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# Subtemporal approach for a P2–P3 junction aneurysm of the posterior cerebral artery

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## ABSTRACT

Cerebral aneurysms at the posterior cerebral artery (PCA) are rare, accounting for < 1% of all intracranial aneurysms and about 7% of the posterior circulation aneurysms. Aneurysms are seen rarely at the P2–P3 junction of PCA; few patients have been reported in the literature because of the low incidence of aneurysms at this location. P2–P3 junction aneurysm surgery is challenging. They are usually managed by the subtemporal approach. This is a case report of rupture saccular aneurysm of the posterior cerebral artery on P2–P3 junction, revealed in a 46-year-old male suffering from subarachnoid haemorrhage; on Computed tomography (CT) scan, and cerebral angioscan. Successful clip occlusion of the aneurysm was performed via a subtemporal approach without additional neurological deficits or surgical complications. P2–P3 junction PCA aneurysms can be successfully clipped via the subtemporal.

Keywords
posterior cerebral artery aneurysm,
P2–P3 junction aneurysm,
subtemporal approach

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## INTRODUCTION

Aneurysms of the posterior cerebral artery (PCA) represent approximately 1% of all intracranial aneurysms (1– 4) and usually are reported with vertebrobasilar or posterior circulation aneurysms. P2–P3 junction PCA aneurysms are even more rare with an incidence of only 0.3 %. (5–9) The surgical approach and dissection of the PCA is technically challenging owing to the complexity of its perforating branches and their intimate relationship with the cranial nerves and upper brain stem. Selective catheterization of the PCA and endovascular treatment of aneurysms arising from its different segments are technically feasible, offering a viable alternative to the surgical approach (10).

The surgical treatment of P2–P3 junction aneurysms is challenging and many of these aneurysms are currently treated via an endovascular route. However, complete closure of the aneurysm by surgical clipping still remains the best and most permanent treatment for this type of aneurysm (7, 11–13)

A precise knowledge of the segmental anatomy of the PCA and its branches is essential when the surgical or endovascular approach to an aneurysm is planned, particularly if parent vessel occlusion is contemplated. The PCA can be subdivided into four anatomic

segments (14–15). Each of these segments gives off groups of branches that supply distinct anatomic territories: brain stem and thalamic branches, ventricular branches, and cortical branches. Their location along the four anatomic segments of the PCA affects their treatment and corresponding long-term clinical outcome.

Here, we report a rupture saccular aneurysm of posterior cerebral artery on P2–P3 junction which was successfully clipped via a subtemporal approach. We review the radiographic features, clinical presentation, and possible endovascular or surgical clipping treatment.

## CASE REPORT

We report a 46-year-old male with an unremarkable medical history. Who presented to the emergency department with sudden onset of severe headaches and nausea without disturbed consciousness. On admission no neurological deficits were revealed during clinical examination, body temperature was 37.5 C°, and the patient's vital signs were within normal limits (WFNS 2). A Computed tomography (CT) scan revealed subarachnoid hemorrhage classed Fisher 2, cerebral angioscan showed an aneurysm dilation at the P2–P3 junction of the left PCA **(Fig. 1).** Clip occlusion of the aneurysm was performed via a subtemporal approach.

