



Posterior Communicating Artery Aneurysm

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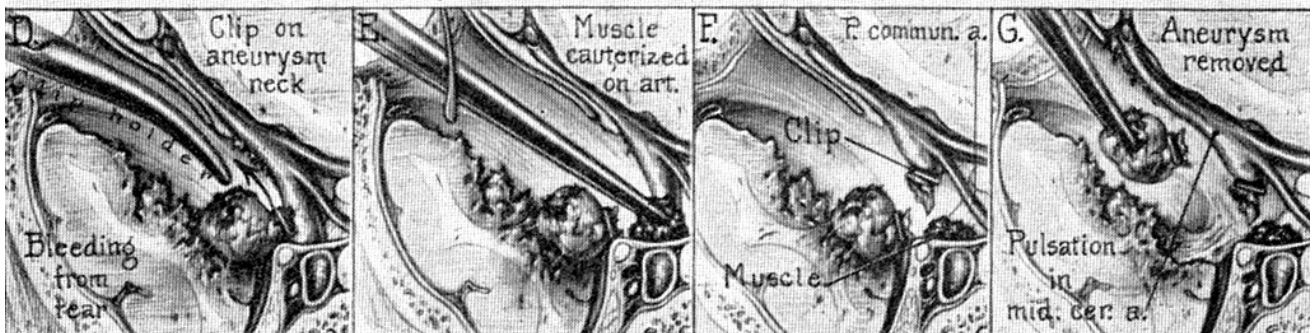
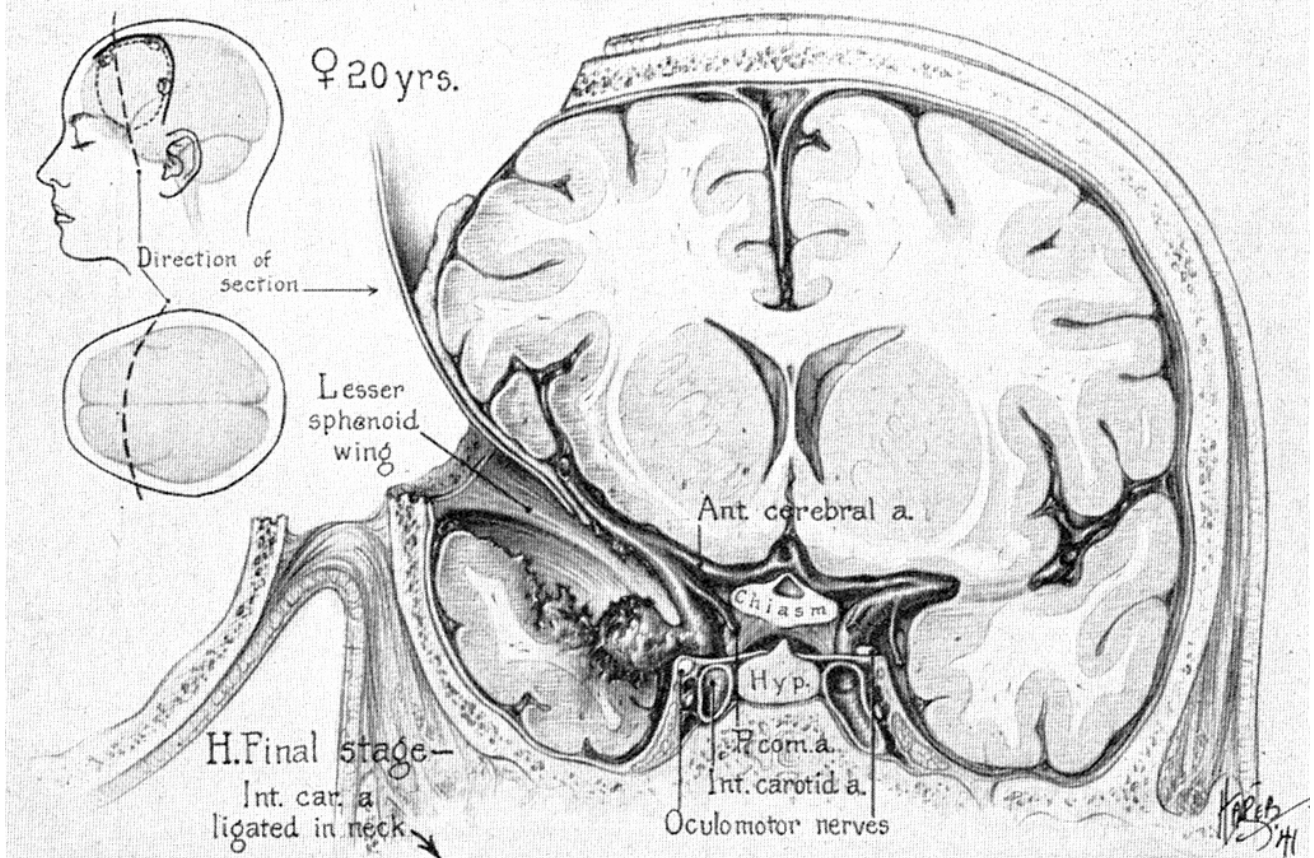
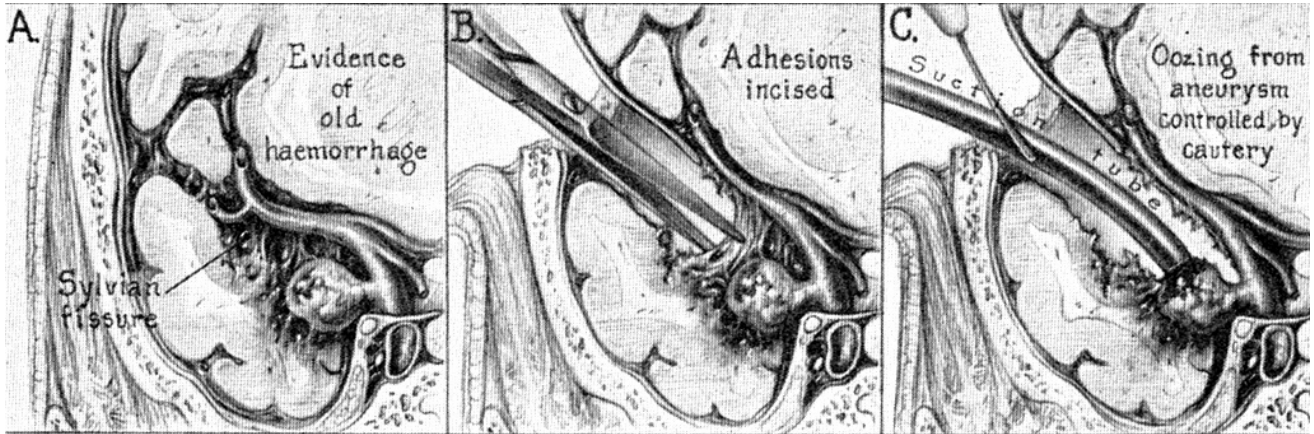


Figure 1: Walter Dandy, a pioneer in aneurysm surgery, demonstrated how to expose and control intraoperative aneurysm rupture and place a silver clip across the neck of a posterior communicating artery aneurysm. The aneurysm was subsequently resected.

Aneurysms of the posterior wall of the internal carotid artery (ICA,) originating from the anterior choroidal artery (AChA) and posterior communicating artery (PCoA,) are the most common intracranial aneurysms (up to 35% of all aneurysms.)

PCoA aneurysms represent roughly one-quarter of all ruptured aneurysms. In addition to subarachnoid hemorrhage, patients with PCoA aneurysms commonly present with mass effect on the oculomotor nerve or, less commonly, with embolic phenomena. A spontaneous painless third nerve palsy is assumed to be caused by a PCoA aneurysm until proven otherwise.

A spontaneous subdural hematoma along the tentorium and reaching the convexity can also be caused by a PCoA aneurysm. Such a hematoma often causes symptomatic mass effect with impending brain herniation and requires emergent evacuation.

In this chapter, I will describe the operative techniques for clip ligation of PCoA aneurysms. The similar procedure for [anterior choroidal artery aneurysms](#) is described in its own dedicated chapter.

Indications for Surgery

Modern treatment options for PCoA aneurysms include observation, endovascular treatment, or microsurgical clip ligation. Observation is a reasonable option for small unruptured aneurysms or larger ones in older patients (>75 years old) or patients with underlying medical conditions that affect their survival.

Observation for unruptured PCoA aneurysms is an actuarial decision. The Second International Study of Unruptured Intracranial Aneurysms (ISUIA 2) grouped PCoA aneurysms with posterior circulation aneurysms in the group with higher risk of rupture, citing a 2.5% rupture risk over 5 years for those smaller than 7 mm and a rapidly increasing risk for larger lesions. However, some have criticized this study and argue that the rupture risk is more in line with those of other small anterior circulation aneurysms that can be observed safely.

Thus, patients with significant life expectancy should be considered for intervention more aggressively than those with other small anterior circulation aneurysms. Aneurysms chosen for observation should be reconsidered for intervention if they increase in size or cause an oculomotor nerve palsy.

PCoA aneurysms are often amenable to both microsurgical and endovascular treatment modalities. Specifically, PCoA aneurysms are among those most readily amenable to clip

ligation, requiring minimal microdissection and brain retraction during surgery.

I generally recommend microsurgical clip ligation for patients who are younger (<50 years old,) for those few patients who have poor vascular anatomy for endovascular treatment, and for those with a fetal posterior cerebral artery (PCA.) In addition, I recommend microsurgical clip ligation if the aneurysm primarily arises from the PCoA itself or is associated with an oculomotor nerve palsy. Oculomotor nerve palsies tend to resolve after either modality; recovery rates may be slightly higher after clipping than coiling.

For giant aneurysms, local mass effect is effectively relieved through aneurysm decompression after clipping. Older patients tolerate endovascular treatment more readily than microsurgery and the hemorrhagic risks of aneurysm remnants after embolization are unknown but most likely small.

Calcified aneurysms, identified on computed tomography angiography (CTA,) are best managed via endovascular methods because clip ligation has a reasonable likelihood of compromising the origins of the PCoA and the ICA by the thick collapsed walls of the parent vessels after clip deployment.

Preoperative Considerations

Initial radiologic evaluation of these aneurysms generally includes either a conventional catheter arteriography or a

computed tomography/magnetic resonance angiography. CTA has become the mainstream initial study for evaluation because it provides fine vascular detail. Moreover, it shows the surrounding skull base anatomy, including the location of the anterior and posterior clinoid processes with respect to the neck of the aneurysm.

Bone windowing of a CT scan can reveal the presence of a middle clinoid process, which is relevant when the surgeon is preparing for proximal control. A subset of these aneurysms project laterally into the temporal lobe, rather than into or below the tentorial edge. This anatomic variation warns the operator against early temporal lobe retraction in patients with a ruptured aneurysm until proximal control is reliably established.

The presence of a fetal PCA clearly demands preservation of the PCoA during clip application. Rare PCoA aneurysms arise primarily from the PCoA rather than the ICA and require alternative clipping strategies. Small PCoAs may be sacrificed with impunity if necessary and if a prominent P1 is evident on imaging.

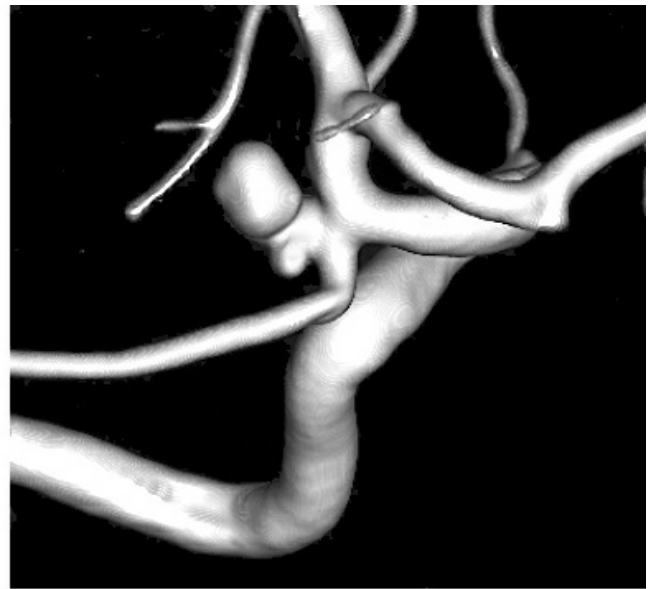


Figure 2: A typical PCoA aneurysm is shown originating from the junction of the ICA and PCoA (left upper image.) The aneurysm may occasionally arise primarily from the PCoA (right upper image.) Large PCoA aneurysms can incorporate the ICA into their neck (lower image.)

Intraoperative neurophysiologic monitoring, including somatosensory and motor evoked potentials, can monitor the tolerance of the patient to temporary occlusion and warn the

surgeon regarding an undetected compromise of perforating vessels after clip ligation.

Operative Anatomy

The PCoA arises from the posterior wall of the supraclinoid ICA. At its branch point, the PCoA provides a natural demarcation between the proximal ICA's ophthalmic segment and its distal communicating segment. The posterior wall of the communicating segment gives rise to the AChA, a key artery to identify and preserve during PCoA surgery.

The PCoA projects posteriorly and medially to bridge the anterior (ICA) and posterior (basilar artery) circulations. The PCoA connects to the posterior cerebral artery (PCA), demarcating the junction of the P1 and P2 segments of the PCA, and it gives off several vital thalamoperforators along its course.

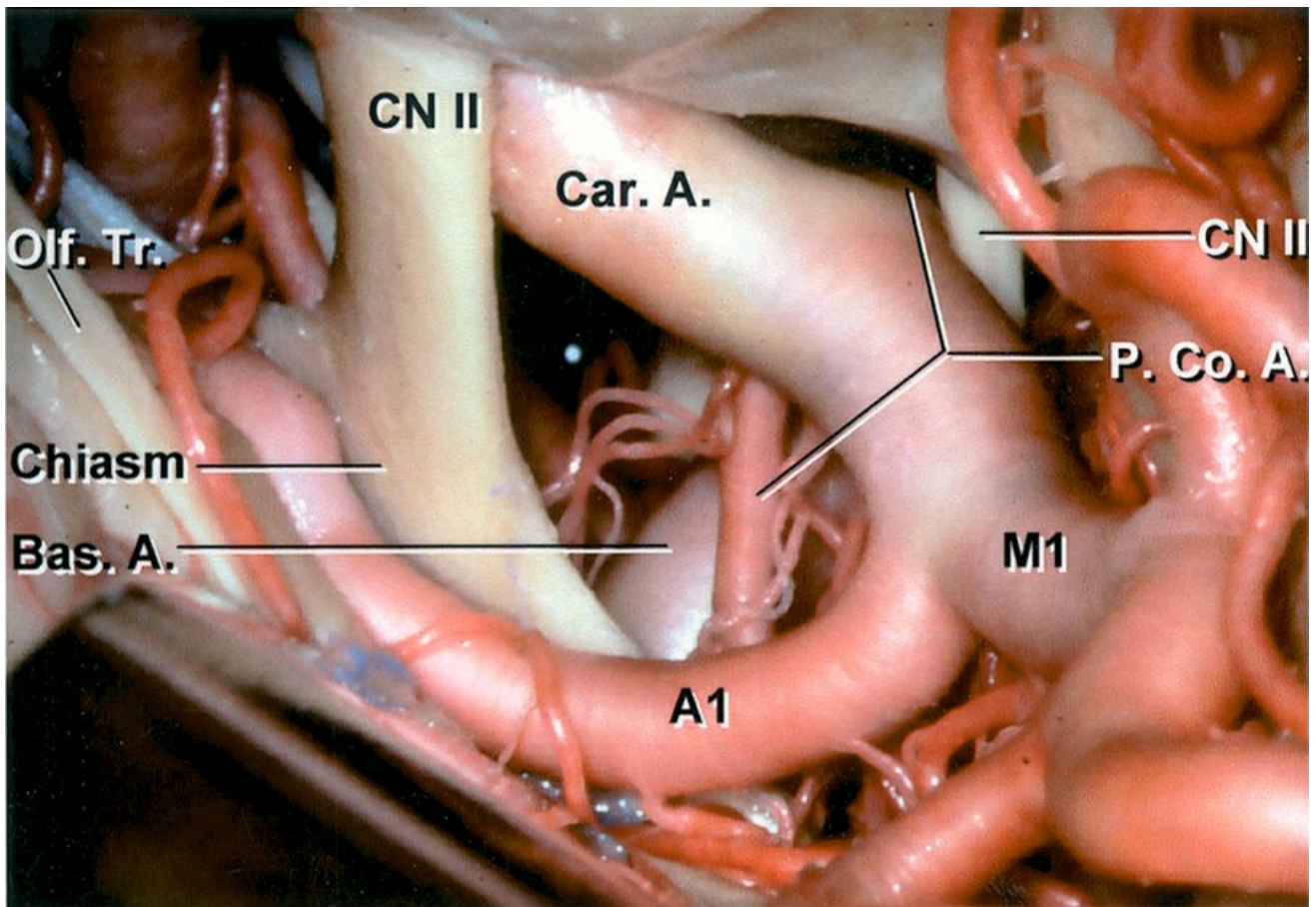
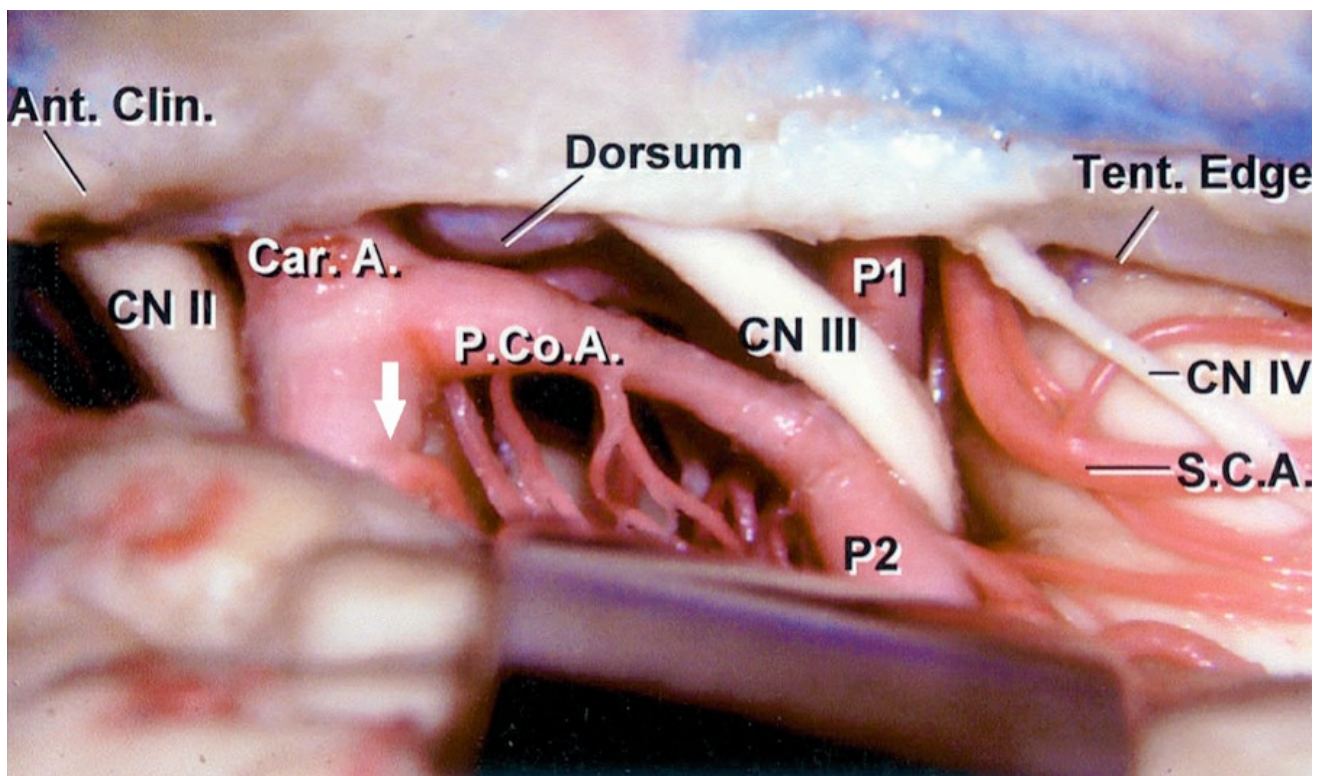


