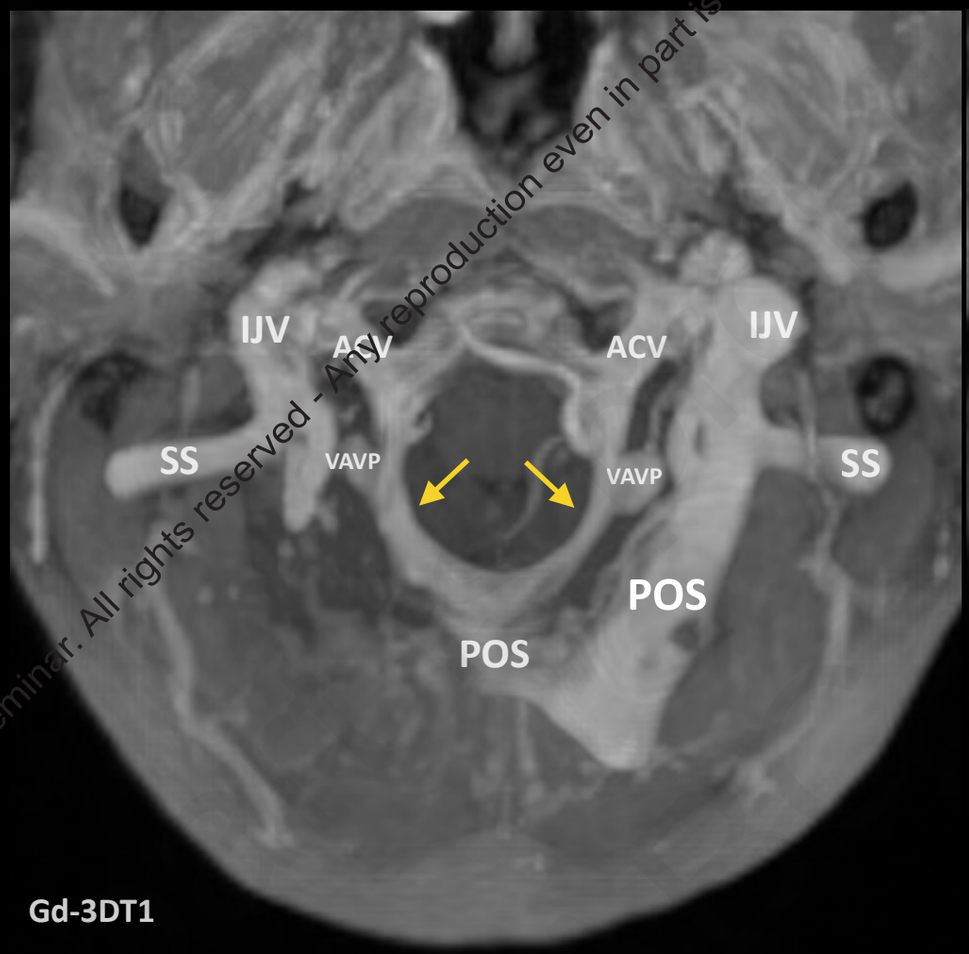
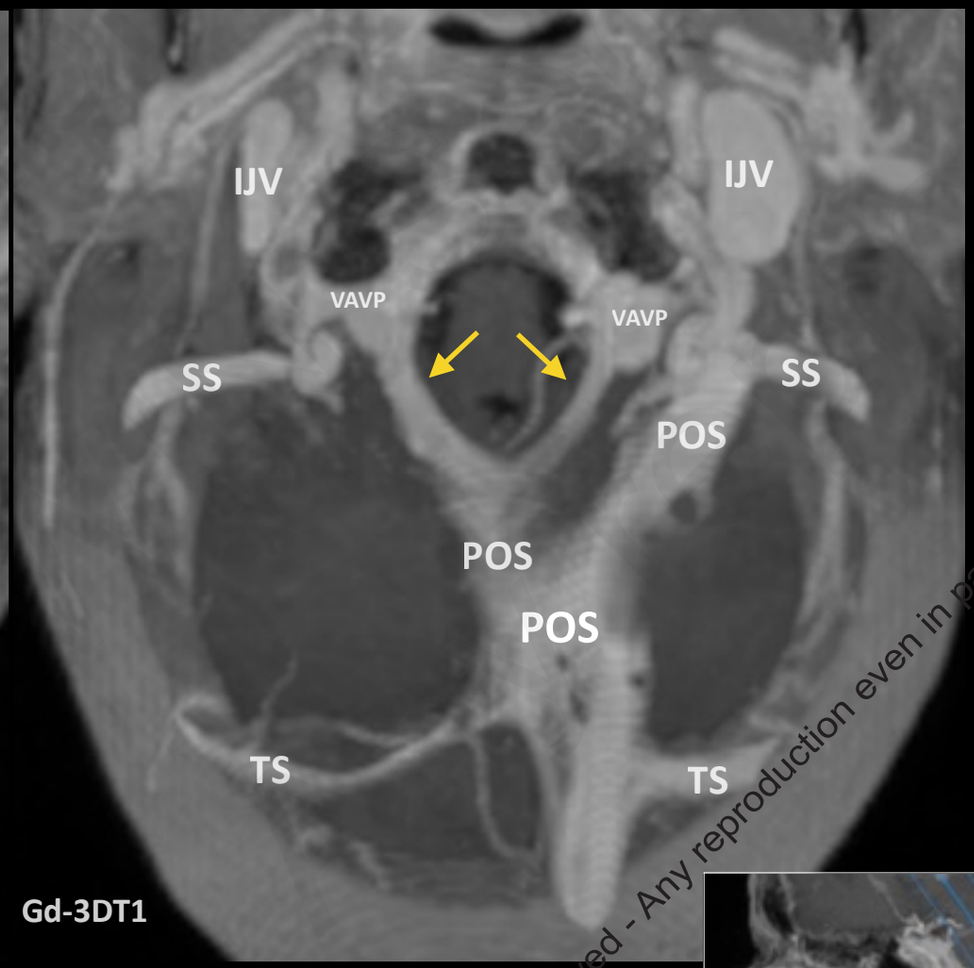
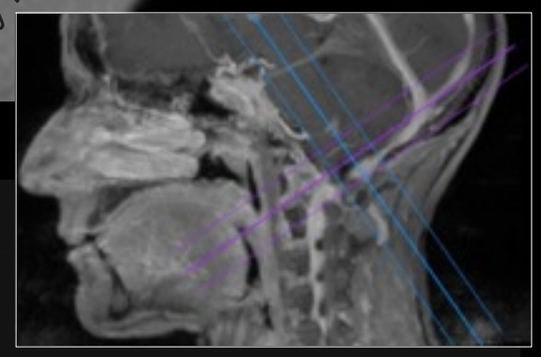