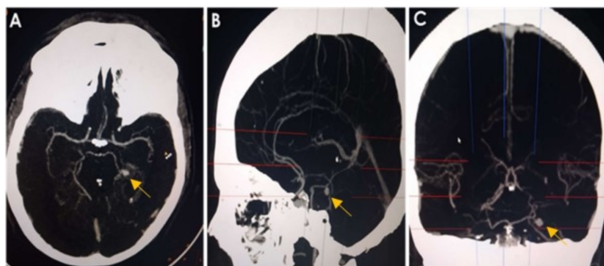


**Figure 1.** Angio-CT showing P2-P3 aneurysm (yellow arrow). A: axial slide; B: sagittal slide; C: coronal slide.

After general anesthesia, the patient was placed in a supine Position, positioned with Mayfield surgical frame and submitted to a subtemporal approach **(Fig. 2)**. Superficial dissection strategy for P2–P3 aneurysm was done by detaching and mobilizing the anterior temporal lobe opening the operative corridor through the carotid-oculomotor triangle **(Fig 3)**. . The temporal lobe was mobilized supero-medialy to open the subtemporal corridor. The ambient cystern was opened releasing the CSF, the superior cerebellar artery"SCA" was identified first emerging from the basilar trunk then the third nerve is identified by following the posterior communicating artery from the ICA. Then a deep dissection strategy happens along the posterior communicating artery, following this artery to the P1-P2 junction. Dissecting the P2 segment was necessary laterally over the oculomotor nerve to the tentorial edge **(Fig.3)**. In the sequence, the P2A segment was followed to the P2-P3 aneurysm. A large aneurysm was found at the P2–P3 junction of the left PCA. After dissecting the aneurysm neck, a definitive clip was placeded without excessive brain retraction.

With a dissection of the neck of the aneurysm a definitive clip was placed under proximal controle **(Fig. 3)**.

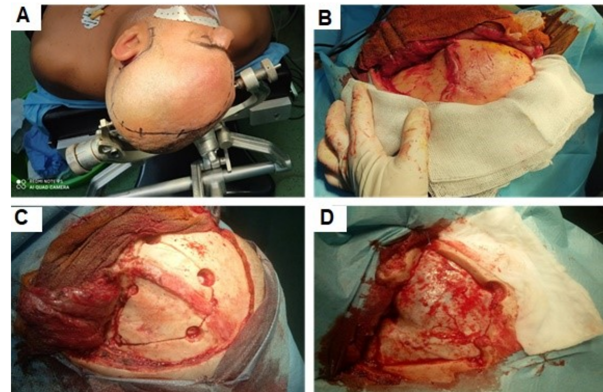


**Figure 2.** Positioning (A), Incision (B), Bone flap (C), Dural exposure (D).

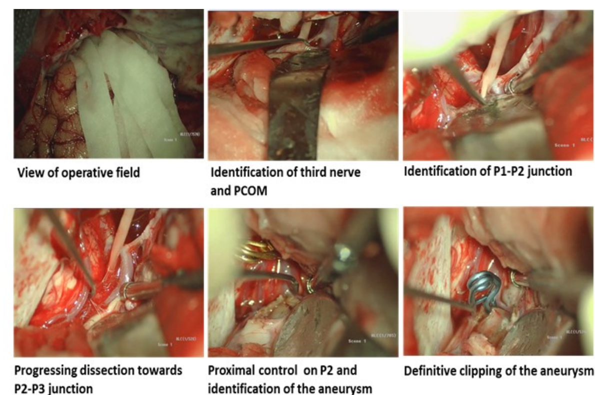


**Figure 3.** Microsurgical steps for exposition of the aneurysm and its exclusion.

No neurologic deficit occurred after treatment. Clinical presentations and grades were typical. The

patient was discharged after an uneventful postoperative course.

A postoperative cerebral angiogram revealed normal arterial anatomy of that region with no remnant of the aneurysm neck **(Fig.4)**.

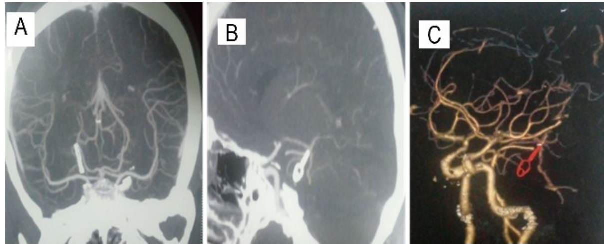


**Figure 4.** AngioCT control in different sequances, coronal (A), sagittal (B), 3D sequence (C).

## Discussion

Aneurysms arising from the PCA have a predilection for the P1 and P2 segments. This is the case in the previous reported series (2, 3, 16). These aneurysms have some peculiar morphologic features and present with specific clinical findings that distinguish them from aneurysms occurring at other anatomic locations of the intracranial circulation. They frequently affect young patients, with an average age of 38 years (16). This is younger than the average age of 50 to 60 years for aneurysms occurring at other anatomic sites. Also, Aneurysms in the peripheral PCA have a tendency to become large, there is a higher incidence of large and giant aneurysms (almost 23% of PCA aneurysms, versus 3–5% at other anatomic sites) affecting the PCA (1, 17). In his series of PCA aneurysms, Drake (18) reported a 42% incidence of giant aneurysms and Yasargil (19) a 50% incidence of giant aneurysms. Pia and Fontana reported 24% incidence of the PCA giant aneurysms.