Figure 3: A right-sided pterional exposure of the ICA terminus is shown. The Sylvian fissure has been widely split. The PCoA is seen departing and traveling behind the ICA posteriorly and medially. The barely visible “knuckle” of the PCoA takeoff is apparent. Note the relationship between the ICA-PCoA junction and the oculomotor nerve. The AChA is hidden behind the wall of the ICA (image courtesy of AL Rhoton, Jr).



[Click here](#) to view the interactive module and related content for this image.

Figure 4: A right subtemporal view of the lateral ICA is shown. Note the relationship of the PCoA to the AChA takeoff (white arrow.) The anatomic location of the ICA-PCoA junction in relation to the oculomotor nerve is again indicated. Several thalamoperforating arteries along the course of the PCoA are shown (image courtesy of AL Rhoton, Jr.)

Two important anatomic variants of the PCoA are worth further discussion: the fetal posterior cerebral artery (PCA) and the PCoA infundibulum. A fetal PCA is a developmental variant found in 20-30% of patients. It occurs when the PCA fails to transition from the PCoA to the basilar artery for its main supply, resulting in a large PCoA that preferentially or entirely supplies the PCA distribution.

Special care must be taken in this patient population because impingement of the PCoA origin can cause occipital lobe ischemia; this is discussed below. This variant is associated with an increased rate of PCoA aneurysm formation and rupture.

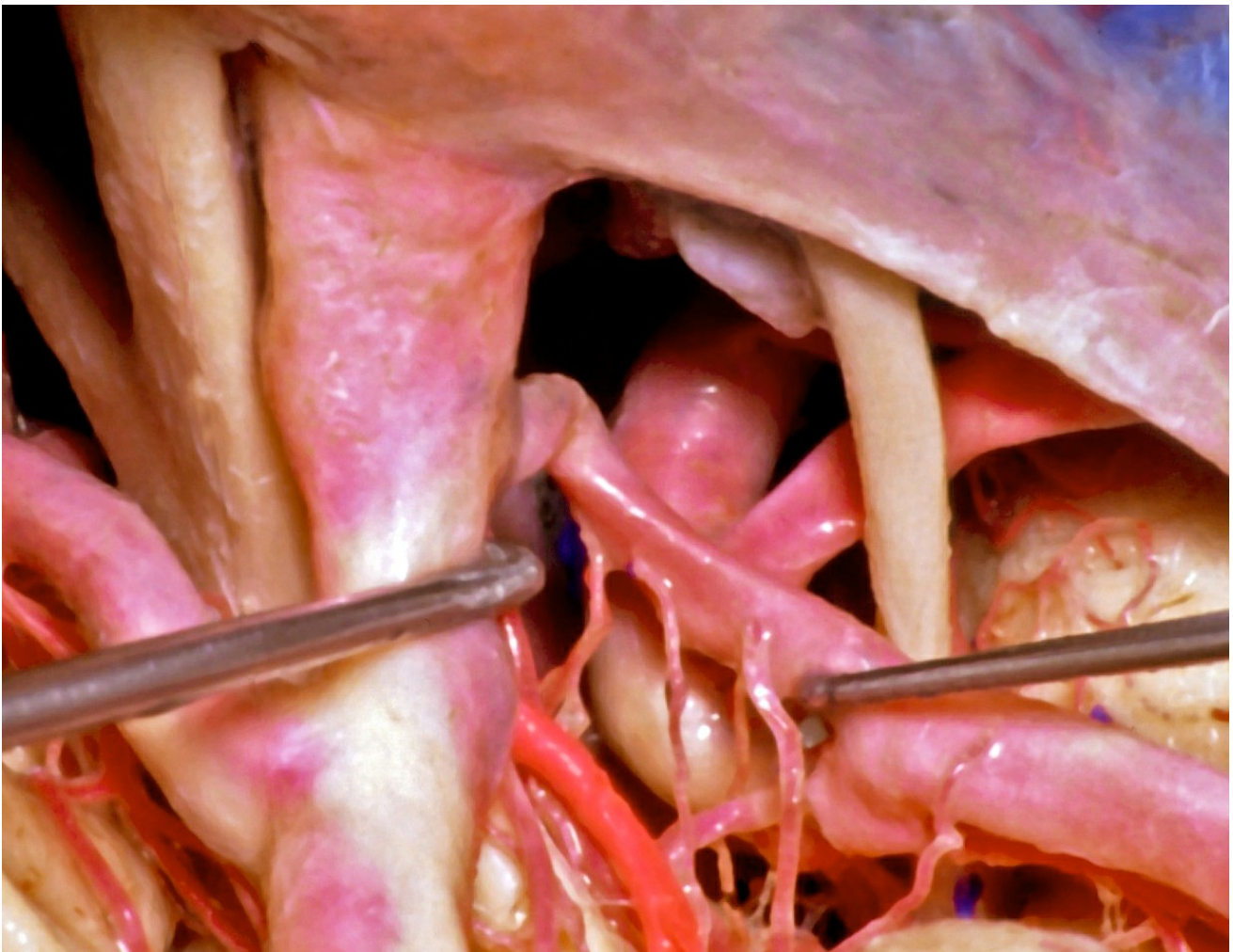
The PCoA infundibulum occurs in 10% of patients and presents as a widened origin of the artery that funnels down to a normal size vessel. This is not a pathologic entity and should not be mistaken for a PCoA aneurysm.

PCoA aneurysms refer to aneurysms of the supraclinoid ICA situated just distal to the takeoff of the PCoA (junctional aneurysm, most common) or directly arising from the PCoA itself (true PCoA aneurysm)(see Figure 2.) Most PCoA aneurysms are based on the ICA between the PCoA and the AChA, incorporating part of the origin of both former vessels. After leaving the posterior wall of the ICA, the PCoA courses posteriorly and medially before piercing the membrane of Liliequist en route to joining the PCA.

Intimately related to PCoA aneurysms is the AChA. A small vessel, but vital end artery that usually arises from the supraclinoid ICA, the AChA may consist of up to three branches. It courses through the crural cistern en route to its entry point into the temporal horn of the lateral ventricle, providing several critical perforators along its way.

AChA classically arises just distal to PCoA aneurysms, but can occasionally arise more distally, either from the ICA

bifurcation or the M1 segment. Occasionally it even emerges from the PCoA itself. Both PCoA and AChA project posteriorly and medially from the dorsal aspect of the ICA. The anterior-to-posterior surgical view of the pterional approach places these vessels coursing away from the surgeon's line of sight. All the operator sees is a knuckle of the very proximal artery at its origin before it becomes hidden behind the ICA.



[Click here](#) to view the interactive module and related content for this image.

Figure 5: A lateral view across the posterior ICA demonstrates the anatomic relationships between the PCoA (mobilized with the right dissector,) its perforating vessels,

and the AChA (in bright red.) The oculomotor nerve is visible (image courtesy of AL Rhoton, Jr.)

Most PCoA aneurysms project inferiorly, posteriorly, and laterally. Lateral-projecting aneurysms are intimately associated with the tentorial edge and temporal lobe and are therefore prone to rupture with even minimal manipulation of the temporal lobe. More inferior-projecting aneurysms are in contact with the oculomotor nerve; however, they are also close to the posterior clinoid process that can interfere with placement of the clip blades.

The PCoA and the oculomotor nerve run within closely related parallel planes, and therefore an enlarging inferior-projecting PCoA aneurysm can infringe on the nerve. The oculomotor nerve contains peripherally-positioned parasympathetic nerve fibers supplying pupillary constrictors, as well as centrally-positioned motor fibers supplying the medial rectus, superior rectus, inferior rectus, and inferior oblique muscles, along with the levator palpebrae superioris. As a result, an enlarging PCoA aneurysm will cause a blown pupil and ptosis followed by laterally and inferiorly pointed or “down and out” eye.

MICROSURGICAL CLIP LIGATION OF POSTERIOR COMMUNICATING ARTERY ANEURYSMS

Please refer to the [Cranial Approaches](#) volume for description of the [extended pterional craniotomy](#) that is suitable for almost all PCoA aneurysms. A posterolateral orbitotomy can

be added for giant aneurysms. In this chapter, I elaborate on the specifics of the pterional approach as it pertains to the exposure of PCoA aneurysms.

The main objectives of patient positioning are to prevent the temporal lobe from obstructing dissection of the aneurysm while exploiting gravity to move the frontal lobe away from the anterior cranial fossa. These maneuvers expand the posteromedial subfrontal operative corridor and are accomplished by slight head extension and limiting head rotation to 20 degrees.

The sphenoid wing must be aggressively drilled until the superior orbital fissure is reached. Osteotomy of the most medial extent of the wing is the most important because it covers the carotid cistern. If this last obstruction is not removed, substantially more frontal lobe elevation is needed to expose the cistern. The roof of the orbit is also drilled so that a flat operative trajectory over the orbit is available.

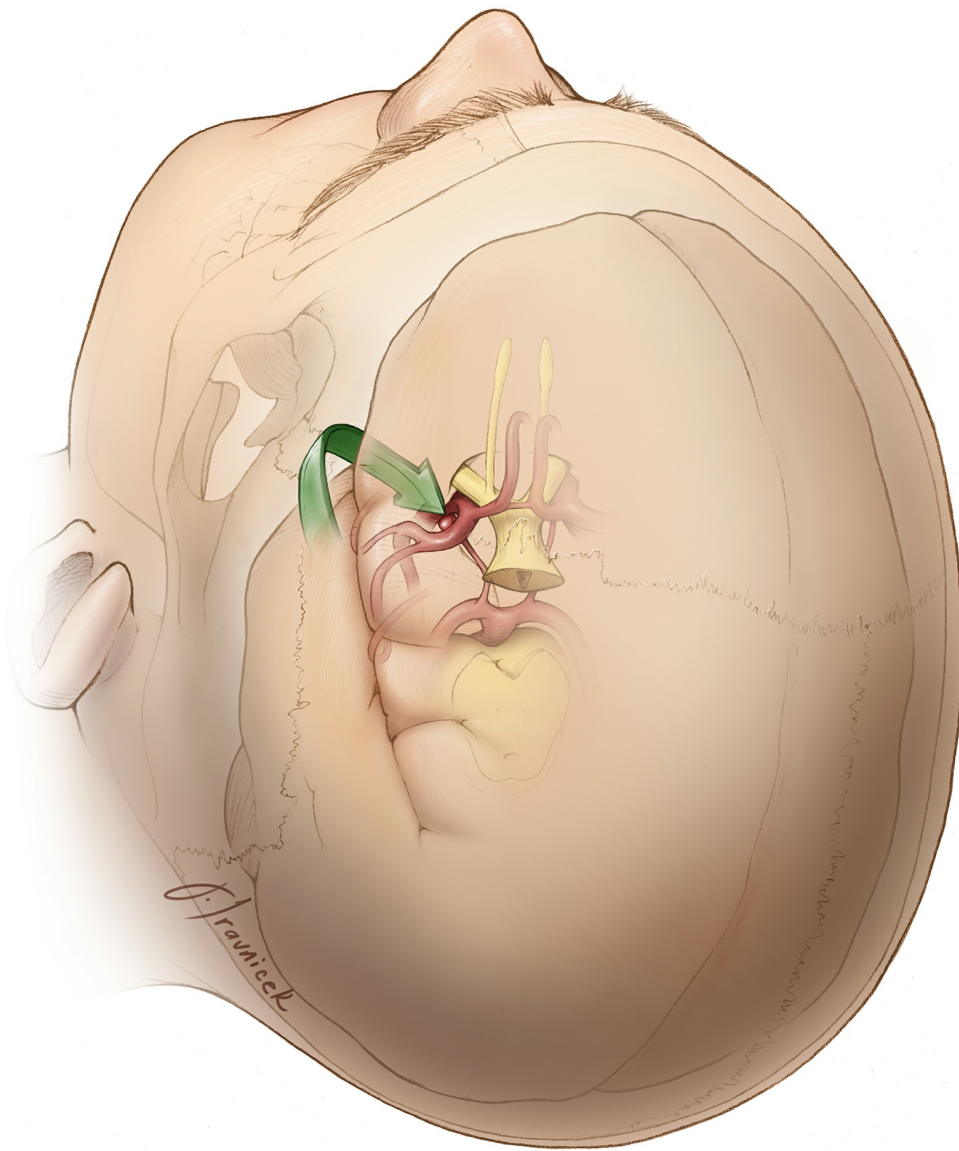


Figure 6: Schematic representation of the posterior subfrontal operative pathway (green arrow) toward the PCoA aneurysm is illustrated. This pathway is possible via a proximal Sylvian fissure split, leading directly to the anterior and lateral aspects of the supraclinoid ICA. Early exposure of the proximal ICA without temporal lobe retraction is necessary to avoid premature sac rupture.

INTRADURAL PROCEDURE

Initial Exposure

There are three main goals that must be accomplished before

the aneurysm can be directly handled.

The first goal is a [proximal Sylvian fissure split](#).

The second goal is mobilization of the frontal lobe and dissection of its arachnoidal attachments over the chiasm and floor of the frontal fossa.

The third goal is establishing proximal control over the supraclinoid ICA. The aneurysm must be exposed solely via frontal lobe retraction. The crux of the initial exposure is freeing up the posterior subfrontal lobe so that it can be safely and gently mobilized without any transmission of force to the aneurysm dome that is frequently adherent to the temporal lobe.