Gd-3DT1



Gd-3DT1



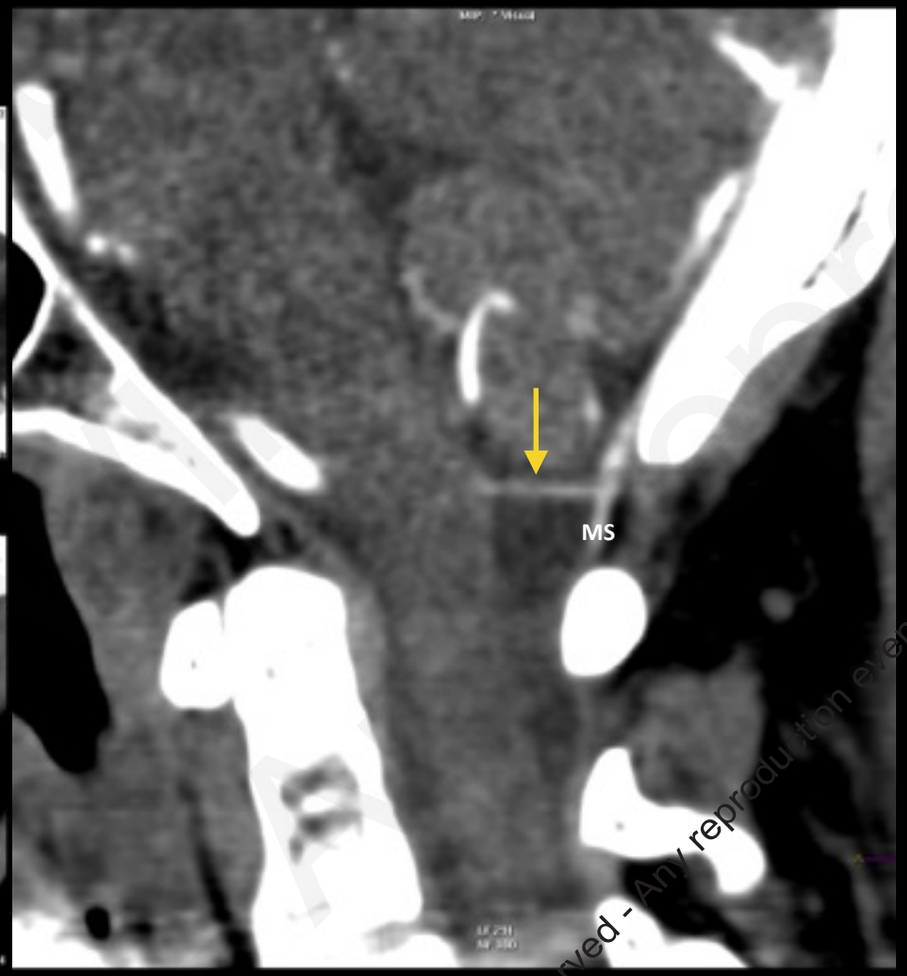
the marginal sinus (MS)

- circular sinus lying in the dura mater disposed around the margin of the foramen magnum
- more developed posteriorly

← persistent occipital sinus	→ anterior condylar veins
← diploic veins of the occipital squama	→ origin of the vertebral artery venous plexus (VAV) at C0/C1
← posterior fossa veins	→ basilar plexus

the marginal sinus (MS)

CTA



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- diploic canal in the occipital squama → exit point : between the external occipital protuberance and opisthion
  ← confluens sinuum, rarely from superior sagittal sinus (SSS)
  → connects with the suboccipital venous plexus → AVVP / DCV
  ← occipital diploic veins
- may be multiple
- present ~ 30 % of the times

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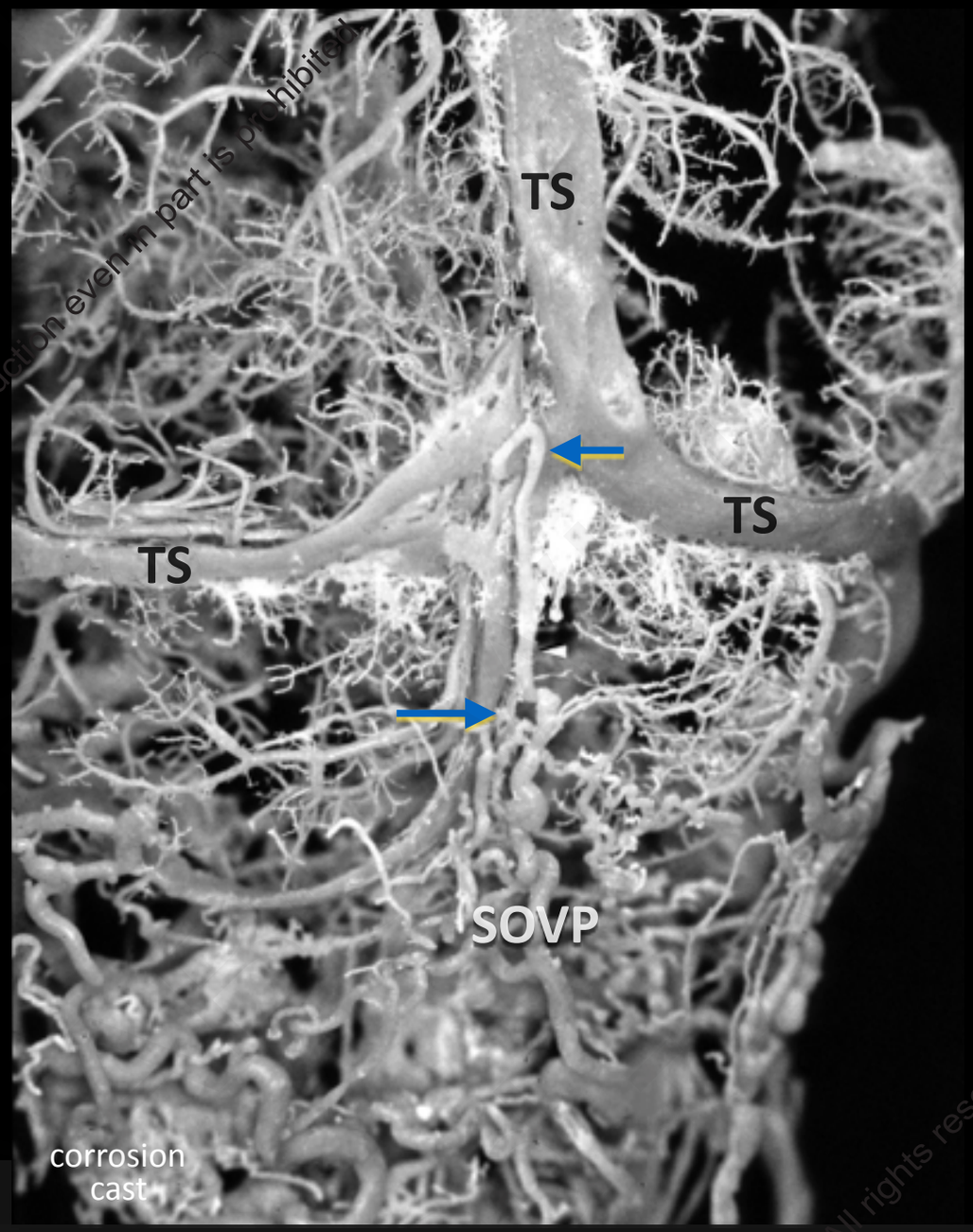