Larger aneurysms may compress surrounding structures, leading to visual and memory disturbances and seizures.(8,9,20,21) Although our large aneurysm with a long diameter of 20 mm, it did not have any mass effect.

The most common clinical presentation of PCA aneurysms described in the literature is the SAH (80%) (2, 3, 16).

The most important consideration when evaluating these aneurysm patients preoperatively is to understand the anatomy of the segment of the parent artery involved. This is critical for interpreting the risk of different treatment options to exclude the aneurysm from the circulation.

The paired posterior cerebral arteries (PCAs) are the terminal branches of the basilar trunk. As such, the proximal portions of these arteries are frequently involved with aneurysms of the basilar tip.

Aneurysms of the PCA itself are less common and represent between 0.7% and 2.3% of all intracranial aneurysms.

Zeal and Rhoton 21 in 1978 described the anatomy of the PCA and divided it into four segments. The P1 segment is from the origin of the PCA to the insertion of the PCoA. The cerebral peduncle constitutes the medial border of the P1 segment, and the occulomotor nerve courses between the P1 and the proximal superior cerebellar artery. The P2 segment extends from the PCoA around to the posterior margin of the midbrain. From the P1 and P2 segments, perforating arteries to the thalamus and brain stem arise. The portion of the PCA from the posterior margin of the midbrain to the anterior limit of the calcarine fissure is referred to as the P3 segment. The remainder of the PCA is commonly referred to as the P4 segment or cortical segment.

Due to the difference in surgical approach to the anterior versus posterior midbrain, the P2 segment is further divided into P2a and P2p segments. These segments are divided by the posterior border of the cerebral peduncle (22).

Although the above anatomic description is the most widely accepted, other authors have described the PCA anatomy based solely on surgical approach. The surgical segments of the PCA have been defined as the S1 or anterior, S2 or middle, and S3 or posterior (23). Lesions of the S1 segment are typically approached via a pterional, orbitozygomatic, temporal-polar, or subtemporal craniotomy. Pathology in the S2 segment is commonly accessed through a subtemporal craniotomy. An occipital interhemispheric approach is best suited for the S3 segment (23). The various segments of the PCA harbor important vasculature that must be appreciated when making treatment plans.(22)

Surgical treatment of patients with posterior circulation aneurysms presents unique challenges. Surgical exposure of many of these aneurysms requires complex skull base approaches. The posterior circulation is intimately involved with the brainstem, and ischemic complications that arise

when treating patients with these aneurysms frequently result in clinically significant deficits. Because posterior circulation aneurysms are rare, only a handful of centers worldwide have clinically relevant experience with large numbers of these patients.

For many years, treatment options were restricted to surgery alone with different approaches. Direct interventions for aneurysms of the posterior circulation are more difficult than are those for aneurysms of the anterior circle of Willis. However, PCA aneurysms of the P2, P3 and P4 segments do not pose the same technical difficulties, nor have the same prognosis as basilar or P1 segment aneurysms. (5,8,13,24,25) The surgical treatment of P2–P3 junction aneurysms is challenging and many of these aneurysms are currently treated via an endovascular route. As aneurysms of this region have a tendency to be giant, they become symptomatic and also cause bleeding. Endovascular techniques may successfully prevent bleeding but they will not generally remove the mass effect. The complete closure of the aneurysm by surgical clipping still remains the best and most permanent treatment for the aneurysm. (7)