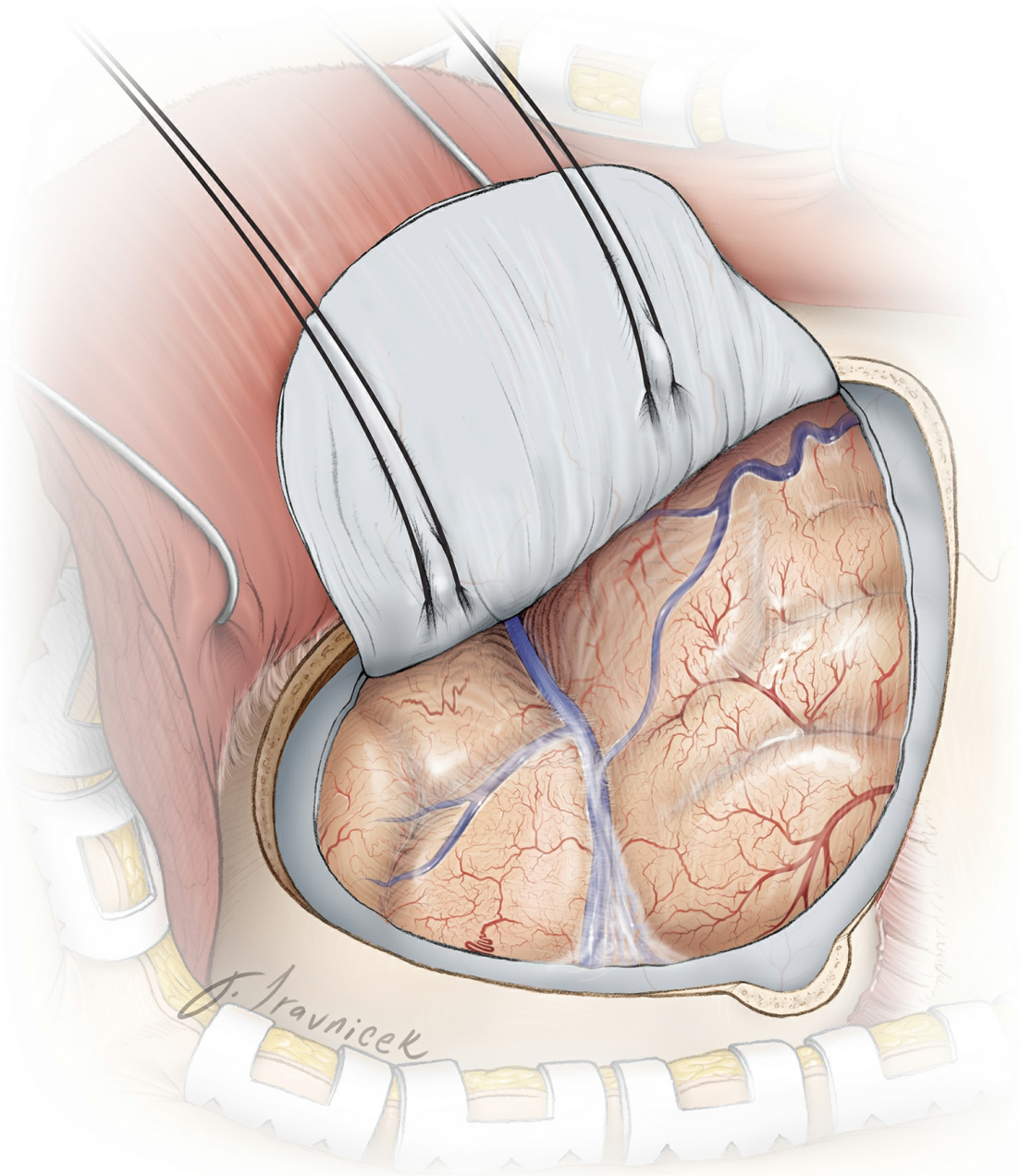


Figure 7: Initial intradural exposure is illustrated. Adequate sphenoid wing removal is evident when the dura can be mobilized flat over the orbital roof and along the anterior edge of the craniotomy.

Initial gentle elevation of the frontal lobe just lateral to the olfactory tract places the arachnoid bands over the anterior limb of the Sylvian fissure on stretch. The surgeon's attention

then turns to either opening the opticocarotid cistern and freeing up the frontal lobe or opening the horizontal part of the Sylvian fissure.

The angle of view for the operating microscope is adjusted so the camera looks slightly posterior, perpendicular to the horizontal segment of the Sylvian fissure. A generous fissure split is unnecessary for PCoA aneurysms, and only a conservative anterior split (opening the sphenoidal segment) is often adequate.

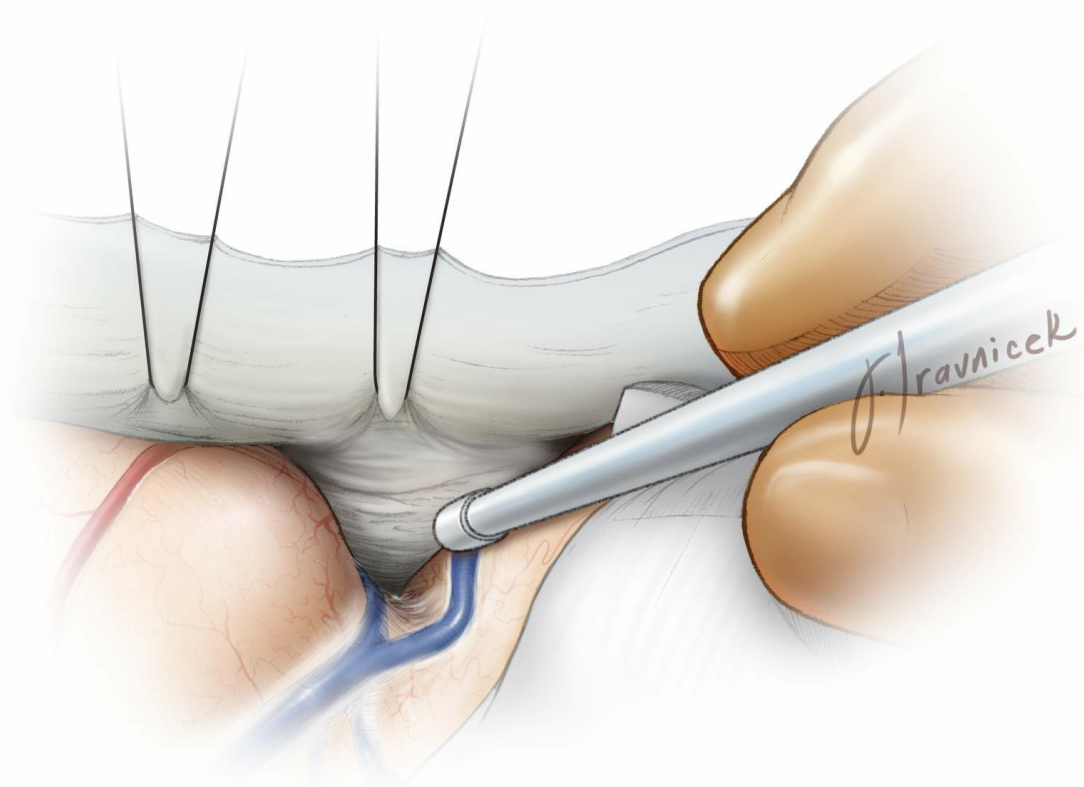


Figure 8: Gentle elevation of the frontal lobe permits cerebrospinal fluid egress and visualization of the thickened arachnoid layers covering the proximal Sylvian fissure.

The arachnoid membranes over the horizontal part of the

Sylvian fissure are thicker than those over the most distal section of the fissure and are usually easier to dissect. The thicker arachnoid layers are made up of two leaflets of arachnoid—those of the frontal and temporal lobes.

This layer can be initially opened either using an arachnoid knife or an upturned No. 11 blade knife. The dissection is continued above the superficial Sylvian vein. Once the superficial layer is incised, the arachnoidal incision is carried medially toward the carotid cistern. A fine dissector frees up the arachnoid from the underlying brain and veins prior to the use of microscissors.

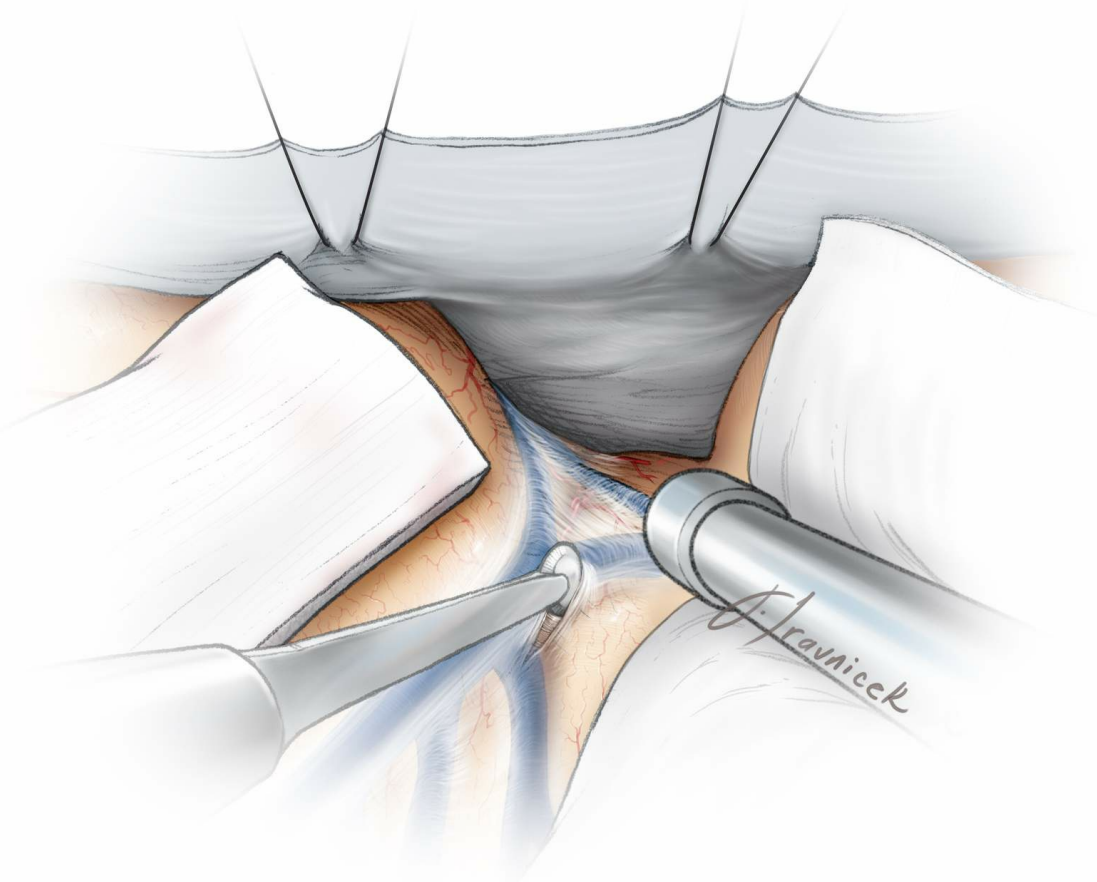


Figure 9: I initially open the opticocarotid cisterns to drain

cerebrospinal fluid, and then proceed with the Sylvian fissure split. I use an arachnoid knife to open the thickened superficial arachnoid layers over the anterior limb of the Sylvian fissure.

During medial fissure dissection, I use the remaining borders of the sphenoid ridge as a landmark or roadmap to avoid “wandering around” and causing subpial injury. This road map is especially imperative in the presence of dense subarachnoid hemorrhage because the planes of dissection are difficult to identify.

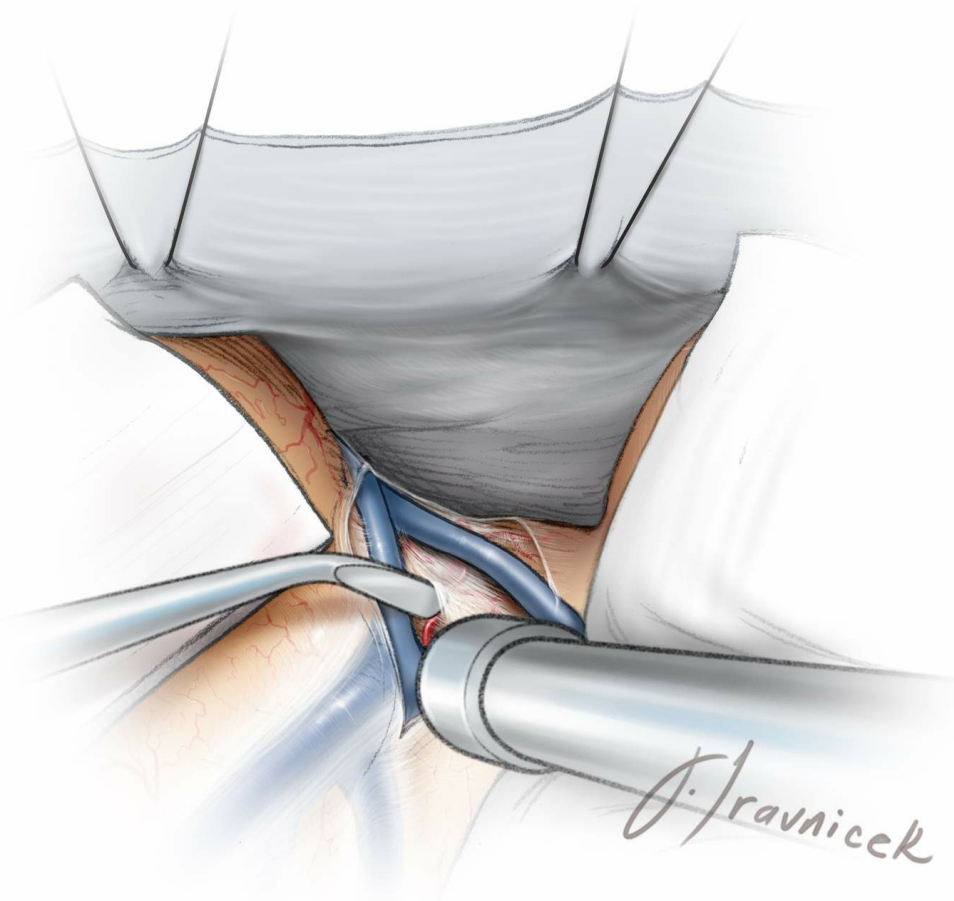


Figure 10: The microscope’s line of sight is directed perpendicular to the axis of the horizontal fissure.

Microscissors are used to dissect the fissure using an “inside-to-outside” technique; a blunt ball-tip probe dissects and mobilizes the entangled vessels away from the arachnoid layers before using the microscissors.

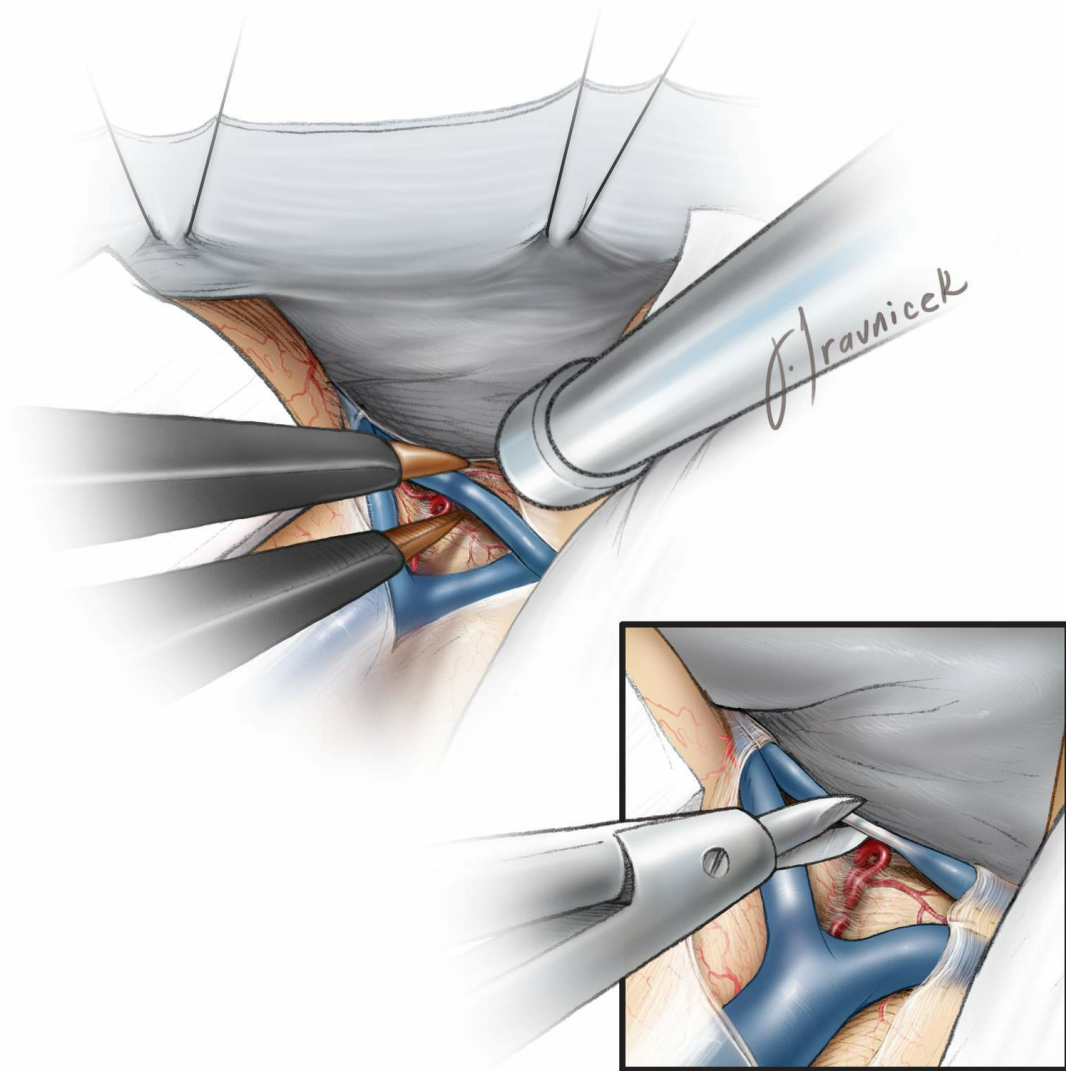


Figure 11: Across the very proximal Sylvian fissure, a bridging vein is present that can be sacrificed with impunity. Once divided, the frontal and temporal lobes can be more readily separated.