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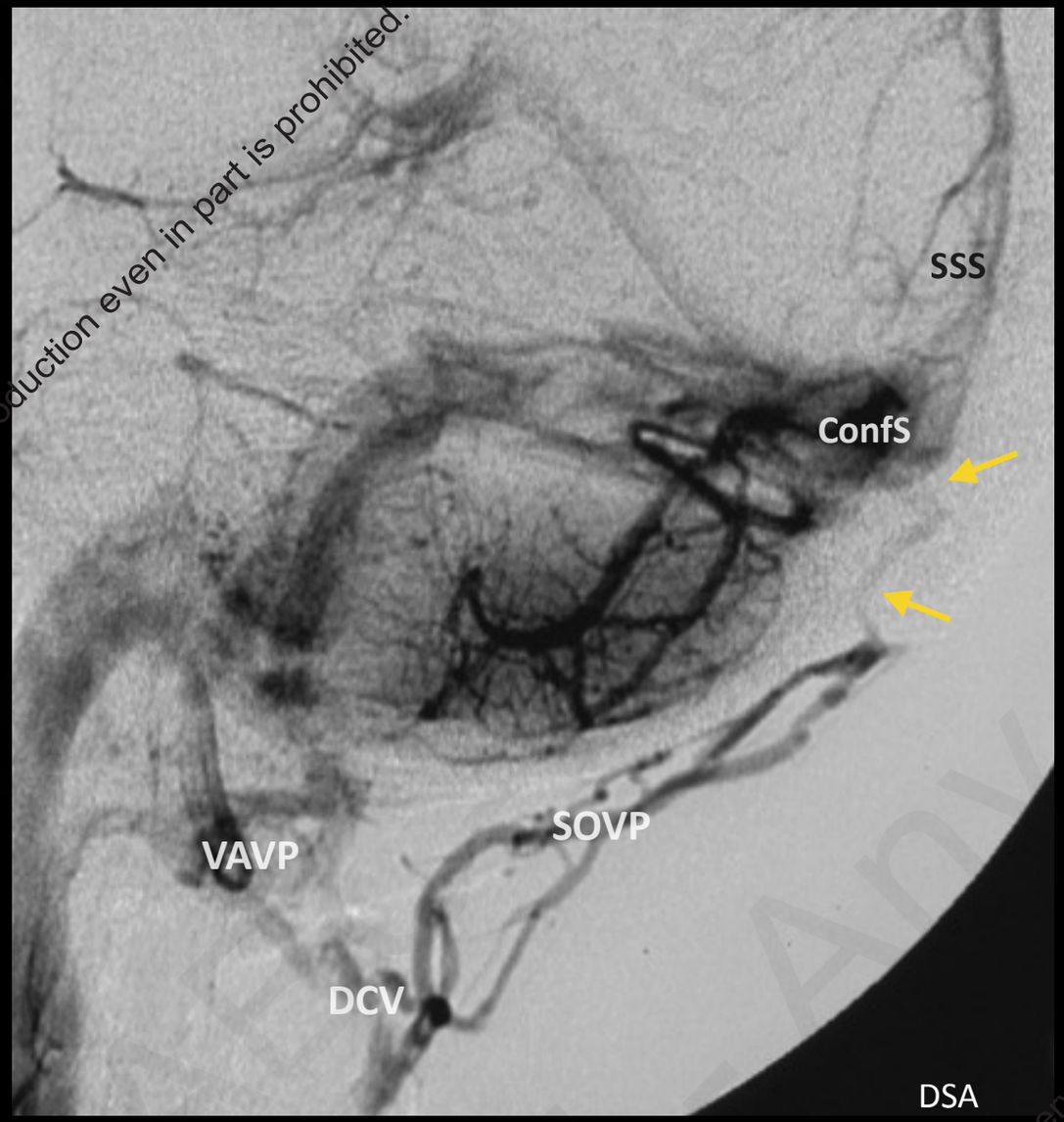