The subtemporal approach was established and introduced by Drake as a standard approach to PCA aneurysms. (24) This approach may require excessive temporal lobe retraction. Severe cerebral edema may occur, with the possibility of temporal lobe contusion and intraoperative rupture (6,26–27,28–29) Ramzisham et al. successfully trapped and subsequently excised a P2 aneurysm via a subtemporal approach without additional neurological deficits.(8) Onada et al. selected the transcortical transchoroidal fissure approach and performed a cortical incision in the middle temporal gyrus, despite the possibility of disturbances to the visual field. They reported that this approach involves less retraction of the temporal lobe in patients at the acute stage after subcranial hemorrhage and with cerebral edema.(5)

Ng et al. trapped a P2 aneurysm by a petrosal approach.16 Sakata et al. treated P1 and P1–P2 junction aneurysms by a pterional approach and treated P2 and P3 aneurysms by a subtemporal approach. They reported excellent or good outcome for 62% of their patients.(12)

The subtemporal approach may sometimes require excessive temporal lobe retraction which can cause complications through postoperative swelling with particularly grave consequences in the dominant language hemisphere. Other potential complications are related to damage of cranial nerves III and IV. Additionally, during prolonged retraction, compression of the vein of Labbe´ causes damage to the brain surface venous drainage, which leads to edema. The use of intraoperative mannitol and the use of lumbar or ventricular drainage for CSF evacuation are usually sufficient to avoid hippocampal resection with its neuropsychological effects.(5,8,11,13,25) Short operative and retraction times and no need for skull-base resection are the benefits of the subtemporal approach.(11,24,28–29).

## Treatment Decisions

The decision to offer treatment for an intracranial aneurysm varies greatly, depending on whether the aneurysm has ruptured. Therapy to exclude the aneurysm from the cerebral circulation should be aggressive for all patients with aneurysms who present with acute subarachnoid hemorrhage. This approach may be tempered for patients with serious medical comorbidities or very poor neurologic status upon presentation. However, patients with ruptured aneurysms should generally be evaluated for treatment in a timely fashion by a neurovascular team.

Patients with unruptured aneurysms must be assessed for treatment based on the patient’s age, symptoms, size of the aneurysm, aneurysm morphology, family history, and comorbid conditions. The literature does not support the superiority of endovascular or microsurgical treatment for aneurysms of the PCA. These complex lesions require review by an experienced multidisciplinary neurovascular team, and combined approaches are an evolving strategy for treatment.

Surgical treatments change depending on the type of aneurysm. For saccular aneurysms, even for giant ones, complete occlusion of the sac and neck should be attempted by placing clips on the aneurysmal neck wherever safe and feasible.(4, 6, 8,21, 25, 27) However, clip placement in the neck may sometimes be difficult or hazardous. Other surgical options available are clip placement in the proximal artery, excision of the aneurysmal sac without or with the restoration of distal flow via direct anastomosis or bypass, and use of a trapping procedure.

In our patient we performed successful neck clipping of the aneurysm via a subtemporal approach. Without additional neurological deficits or surgical complications. Coil embolization has been suggested as the treatment of choice but PCA aneurysms are also good candidates for microsurgical clipping. The subtemporal approach is simple and safe in experienced hands. P2–P3 junction PCA aneurysms can be successfully clipped via the subtemporal approach without excessive temporal lobe retraction and complications related to these or disruption of surface veins.

Recent literature, as well as our own experience indicate that surgical treatment of these aneurysms is relatively safe durable and effective with low mortality and morbidity.

## Conclusion

Aneurysms of the PCA are rare but present distinct anatomic and pathophysiological characteristics.
Understanding the anatomic segments, location of perforating vessels, anastomotic networks, and irrigation enables the surgeon to choose the correct approach and surgical plan.

The literature does not support the superiority of endovascular or microsurgical treatment for aneurysms of the PCA including P2P3 junction aneurysm. Posterior circulation aneurysms are technically challenging lesions that are ideally managed by a multidisciplinary neurovascular team.

The subtemporal approach is simple and safe in experienced hands. P2–P3 junction PCA aneurysms can be successfully clipped via the subtemporal approach without excessive brain retraction, resection of brain tissue or disruption of surface veins.

In the subtemporal approach, CSF release prior to retraction is necessary to prevent temporal lobe injury. The subtemporal approach can provide enough space for revascularization procedures. The most encountered complications were not related to the subtemporal approach but to the specific nature of PCA aneurysms.

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