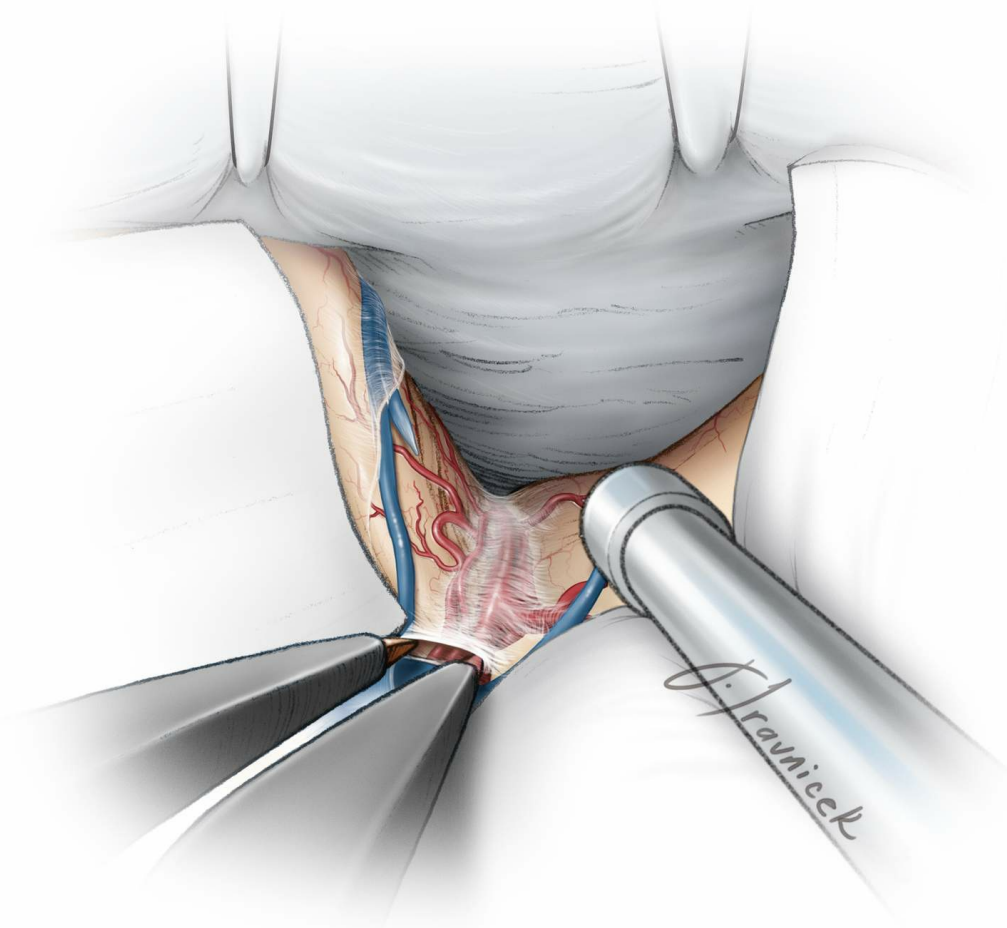


Figure 12: The spring action of the bipolar forceps may be used to dissect the delicate arachnoid bands within the anterior fissure, detaching the frontal lobe at the depth of the fissure.

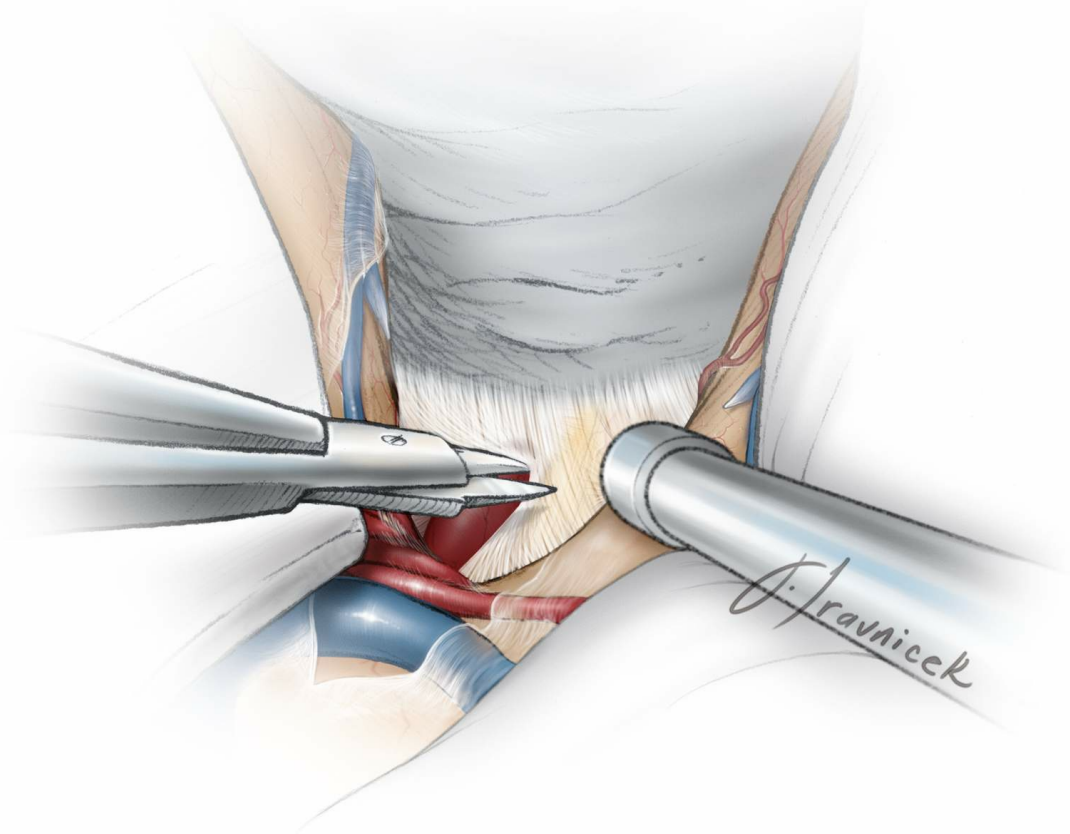


Figure 13: Once the dense medial superficial arachnoid layer is severed, the thick veil of arachnoid band over the opticocarotid cisterns can be seen and opened horizontally as far as the prechiasmatic cistern and posteriorly over the carotid artery.

Further lateral extension of this arachnoid opening will meet the initial Sylvian fissure split, and these two arachnoid incisions unite along the anterior aspect of the internal carotid artery. If the initial arachnoid openings did not achieve adequate brain relaxation, the membrane of Lilliequist is incised between the carotid artery and optic nerve to facilitate further egress of cerebrospinal fluid from the interpeduncular cisterns.

If additional cerebrospinal fluid release is deemed necessary, the lamina terminalis may be sharply opened. Additional Sylvian fissure opening may be tailored at this time to expose the carotid artery bifurcation.

Once the opticocarotid cistern is opened, the dissection proceeds medially, sharply freeing up the attachments of the gyrus rectus to the optic chiasm. This maneuver should continue as far as the contralateral optic nerve.

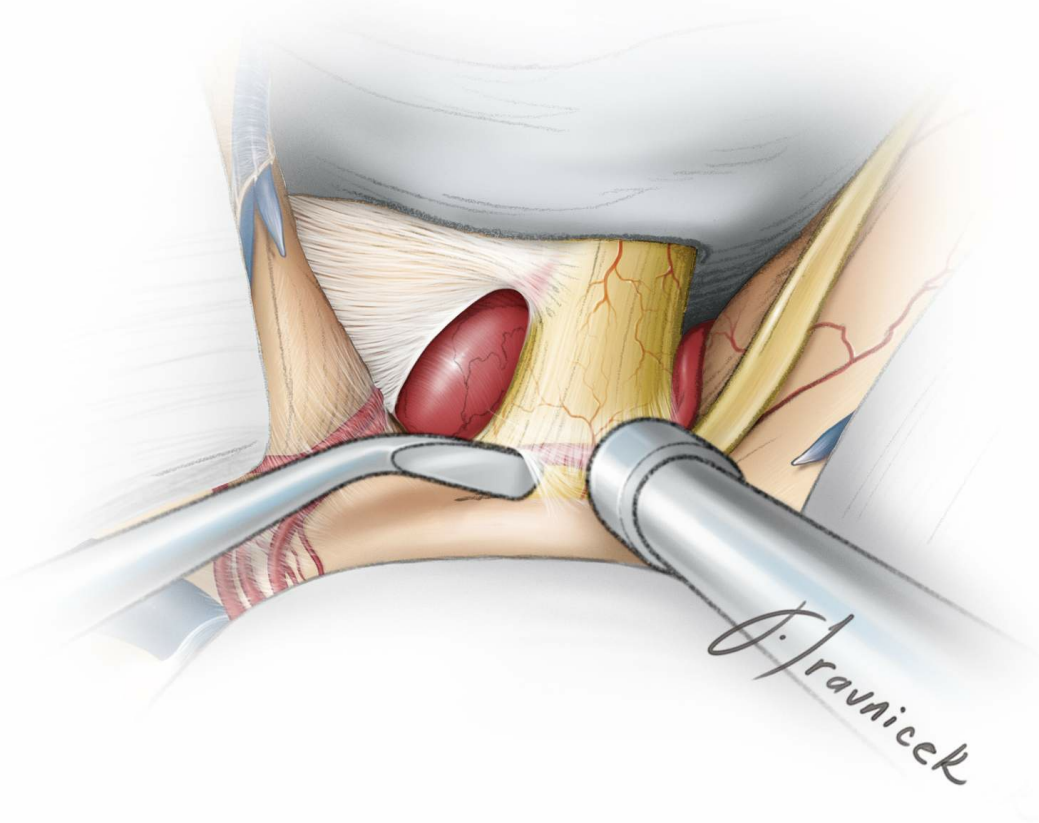


Figure 14: A ball tip dissector and microscissors are used to release the frontal lobe from all its adhesions to the optic nerve and chiasm. The arachnoid bands between the olfactory tract and optic nerve are excised.

Now that the first two goals have been accomplished, the frontal lobe can be mobilized safely without concern about transmission of force to the temporal lobe. Throughout the dissection process described above, the temporal lobe should remain untouched.

The next step is establishing proximal control over the proximal ICA at the skull base. To do so, the anterior wall of the ICA (away from the aneurysm) is traced proximally to the opticocarotid triangle, followed by circumferential dissection around the ICA, providing space for the temporary clip blades. If this dissection step exposes the proximal neck of the aneurysm without adequate space for temporary clip deployment, additional exposure of the proximal ICA is mandatory.

There are two situations when it is difficult to establish proximal control. The overlying falciform ligament may obscure the medial blade of the temporary clip, in which case a small cut in the ligament allows more exposure. The second situation is more challenging, and results when the anterior clinoid process obscures the ICA proximal to the PCoA.

This latter anatomic configuration necessitates a partial [intradural clinoidectomy](#) to unroof the ICA so proximal control can be achieved. The dura over the anterior clinoid is cut and reflected posteriorly over the carotid artery while the clinoidectomy is performed.

The surgeon must remain patient and ensure proximal control

at all costs. Skipping this step and inability to secure proximal vascular control violates the most fundamental principle in vascular surgery.

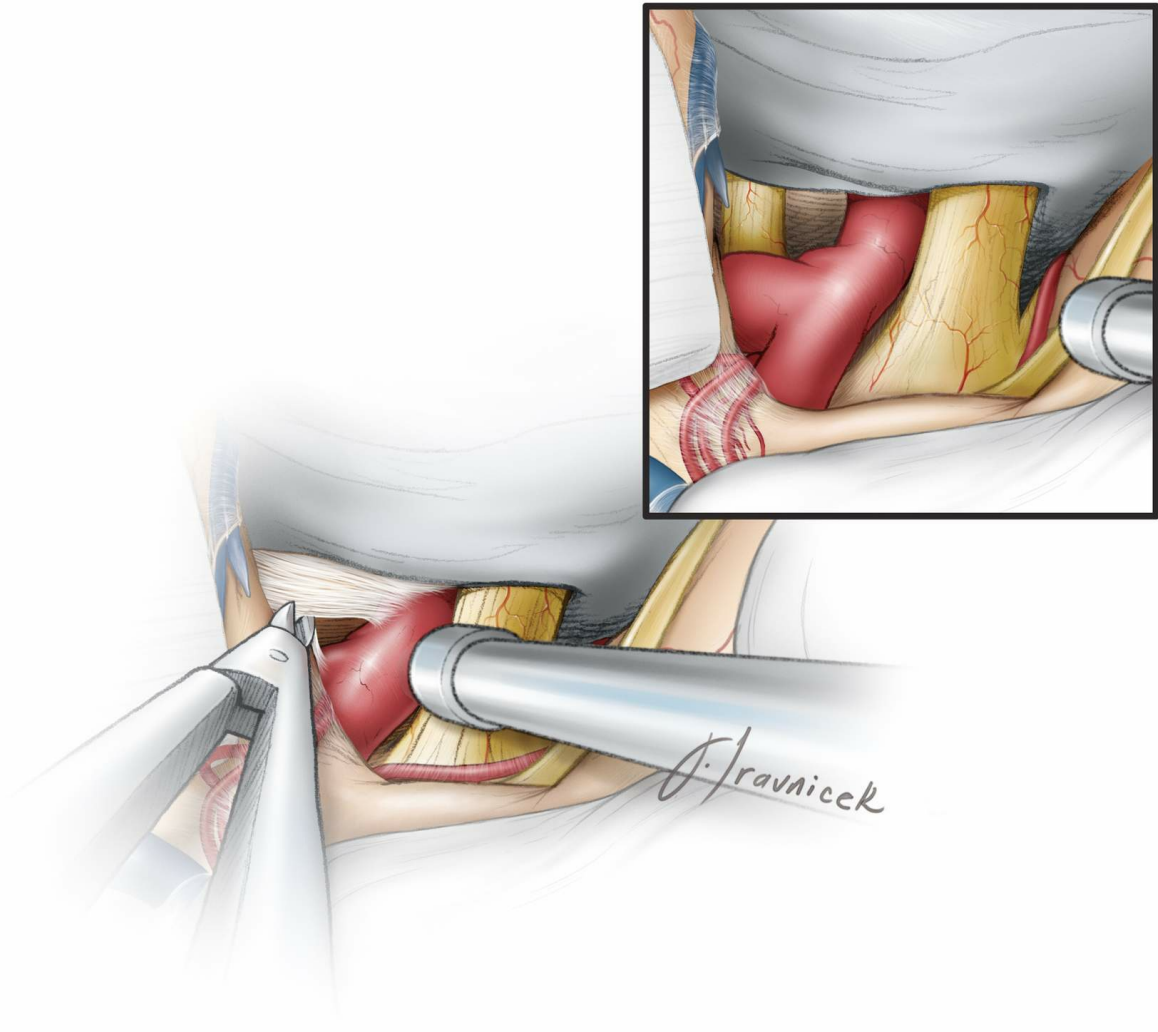
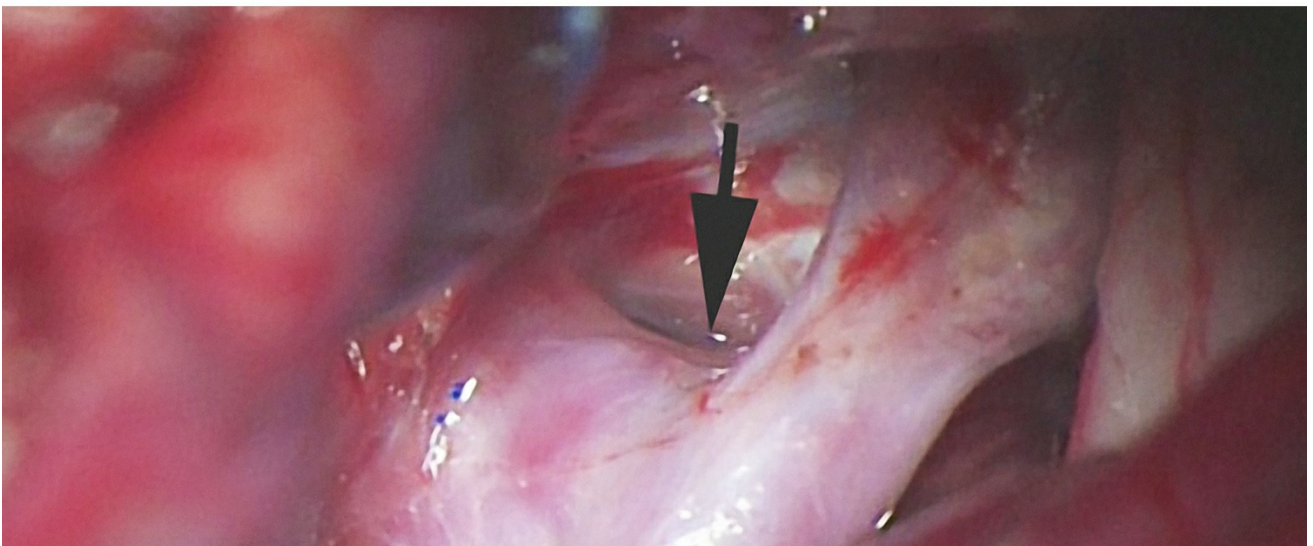
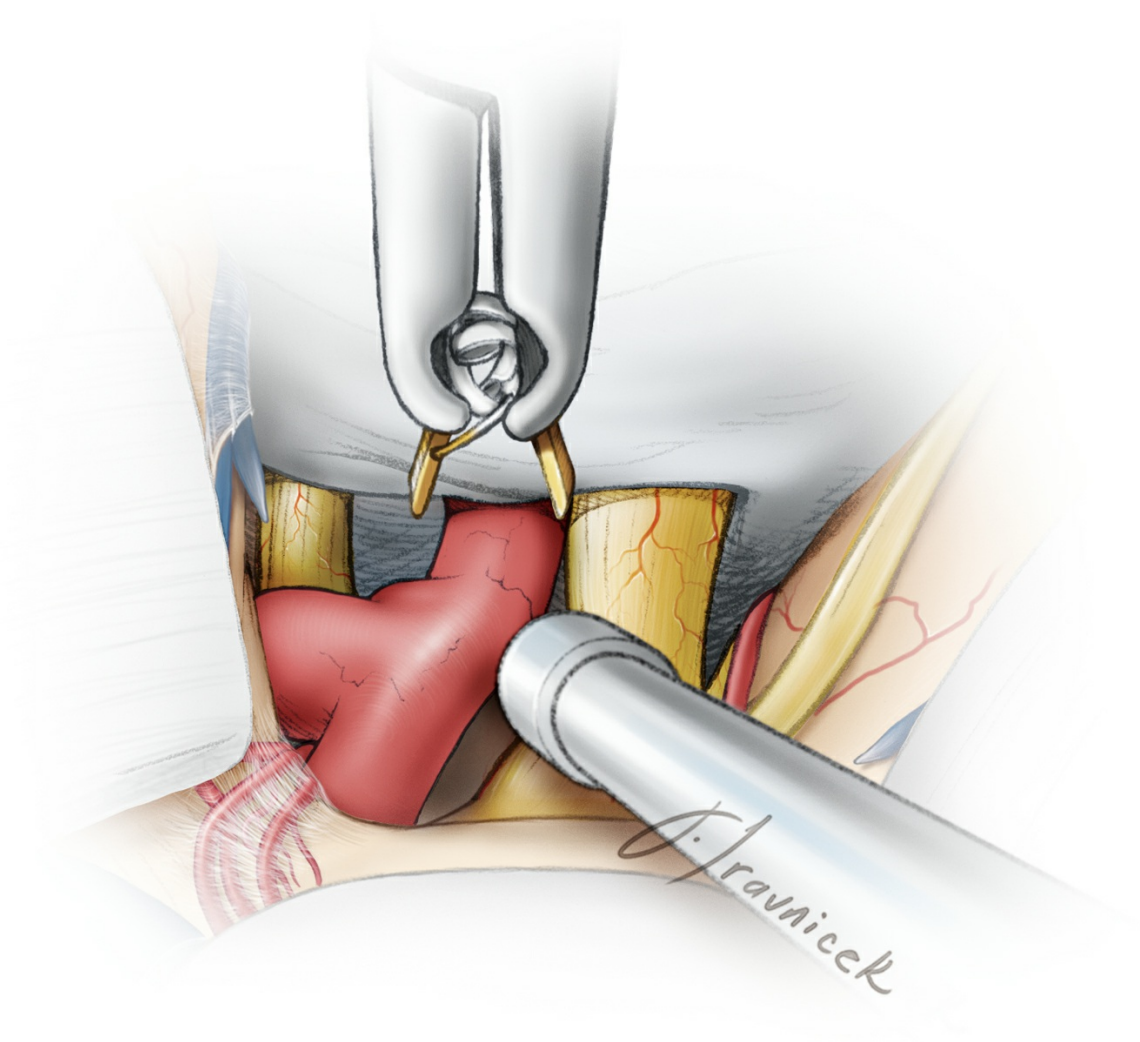