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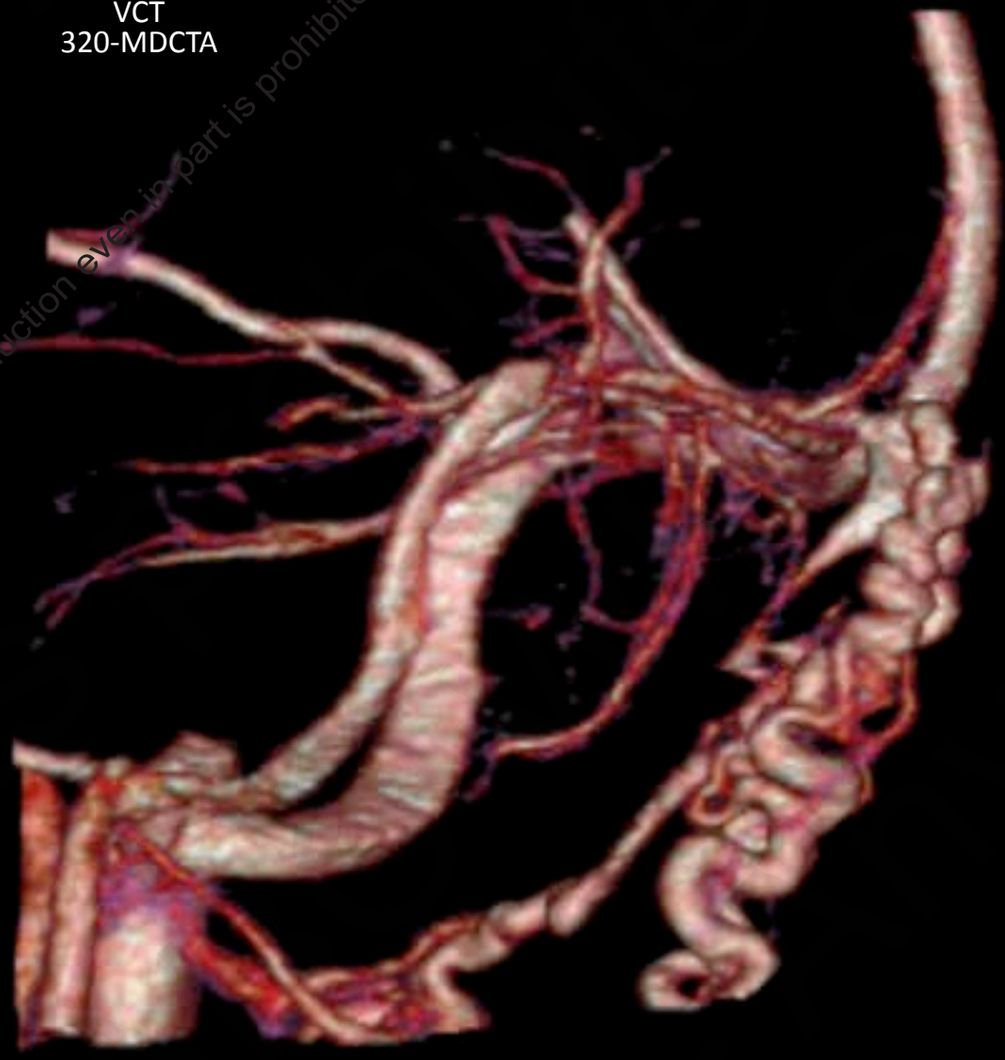
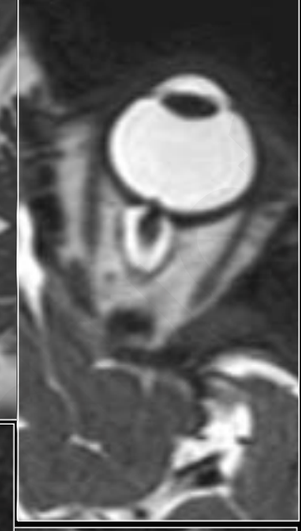
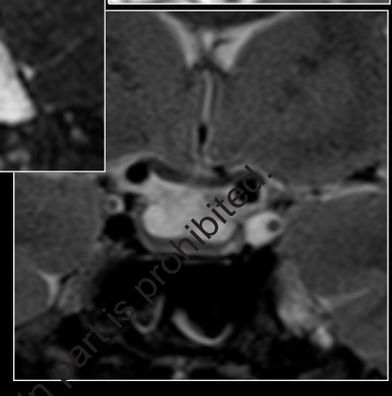
VCT
320-MDCTA







the mastoid emissary vein (MEV)

- originates from the sigmoid sinus (SS) in the posterior mastoid bone
- → occipito-mastoid suture → variable exit, mastoid, occipitomastoid suture or occipital squama
- → posterior genou of the vertebral artery venous plexus (VAVP), deep cervical vein (DCV) or external jugular vein
- present ~ 60-90 % of the times

CAVE: if OEV very large , rule out transverse sinus stenosis and venous PTCS…

the petrosquamosal sinus (PSS)

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- transient embryological channel connecting the transverse sinus (TS) to the external jugular vein (EJV)
- may persist in the adult as a small remnant of little functional importance or as the main /only outflow pathway of the TS

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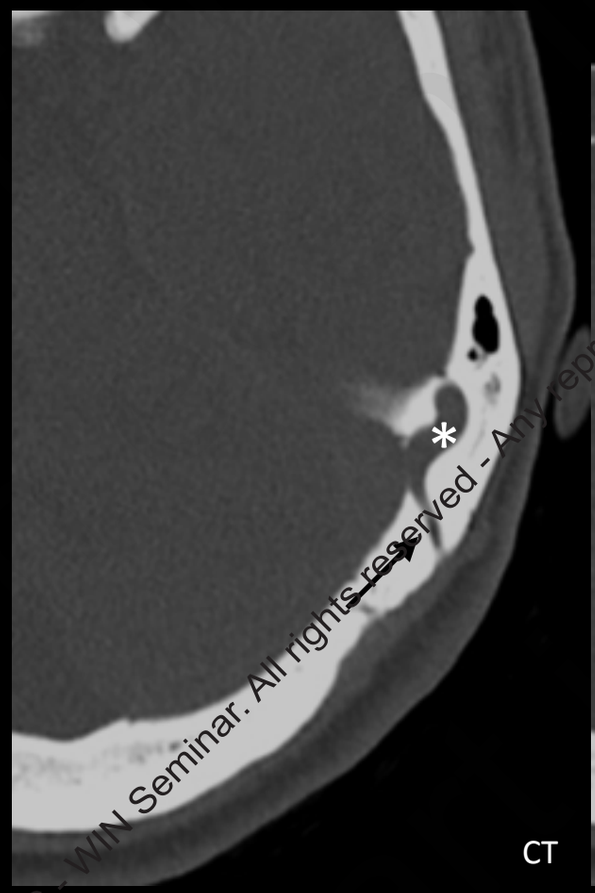

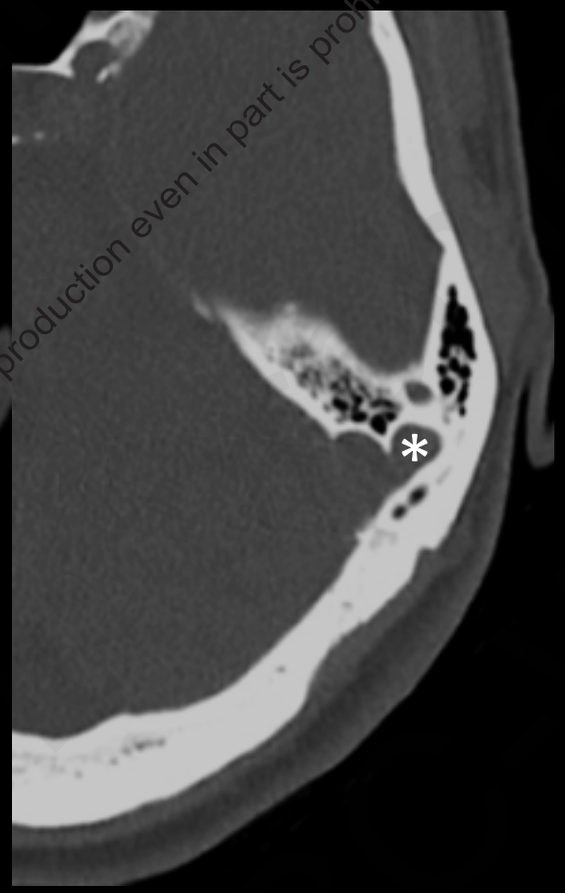

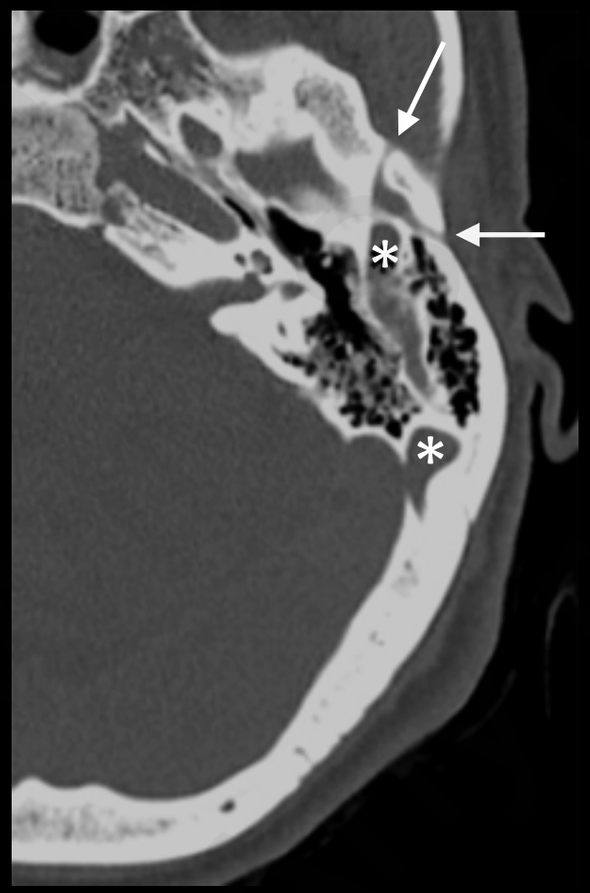

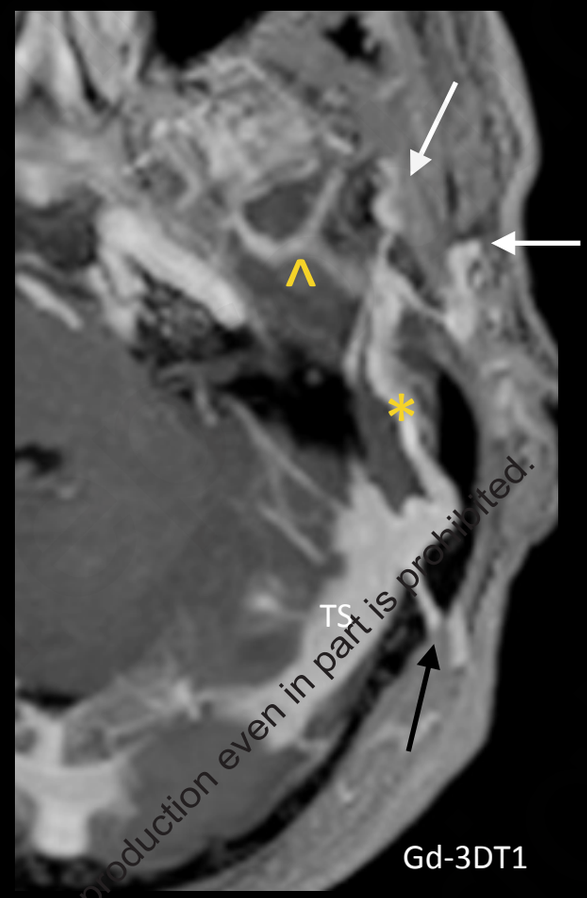

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→ TS / SS junction → the petrosquamosal fissure as an osseous groove or osseous canal (canal of Vergi)

→ connects with the emissary vein of the foramen oval (EVFO) through the floor of the middle cranial fossa

→ connects with the deep/superficial temporal veins through a canal in the temporal bone around the glenoid fossa (spurius jugular foramen or post-glenoid foramen)

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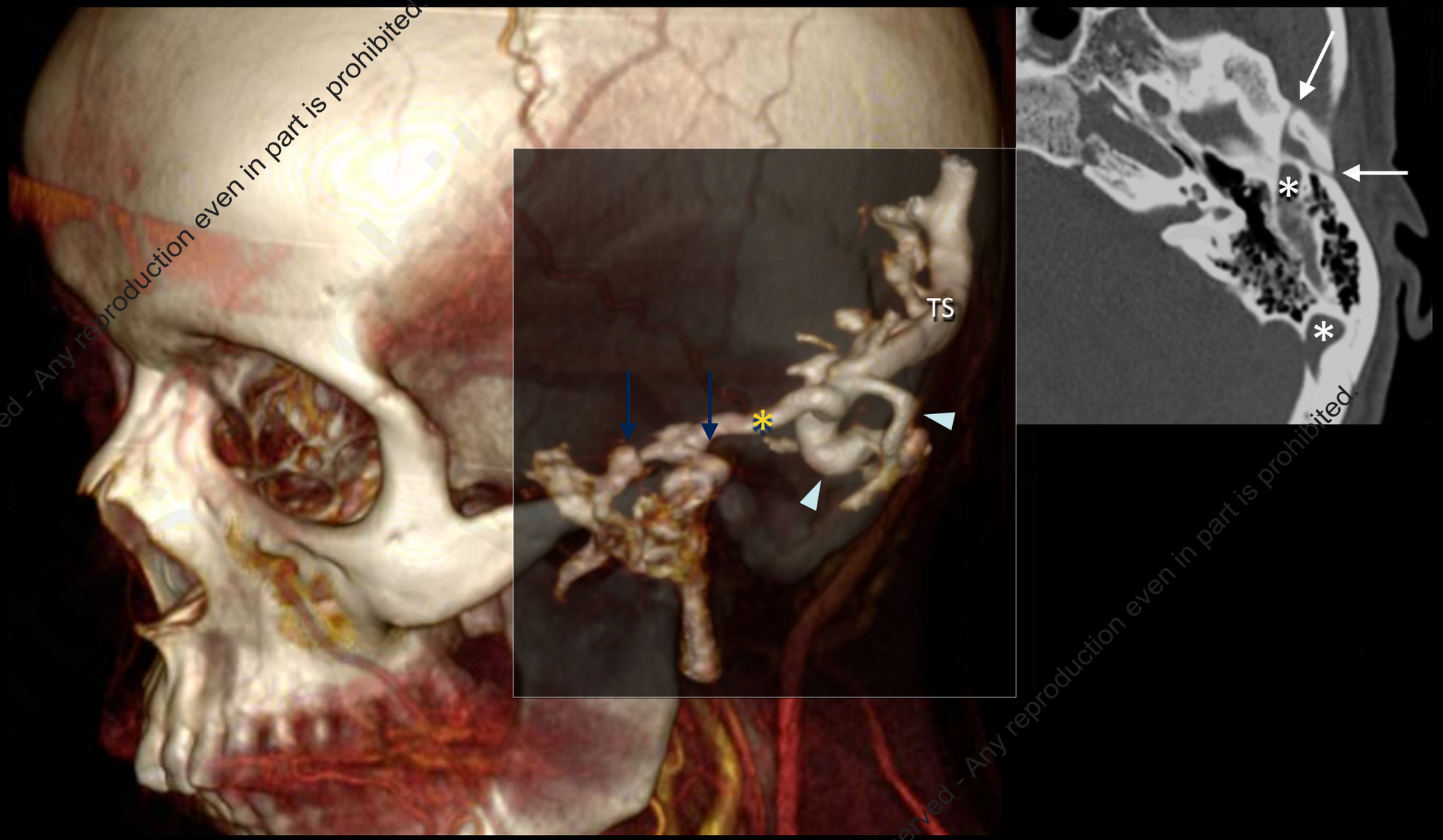