Figure 15: The arachnoid membranes are opened lateral and posterior to the proximal ICA. One of these incisions opens the thick arachnoid band toward the posterior clinoid and tentorium. This maneuver ensures an unobstructed view of the posterior ICA and oculomotor nerve.

the more distal segment of the PCoA can often be identified along the medial border of the ICA, coursing away from the surgeon. The artery and its perforators may be visualized through the opticocarotid triangle.



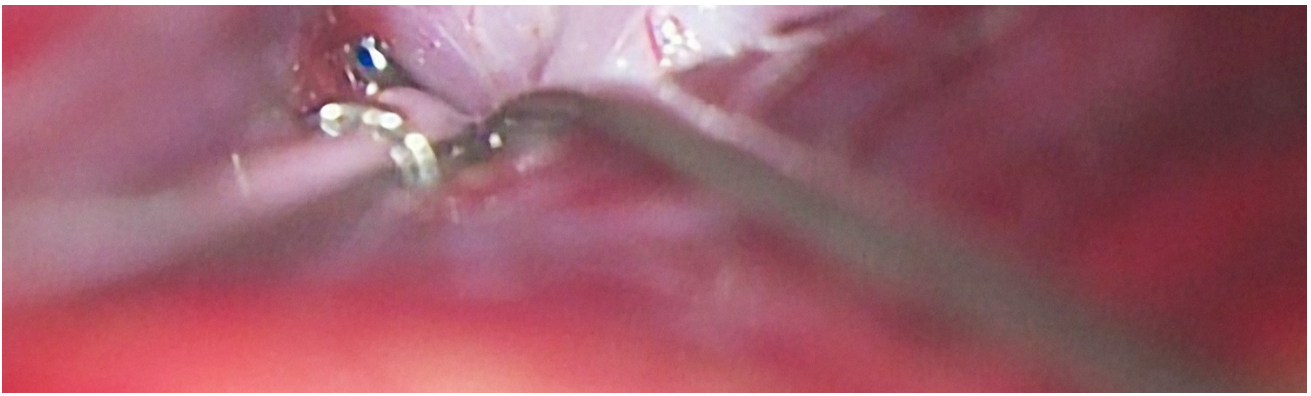


Figure 17: The origin of the PCoA is often apparent only as a small knuckle immediately inferior to the aneurysm sac (upper sketch.) The permanent clip is later placed between this knuckle (at the arrow, lower photo) and the true neck of the aneurysm. Temporary clip application is often necessary, especially for ruptured aneurysms, during the next steps of aneurysm neck dissection.

Aneurysm Dissection

The basic tenets of aneurysm dissection before clip application involve:

1. Sharp arachnoid dissection and avoidance of excessive brain retraction
2. Proximal control and methodical dissection along the normal vascular tree toward the aneurysm neck
3. A relatively liberal use of short periods of temporary proximal occlusion to provide aneurysm decompression so that I can identify and protect the neighboring perforators
4. Meticulous and patient aneurysm dissection, which thoroughly discovers the aneurysm's anatomy and

clarifies an unhindered corridor for clip application

5. Placement of the permanent clip before an adequate neck exposure leads to inadequate clip ligation, perforator injury, and ultimately intraoperative aneurysm rupture.

With the brain relaxed, the frontal lobe completely released, and proximal control secured, the focus of dissection can now shift toward the circumdissection of the neck, the most critical part of the operation. Application of the clip is a relatively straightforward affair. The creation of space for the clip blades is the challenge, and preclipping dissection requires surgical intellect and appreciation of three-dimensional (3D) anatomy based on a detailed study of the preoperative images.

The aneurysm sac and PCoA travel away from the operator. As a result, only a small knuckle, representing the origin of the PCoA, is visible. I prefer to use brief periods of temporary proximal ICA occlusion; I do not believe etomidate burst suppression is necessary during temporary proximal ICA occlusion if a functional circle of Willis is present. The loss of turgor in the aneurysm remarkably facilitates its neck dissection during high-risk maneuvers.

The neck dissection proceeds between this knuckle and the proximal neck of the aneurysm and proceeds distally along the lateral aspect of the ICA. Although this maneuver can be tedious, sharp dissection under high magnification almost

always finds a plane between the PCoA and the aneurysm neck.

A small section of the aneurysm neck measuring only a few millimeters is isolated, just enough to place a clip blade. There is no need to dissect more of the artery or dissect out onto the aneurysm dome. If the PCoA cannot be readily identified, the ICA can be gently retracted laterally to explore the opticocarotid triangle. Since the PCoA courses medially, it can often be found behind the ICA and traced back to the proximal neck.

The distal neck is the space between the AChA and the aneurysm; similar microsurgical principles mentioned above apply to this space as well. The AChA may be adherent to the fundus of larger aneurysms. Temporary proximal ICA clipping is especially beneficial to soften the aneurysm, allowing dissection of the neck away from the AChA without placing the AChA at risk. Once the proximal and distal necks have been dissected and the courses of the PCoA and AChA identified, definitive clipping of the aneurysm can commence. However, one further step is mandatory.

It is imperative that the surgeon explores the neck of the aneurysm almost in its entirety. In particular, it is often challenging to identify the deeper part of the aneurysm neck which is visually obstructed by the intimidating pulsatile aneurysm fed through the high-flow carotid system. At this stage, I resist the temptation to deploy the clip and instead demand a more thorough neck inspection.

With temporary ICA occlusion in place, I mobilize the proximal and distal neck and dissect the portion of the neck turning away from my line of sight, ensuring that I can see where the neck turns around to form its medial border with respect to the wall of the ICA. This maneuver is critical because a lack of understanding of the 3D neck anatomy will lead the operator to apply the clip at a wrong angle away from the ICA axis, partially clipping the neck and precipitating an intraoperative rupture.

Completing dissection blindly using the clip blades and “guessing the deeper aneurysm neck borders” are recipes for disaster. These novice maneuvers are a result of a nervous surgeon who allows his or her emotions to control microsurgery.

Partial neck closure because of improper clip placement is often catastrophic because it leads to turbulence within the sac and invariably precipitates an intraoperative rupture. The novice surgeon then rushes chaotically to reposition the clip and “hopes” for cessation of bleeding by placing multiple clips, which are often longer than necessary. This technique often causes perforator injury due to blind application of the clip blades, and it leads to postoperative ischemia and hemiplegia.

In ruptured cases, the subarachnoid clot around the dome is left undisturbed until the aneurysm is secured. The dissection should be limited along the posterolateral wall of the supraclinoid ICA and the neck; the surgeon should not

wander and unintentionally puncture or uncover the aneurysm dome. The sequence of dissection should proceed methodically from proximal to distal, revealing the knuckle of the PCoA origin, the proximal neck, the sac itself, the distal neck, and then the PCoA within the opticocarotid triangle. Next, the clip is deployed.

Clip Application

Most small PCoA aneurysms have narrow necks. My colleagues ligate these aneurysms with a simple straight clip, angled perpendicular to the ICA axis with the tips pointing laterally. Although this technique can lead to an accordion effect and potentially cause stenosis of the ICA lumen, this is less of a concern with an aneurysm harboring a narrow neck.

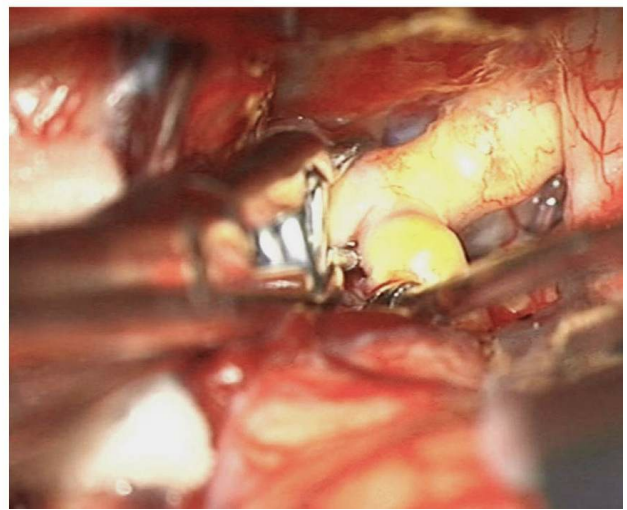
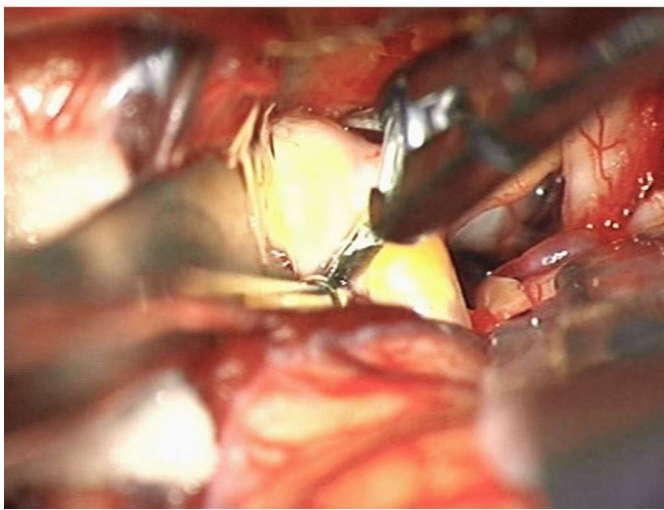
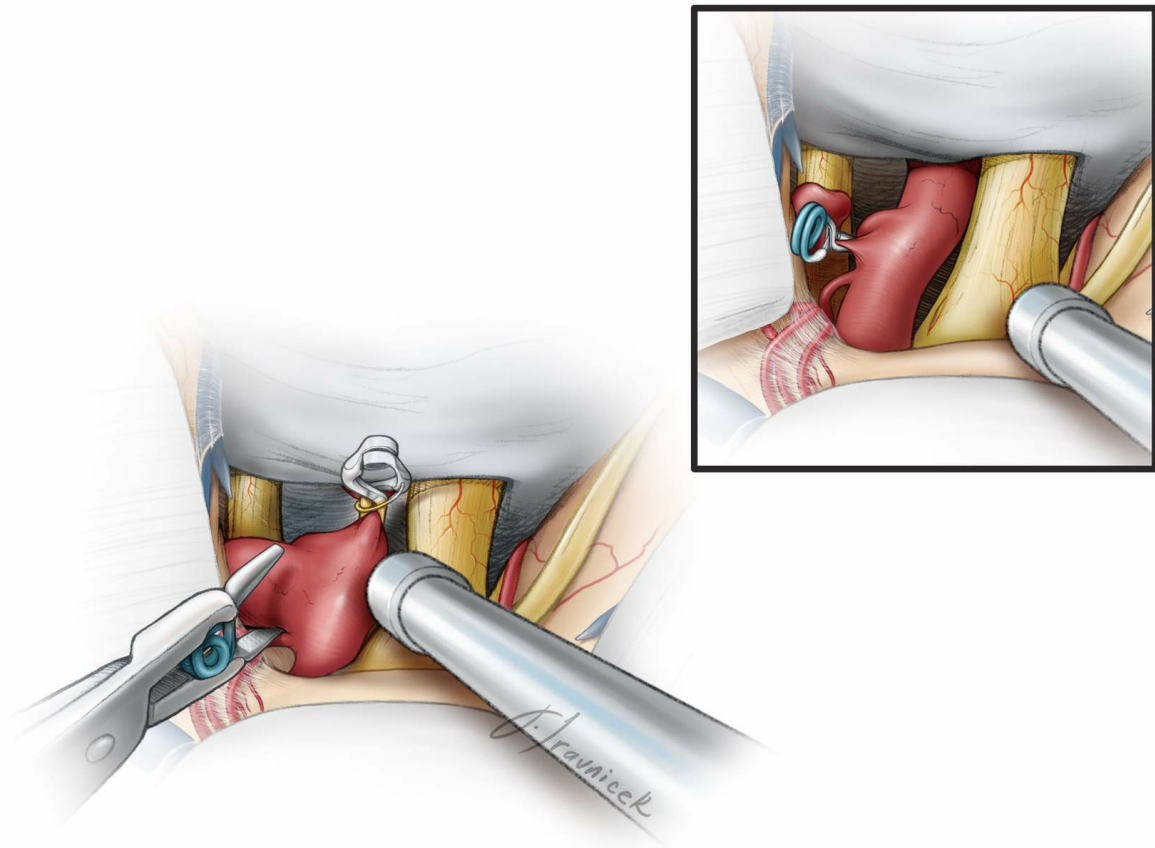


Figure 18: The aneurysm can be best manipulated and dissected under brief periods of temporary occlusion. Clip application follows (upper illustration.) The origin of the PCoA should not be compromised. I insist on releasing the clip blades not perpendicular (left lower image) but parallel (right lower image) to the long axis of the ICA, especially for atherosclerotic aneurysms.

As the clip blades are gradually closed, the surgeon's attention is focused on the blades to ensure that they are free of the PCoA, AChA, anterior thalamoperforators, and the oculomotor nerve.

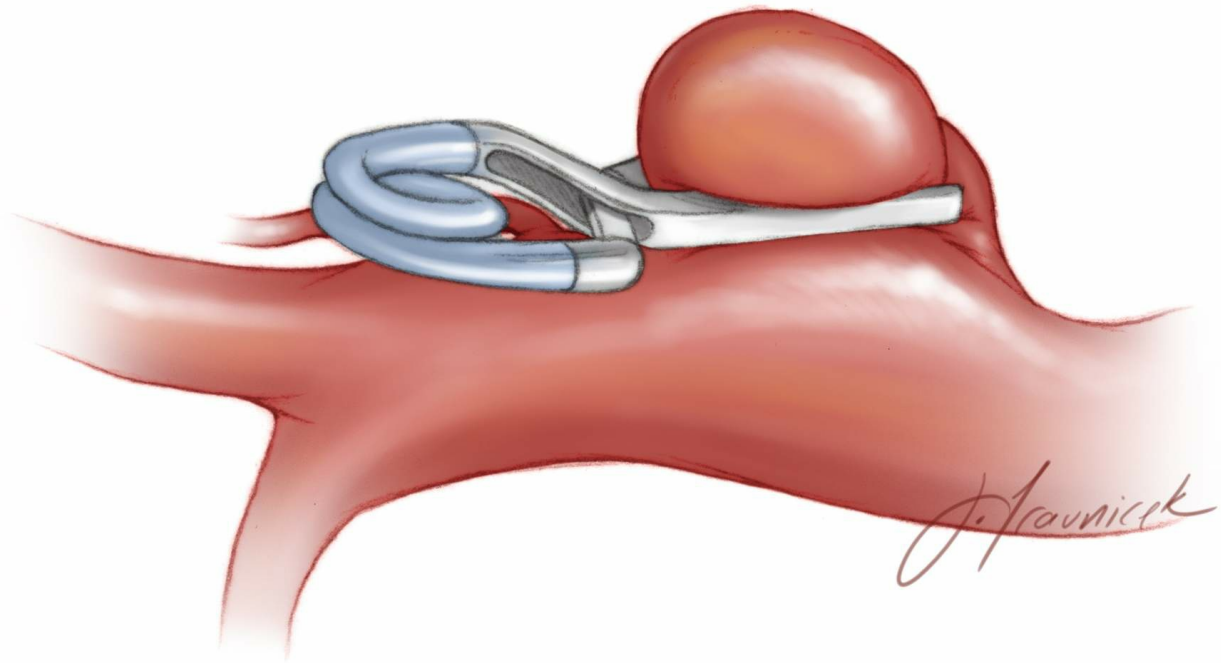
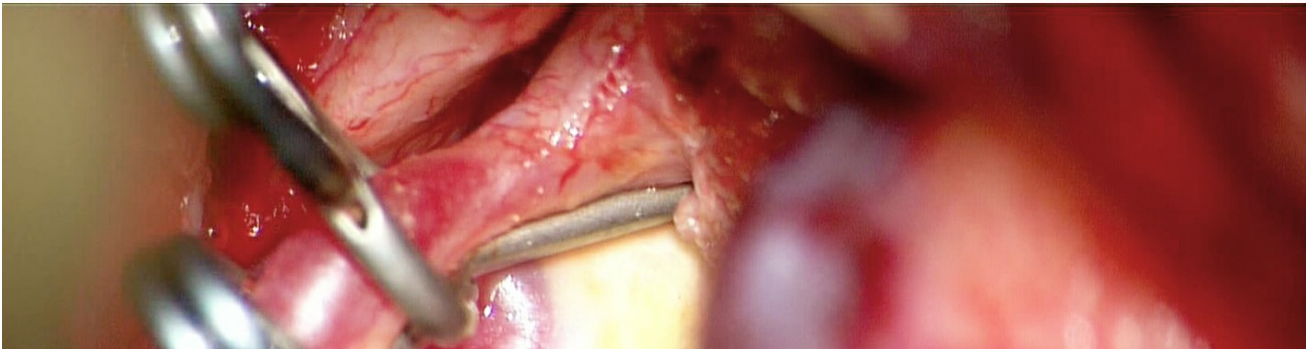
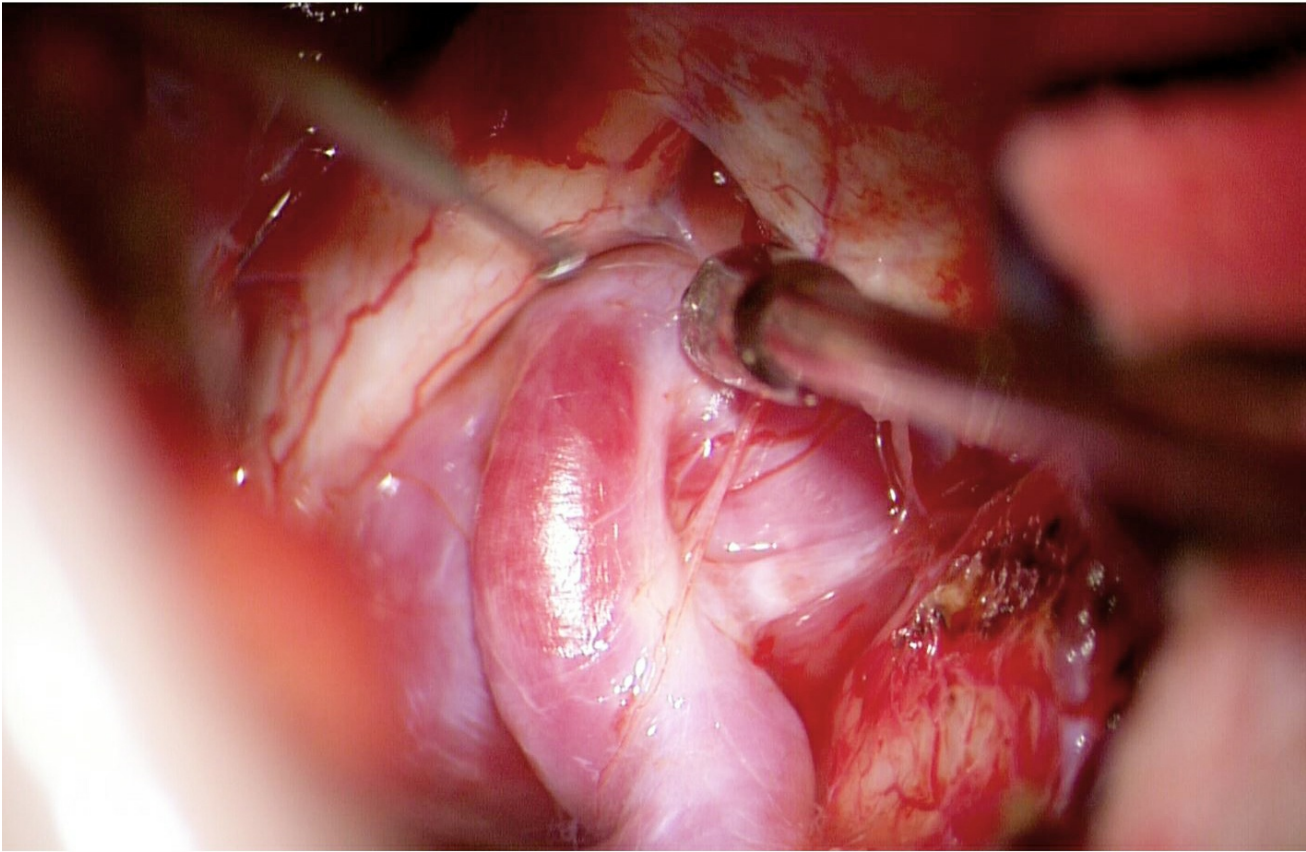
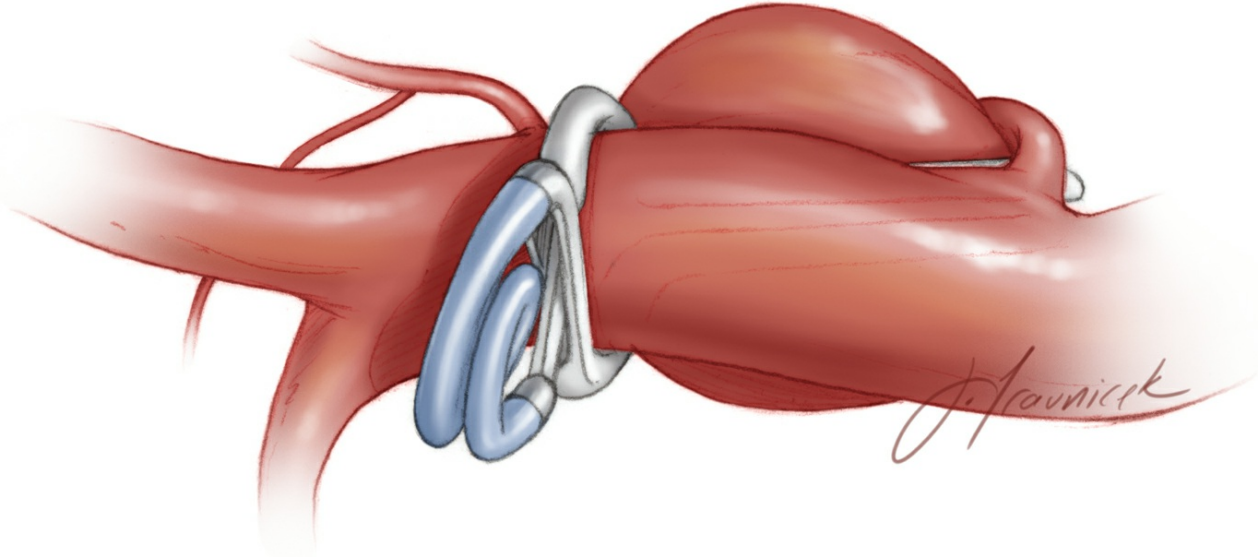


Figure 19: A small laterally-projecting PCoA aneurysm was clipped using a single straight clip parallel to the axis of the ICA. The aneurysm arises immediately adjacent to the origin of the PCoA. Compared with a perpendicular straight clip, this construct is more favorable to effectively exclude the aneurysm.

Although I prefer to use a simple straight clip parallel to the axis of the ICA, this is not anatomically always feasible, as in the case of posterior-projecting aneurysms. For these aneurysms, I use an angled fenestrated clip, encasing the ICA. This construct avoids “dog ears” and is most effective for collapsing the neck. Furthermore, delayed clip displacement is

unlikely.



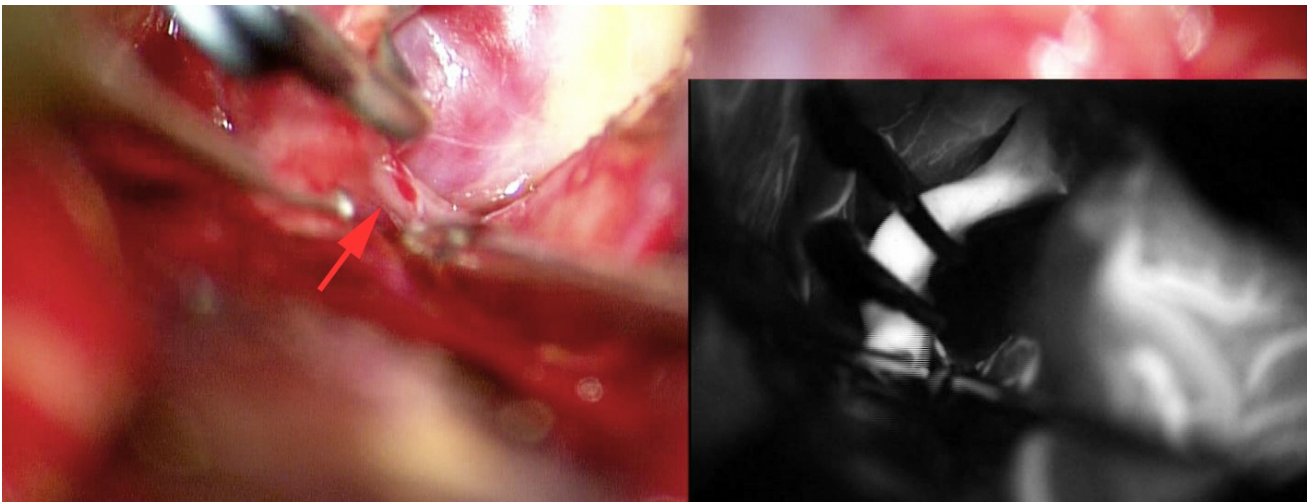


Figure 20: A small PCoA aneurysm projecting posteriorly was clipped using an angled fenestrated clip (upper sketch.) The fenestration encircles the ICA. The AChA is shown just distal to the heel of the clip, proximal to the ICA bifurcation. This construct does not require isolation of the AChA (arrow) in the event of its attachment to the dome of larger aneurysms (middle and lower photos.)

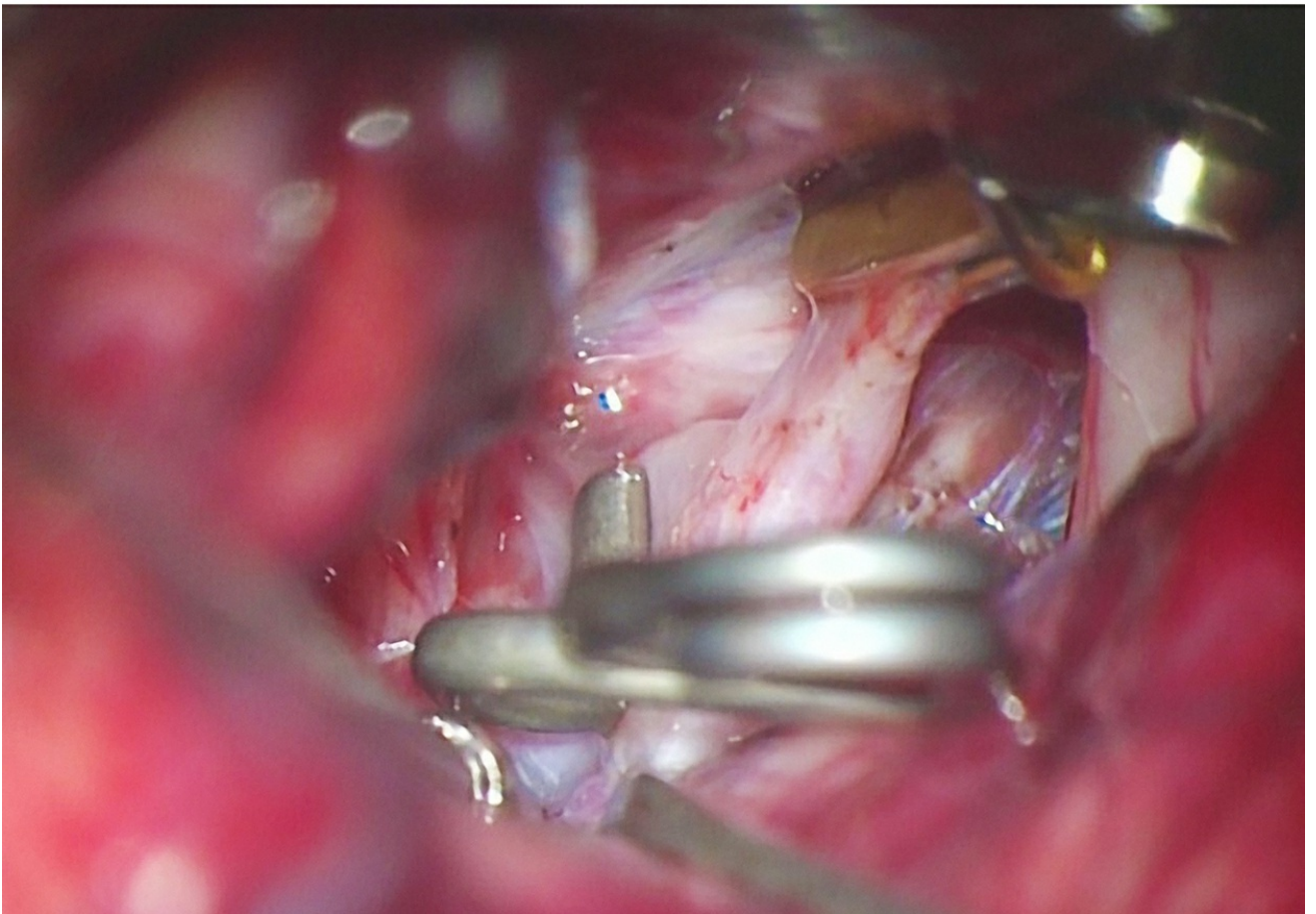
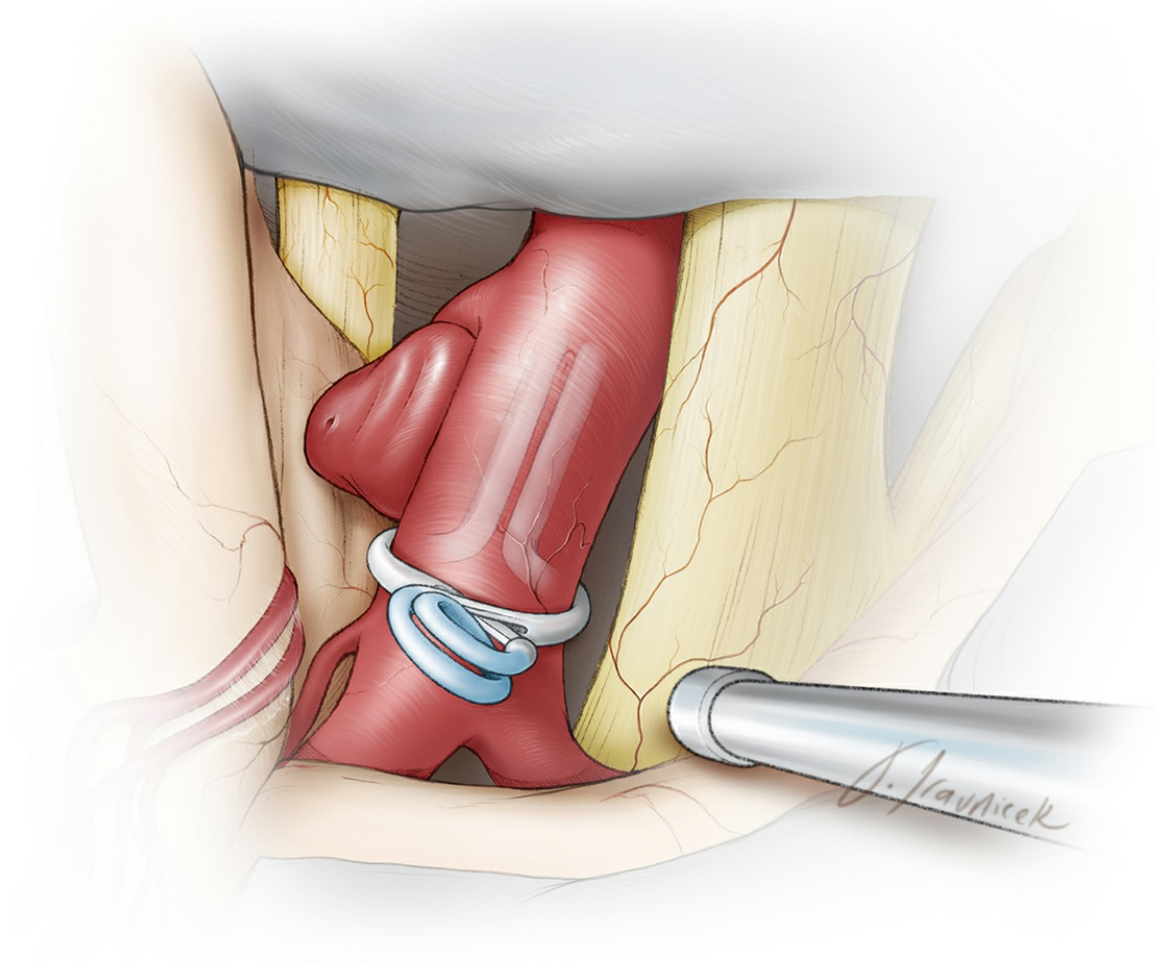


Figure 21: An operative view of the final clip construct for a posterior-projecting PCoA aneurysm. Care must be taken to ensure that neither the PCoA nor its medial thalamoperforators are inadvertently included in the clip blades. The tip of the blades should not compromise the PCoA's origin.