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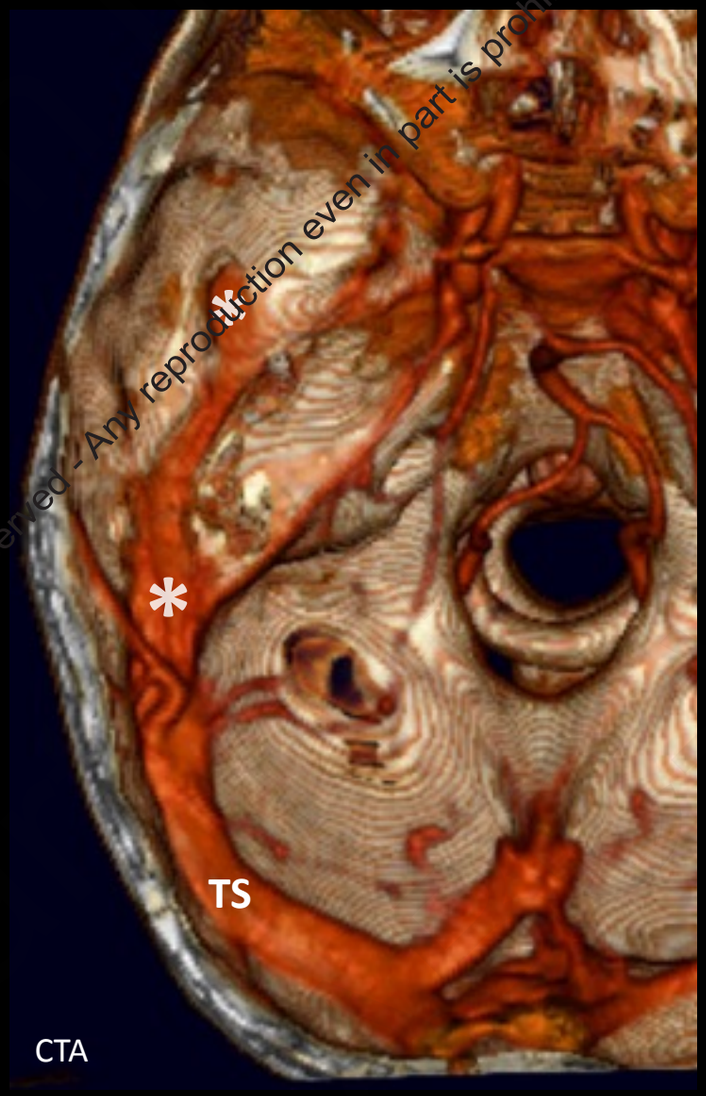