Clipping can cause slight traction on the aneurysm dome, precipitating premature rupture if the sac is adherent to the temporal lobe. The surgeon should continue with slow clip closure to stop the bleeding. If bleeding does not cease upon clip closure, either the clip blades are too short or a neck tear has occurred. In either situation, proximal ICA occlusion is mandatory and careful inspection of the neck is warranted. I avoid trapping the ICA because its retrograde flow is often manageable under only proximal ICA occlusion.

Clip ligation of medially-projecting aneurysms requires the distal clip blades to negotiate with the posterior clinoid that can hinder optimal clip placement. Angled fenestrated clips can be especially useful in this circumstance. Loss of motor evoked potentials is most likely due to compromise of the AChA/PCoA and their perforators until proven otherwise.

Fluorescence videoangiogram has certain limitations for evaluating PCoA aneurysms after their ligation. Most often, because of the deep operative corridor and the hidden ACoA aneurysm, enough excitation light cannot reach the fluorescent agent within the sac for the camera to detect the emission signals. This phenomenon leads to false negative

results. Therefore, puncture of the dome or intraoperative catheter angiogram is necessary for confirmation of aneurysm exclusion.

After the sac is punctured, it should be carefully mobilized to ensure that the PCoA/AChA and their perforating vessels are not incorporated within the blades. The puncture is especially important for decompression of the oculomotor nerve if corresponding preoperative cranial nerve dysfunction was present. I do not dissect the aneurysm dome from the nerve to avoid traumatic neuropathy.

Additional Considerations

A variety of morphologies are found among PCoA aneurysms.

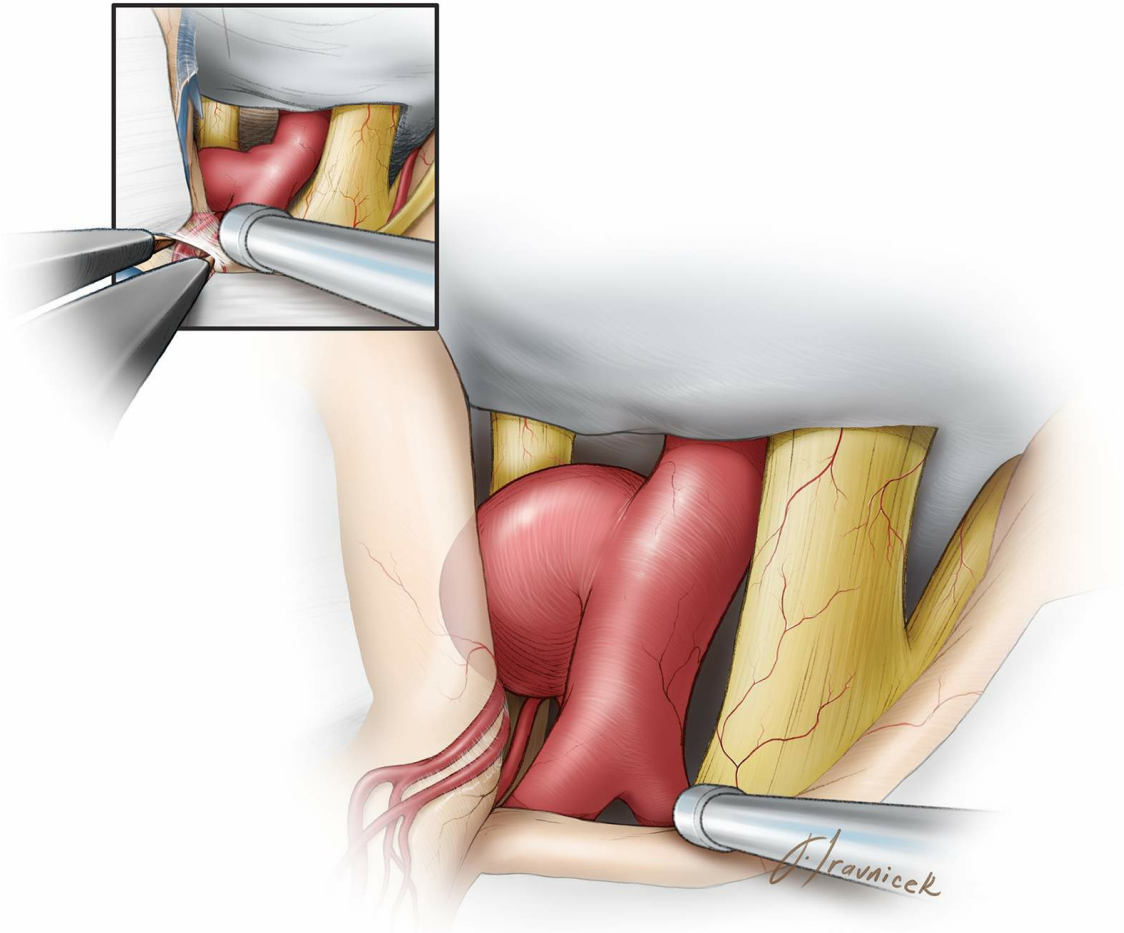


Figure 22: Bulbous or large aneurysms can obscure the origin of the PCoA. Perforators may be attached to the far side of the dome, making it difficult to completely isolate the neck. A more extensive fissure dissection is necessary to expose the ICA bifurcation and ensure identification of the AChA origin (inset image.)

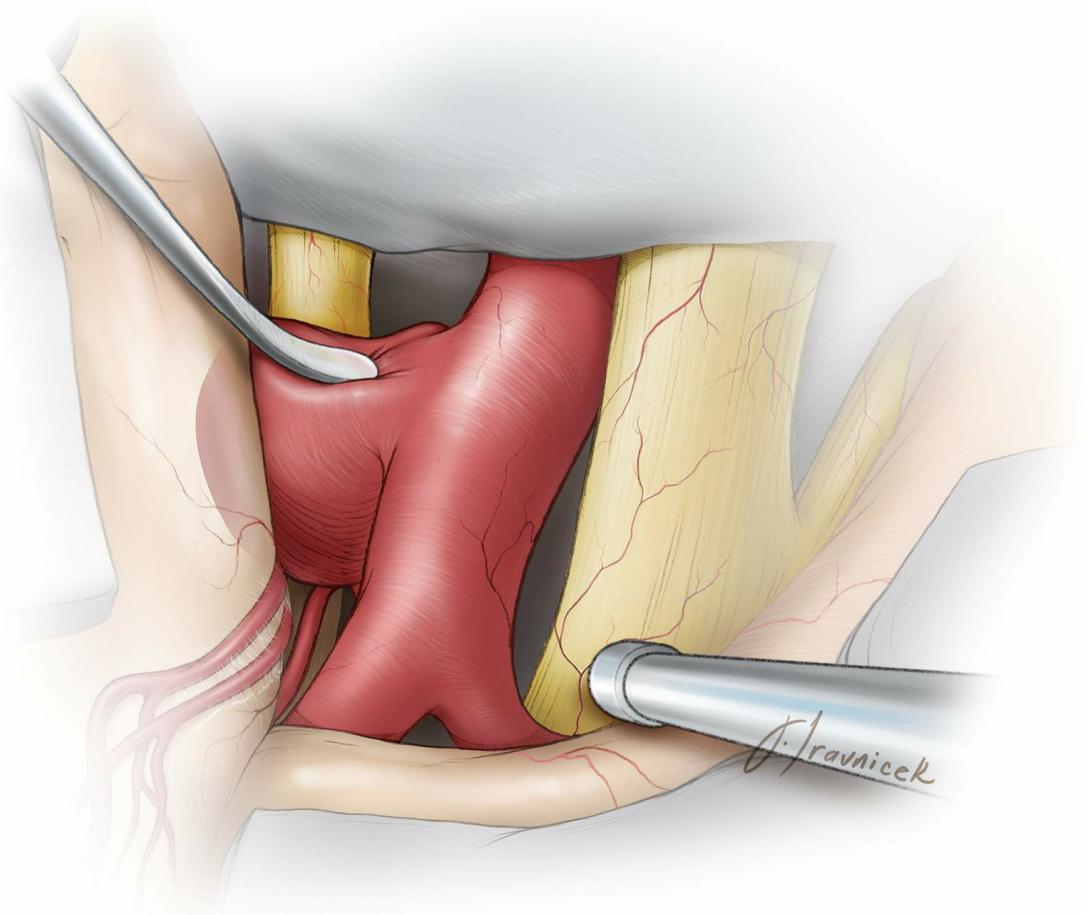


Figure 23: Gentle mobilization of the midbody of the aneurysm, preferably under temporary ICA occlusion, can barely reveal the origin of the PCoA.

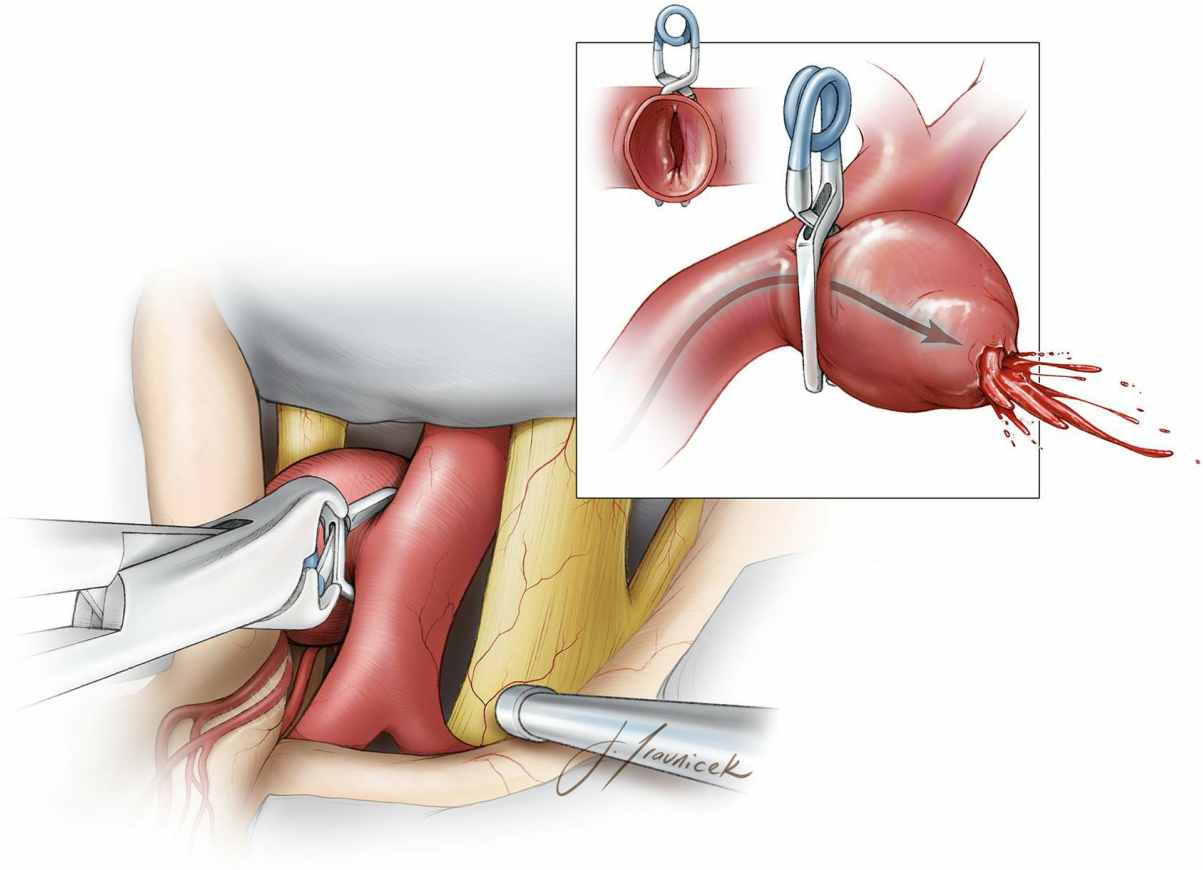


Figure 24: Once the “knuckle” of the PCoA origin has been identified and the route of the PCoA around the inferior pole of the aneurysm is estimated, a straight clip is deployed to collapse the neck parallel to the axis of the ICA. Perpendicular clip application (inset image,) especially in the case of a thick-walled and atherosclerotic aneurysms, leads to partial clipping, intrasaccular turbulence, and rupture.

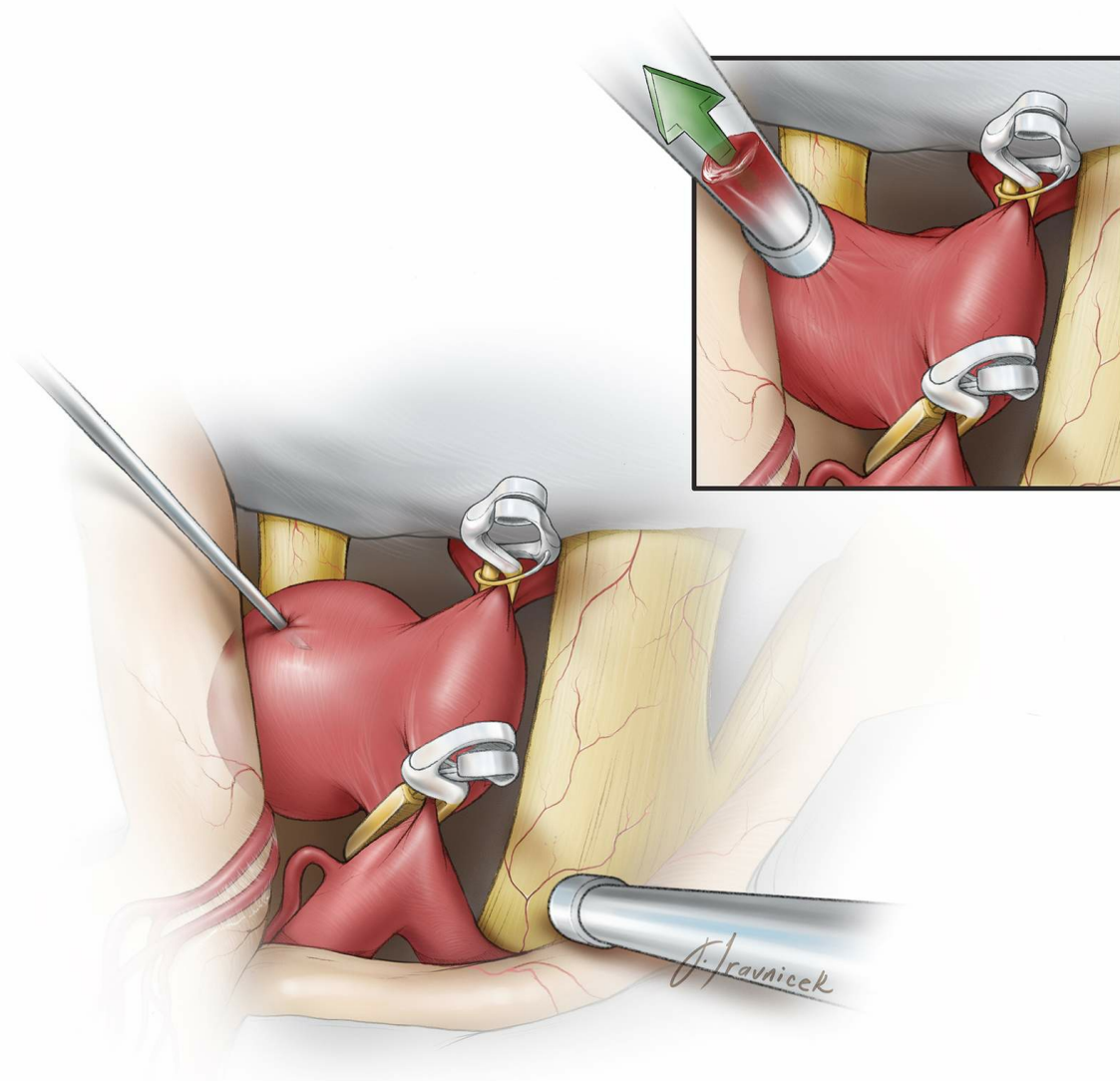


Figure 25: In select cases and for aneurysms causing compressive oculomotor neuropathy, the aneurysm can be trapped, deflated, and then clip ligated.