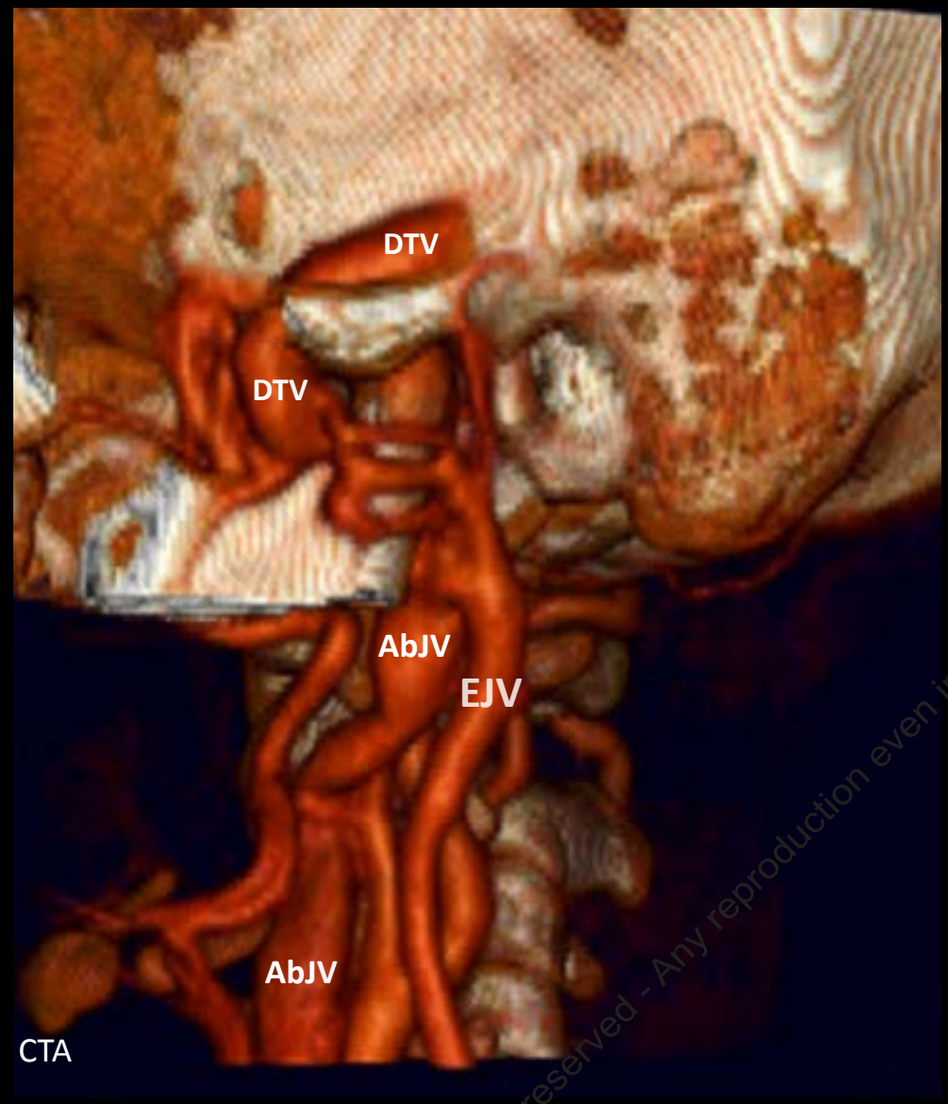

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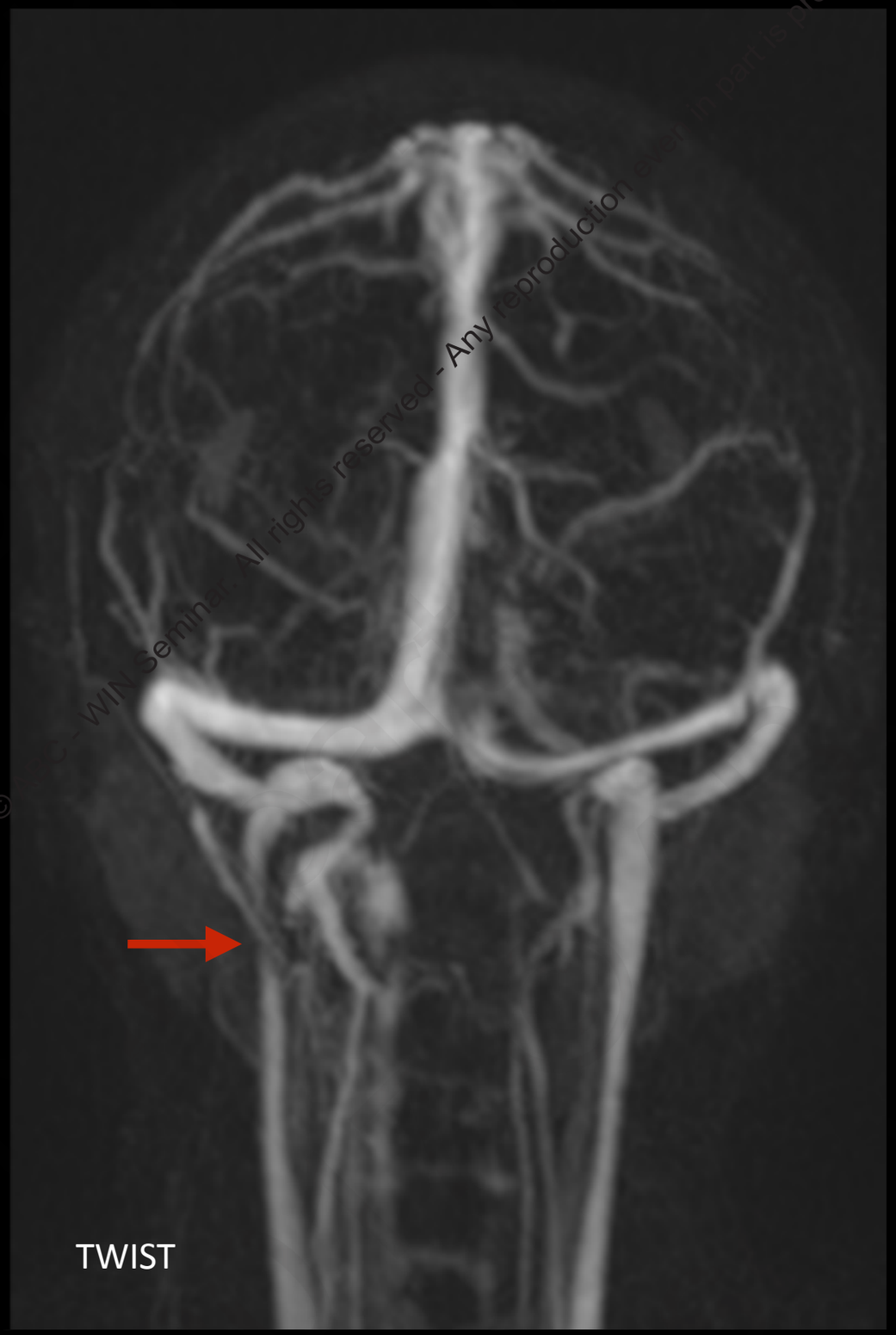
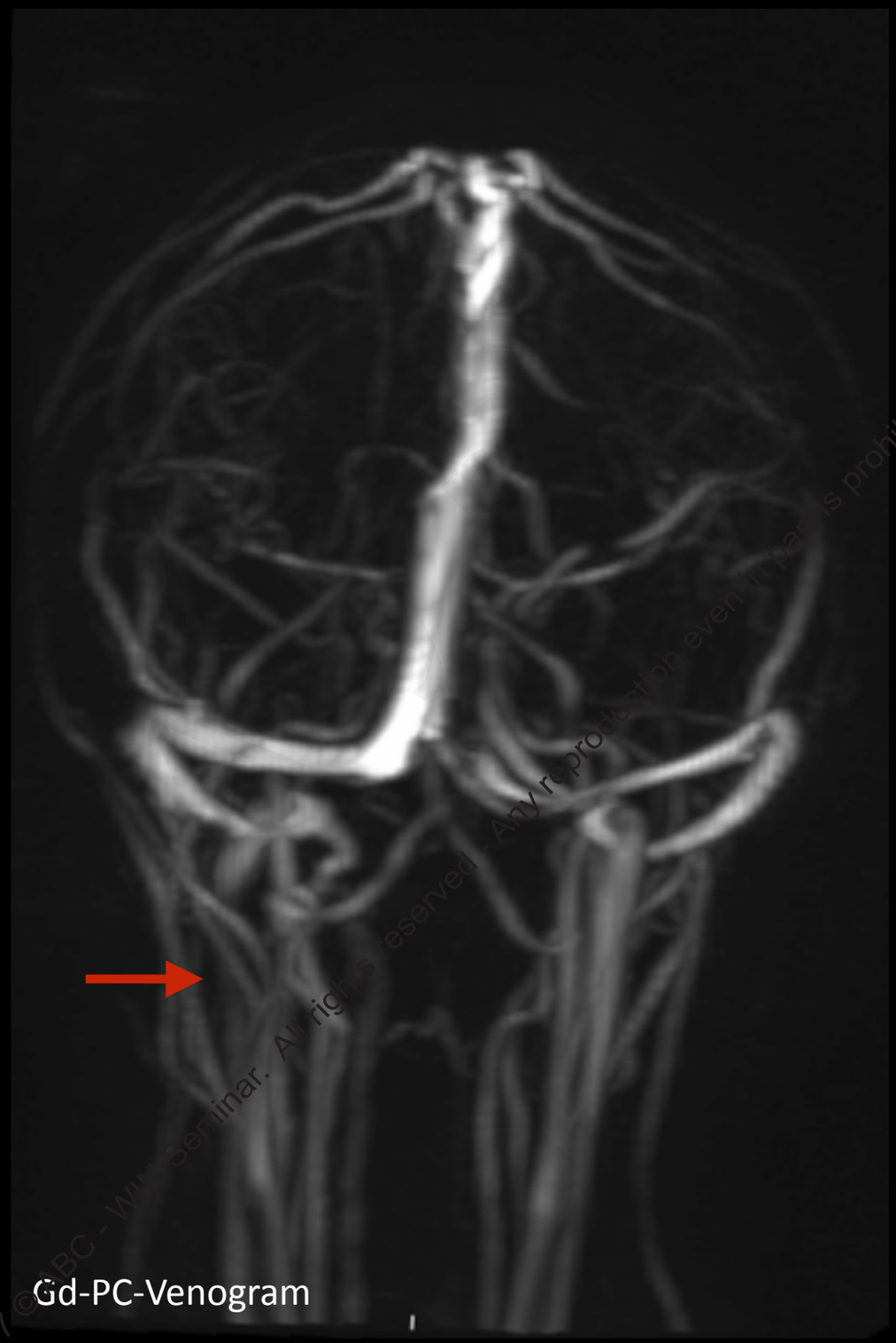
prominence of the vertebral venous system

internal jugular vein stenosis





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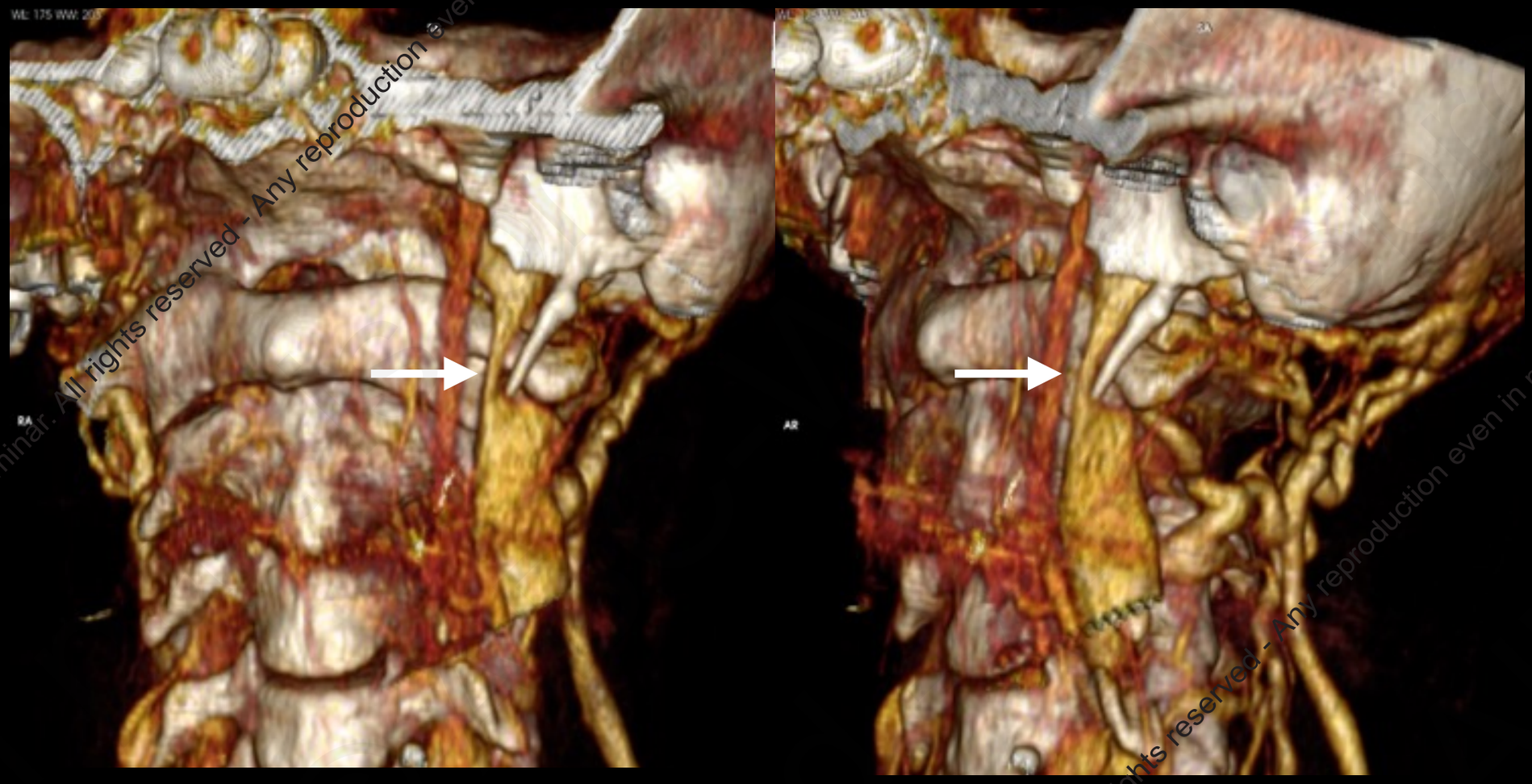

conclusion

the anatomy of the cranio-cervical venous system is complex

can be subject to extreme anatomical variation, but otherwise is highly reproducible

it can be readily demonstrated by different imaging techniques

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