Atretic PCoAs may be sacrificed as long as a dominant P1 is present for retrograde supply to the thalamoperforators. On the contrary, a fetal PCA cannot be sacrificed and every effort should be made to preserve its flow.

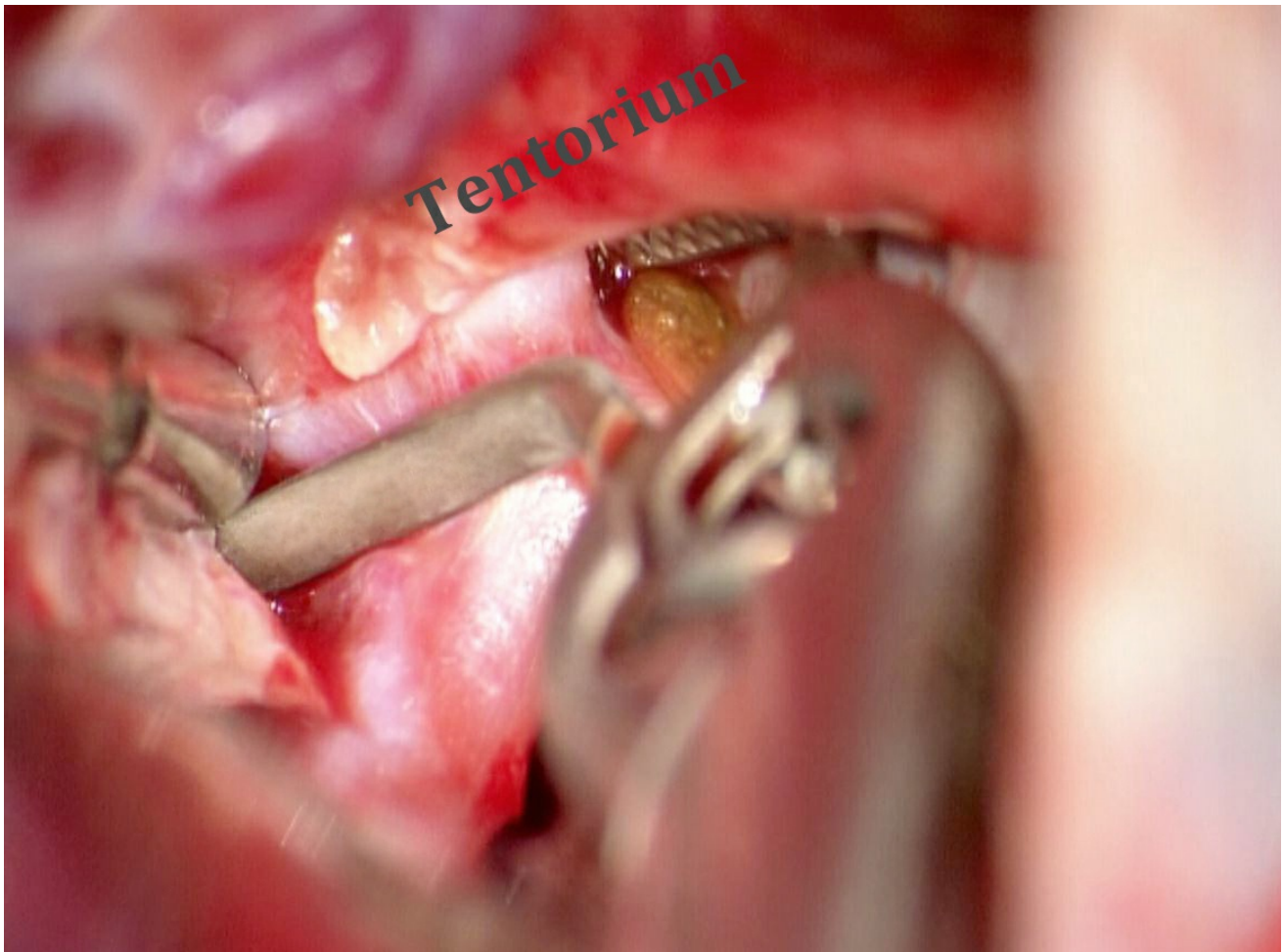


Figure 26: PCoA aneurysms occasionally project underneath the edge of the tentorium. Complete exposure of the neck may require a small incision in the tentorium. Some aneurysm sacs even harbor lobes both above and below the tentorium.

Large and Giant Aneurysms

The technical nuances for exposure of these aneurysms are the same as for smaller aneurysms. However, preparation for the use of suction-decompression technique often proves rewarding.

Certain limitations prevail during dissection and clip ligation of large and giant PCoA aneurysms. Larger aneurysms often splay the distal blades of the single straight clip. The use of a

fenestrated clip(s) to close the distal neck, followed by a short tandem straight clip to close the proximal neck, may effectively solve this problem.

However, because of anatomic constraints, large aneurysms almost always prevent their effective neck dissection for placement of straight clips. Only the medial and lateral borders of the neck are dissectable.

The application of straight clips perpendicular to the ICA axis may lead to intraoperative rupture because of inadequate clip blade closure and resultant partial clipping. In addition, the straight clip may be displaced postoperatively.

For the reasons mentioned above, I prefer to clip any wide-neck or heavily atherosclerotic aneurysm parallel to the axis of the ICA by using an angled fenestrated clip. This avoids an accordion effect on the ICA and a residual neck, which is often seen with perpendicular clipping.

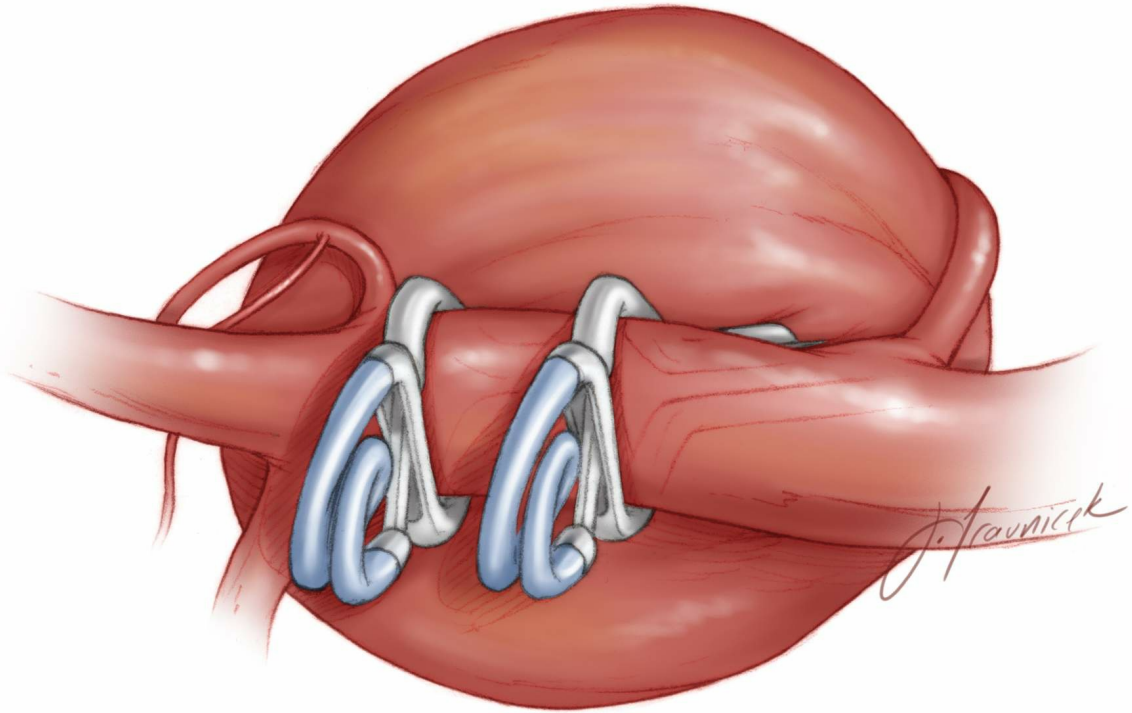


Figure 27: A large PCoA aneurysm with a wide neck is illustrated. Two fenestrated clips are placed in tandem formation to fully occlude the neck. The AChA is shown just distal to the left clip. This construct is ideal because two clips close the atherosclerotic neck effectively. The two-clip construct also provides more flexibility for directing the blades as I maneuver the clips to preserve the origins of the AChA and PCoA. Please also see Figure 20, above.

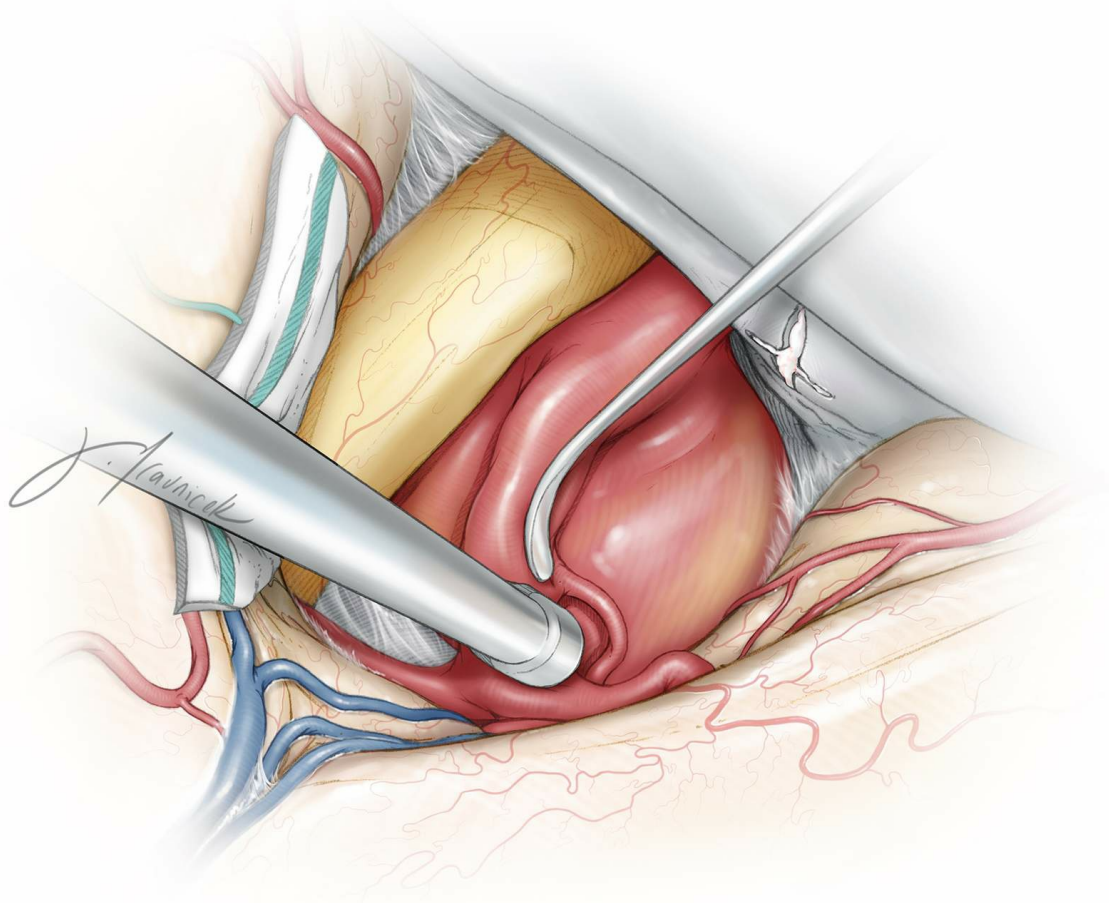


Figure 28: A giant PCoA aneurysm is illustrated. The AChA is draped over the aneurysm pole and is very adherent. Because reconstruction of the ICA lumen is necessary, the aneurysm must be effectively deflated before clip application so the sac can be manipulated.

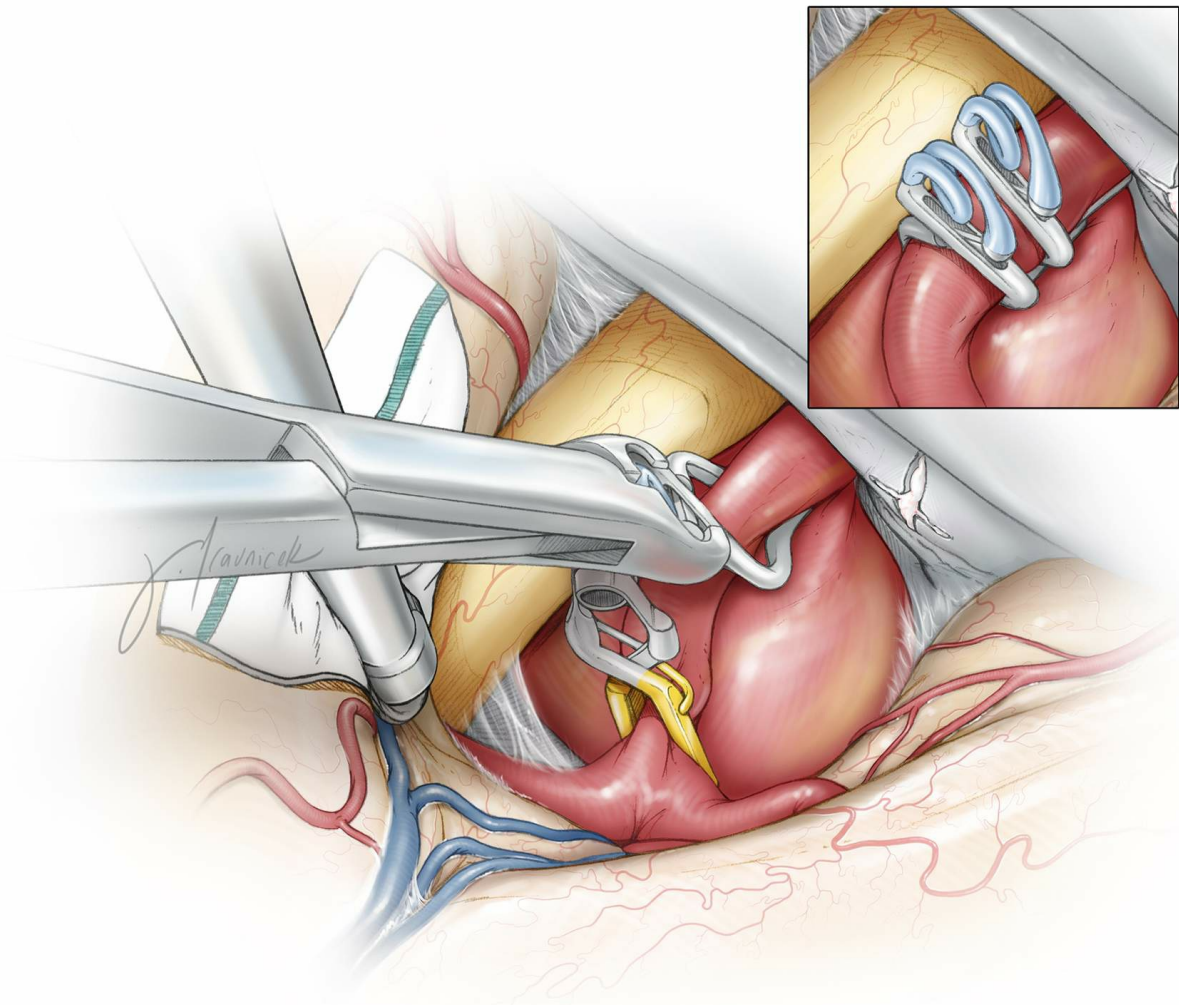


Figure 29: The suction-decompression technique is very useful during ligation of giant aneurysms. Stacked fenestrated clips are used to obliterate the neck. A “booster” or “bolster” clip can be applied over the initial clips to increase their closing pressure. This technique is especially necessary if the intraoperative angiogram reveals persistent filling of the sac. It is imperative to clip reconstruct the ICA lumen generously because extraluminal inspection can underestimate the degree of ICA stenosis incurred by the thick walls of the ICA.

After clip deployment, the construct must be carefully inspected to ensure preservation of all relevant vessels.

Specifically, one must confirm that the AChA is not inadvertently affected. Microdoppler ultrasonography and fluorescence angiography may be used to ensure patency of the vessels and complete aneurysm obliteration.

Clip displacement is possible and usually resolved with the use of a tandem clip. The patient's blood pressure should be kept normal or slightly elevated intraoperatively to disclose the potential risk of clip displacement with higher pressures.

Finally, once the aneurysm is secured, oculomotor compression can be relieved. The aneurysm is punctured and deflated.

Intraoperative Rupture

Please refer to the [Management of Intraoperative Rupture](#) chapter for further details on the topic.

Postoperative Considerations

Hemiparesis is a very disabling complication, nearly always the result of trapping the perforators arising from the PCoA, the AChA, or the PCoA itself. Every effort should be made to avoid this unfortunate outcome.

Standard postoperative care is employed. Anticonvulsants are recommended and tapered off about one week after surgery.

Pearls and Pitfalls

- Generally, retraction of the temporal lobe should be strictly avoided until proximal control is obtained. The

final neck dissection can be completed under temporary occlusion.

- The origin of the PCoA can be mistaken for the proximal neck of the aneurysm. This anatomy must be carefully dissected to avoid occlusion of the PCoA.
- Although a straight clip can accommodate most PCoA aneurysms, those with atypical projections or wide necks require angled fenestrated clips with their blades parallel to the ICA.
- Giant aneurysms require trapping and needle decompression to complete the dissection and clip reconstruction. The perfusion from an unoccluded PCoA can be quite brisk, and this risk should be considered before proceeding with decompression.

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