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Giant Partially Thrombosed Ophthalmic Segment Internal Carotid Artery Aneurysm With Severe Angiographic–Radiological Discordance: Implications for Microsurgical Strategy

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Case Report

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Giant Partially Thrombosed Ophthalmic Segment Internal Carotid Artery Aneurysm With Severe Angiographic–Radiological Discordance: Implications for Microsurgical Strategy

Running title:

Microsurgical Reconstruction of a Giant Ophthalmic ICA Aneurysm

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Keywords: Partially thrombosed aneurysm; ophthalmic segment aneurysm; multimodal imaging; microsurgical thrombectomy; clip reconstruction; optic nerve decompression.

Abbreviations: ACP, anterior clinoid process; CTA, computed tomography angiography; CT, computed tomography; DSA, digital subtraction angiography; ICA, internal carotid artery; ICG, indocyanine green; ICG-VA, indocyanine green videoangiography; MRI, magnetic resonance imaging; OphA, ophthalmic artery; OphSA, ophthalmic segment aneurysm; OphSAs, ophthalmic segment aneurysms; mRS, modified Rankin Scale.

ABSTRACT

Background: Giant partially thrombosed aneurysms of the ophthalmic segment of the internal carotid artery (ICA) present substantial diagnostic and therapeutic challenges because intraluminal thrombus and mural calcification can obscure the true aneurysm morphology, leading to underestimation of lesion size on angiography.

Methods: A 53-year-old man with progressive headache without focal neurological deficits or objective visual impairment underwent multimodal imaging including CT, MRI, CTA, and DSA. The imaging findings were integrated for operative planning, and microsurgical clipping with staged thrombectomy was performed.

Results: CT and MRI revealed a giant partially thrombosed ophthalmic segment ICA aneurysm compressing the optic apparatus, whereas DSA depicted only a small residual lumen, demonstrating marked angiographic–radiological discordance. Microsurgical clip reconstruction with staged intraluminal thrombectomy achieved complete aneurysm exclusion with preservation of the parent ICA and ophthalmic artery. The patient recovered without new neurological deficits and remained functionally independent at 6-month follow-up.

Conclusions: Giant partially thrombosed ophthalmic segment ICA aneurysms may be substantially underestimated by DSA alone. Integration of CT, MRI, CTA, and DSA is critical for defining true aneurysm morphology and optimizing skull base microsurgical strategy. Microsurgical reconstruction with staged thrombectomy remains a definitive treatment option in selected patients.

INTRODUCTION

Ophthalmic segment aneurysms (OphSAs) of the internal carotid artery (ICA) represent a surgically demanding subset of anterior circulation aneurysms due to their close anatomical relationship with the optic nerve, optic canal, anterior clinoid process (ACP), distal dural ring, and ophthalmic artery.[1–2] Their management requires meticulous microsurgical planning to achieve adequate proximal and distal vascular control while preserving critical neurovascular structures within a confined skull base corridor.[3]

Giant intracranial aneurysms (≥25 mm) account for approximately 2–5% of all intracranial aneurysms but are associated with disproportionately high neurological morbidity due to progressive intraluminal thrombosis, mural calcification, and repeated intramural hemorrhage.[4–5] In ophthalmic segment lesions, these pathological changes frequently result in progressive optic apparatus compression, leading to visual dysfunction and, in advanced cases, irreversible optic neuropathy.[6]

A key diagnostic challenge in giant partially thrombosed aneurysms is the frequent mismatch between angiographic appearance and true lesion extent.[7] While digital subtraction angiography (DSA) remains the gold standard for vascular lumen assessment, it may significantly underestimate aneurysm size when the lesion is largely occupied by organized thrombus.[8] In contrast, computed tomography (CT) and magnetic resonance imaging (MRI) provide superior characterization of thrombotic components, calcification, and mass effect, enabling more accurate assessment of true lesion morphology and surgical complexity.[9] However, although multimodal imaging is routinely performed, the implications of angiographic–radiological discordance for operative planning have received comparatively little attention in the neurosurgical literature.

Although endovascular flow diversion has become an established treatment option for paraclinoid aneurysms, its role in giant thrombosed lesions remains controversial.[10–11] In such cases, delayed aneurysm occlusion, persistent mass effect from organized thrombus, and limited immediate decompression of the optic apparatus may restrict clinical efficacy.[12] Consequently, microsurgical reconstruction remains a critical treatment strategy in selected patients, particularly those with progressive visual symptoms or significant skull base compression.[13]

Despite advances in skull base microsurgery, relatively few reports have focused on how the discrepancy between angiographic lumen and true aneurysm dimensions should influence operative planning, including the extent of anterior clinoidectomy, optic canal decompression, proximal vascular control, and staged thrombectomy. This gap is clinically relevant, as inadequate appreciation of true lesion extent may lead to underprepared surgical corridors and increased operative risk.

Here, we present a case of a giant partially thrombosed ophthalmic segment ICA aneurysm demonstrating marked discordance between DSA and cross-sectional imaging due to extensive organized thrombus. Recognition of this discrepancy was fundamental to operative planning because angiography substantially underestimated the true aneurysm dimensions and surgical complexity. Rather than simply illustrating a known imaging phenomenon, this report demonstrates how multimodal imaging directly informed microsurgical strategy, including the extent of skull base exposure, extradural anterior clinoidectomy, optic canal decompression, proximal vascular control, staged thrombectomy, and clip reconstruction. This case therefore highlights the practical value of integrating cross-sectional imaging with angiography to optimize surgical planning and achieve safe aneurysm exclusion while preserving the parent ICA and ophthalmic artery.

ILLUSTRATIVE CASE

A 53-year-old man with a history of long-standing hypertension and chronic tobacco use presented with a 5-day history of severe headache following physical exertion, predominantly involving the temporal and occipital regions. He denied loss of consciousness, seizures, focal neurological deficits, or acute visual deterioration at presentation. Neurological examination was unremarkable, demonstrating intact vision, full extraocular movements, and no objective cranial nerve deficit. Mild subjective visual discomfort was reported on prolonged fixation without measurable visual field impairment.

Initial noncontrast CT of the brain demonstrated a large hyperdense parasellar lesion with peripheral calcification and significant sellar–suprasellar mass effect (Figure 1A). Contrast-enhanced CT showed heterogeneous peripheral enhancement surrounding the calcified component (Figure 1B). Although these findings suggested a complex vascular lesion, multimodal imaging was pursued to further characterize aneurysm morphology, thrombus burden, and neurovascular relationships.

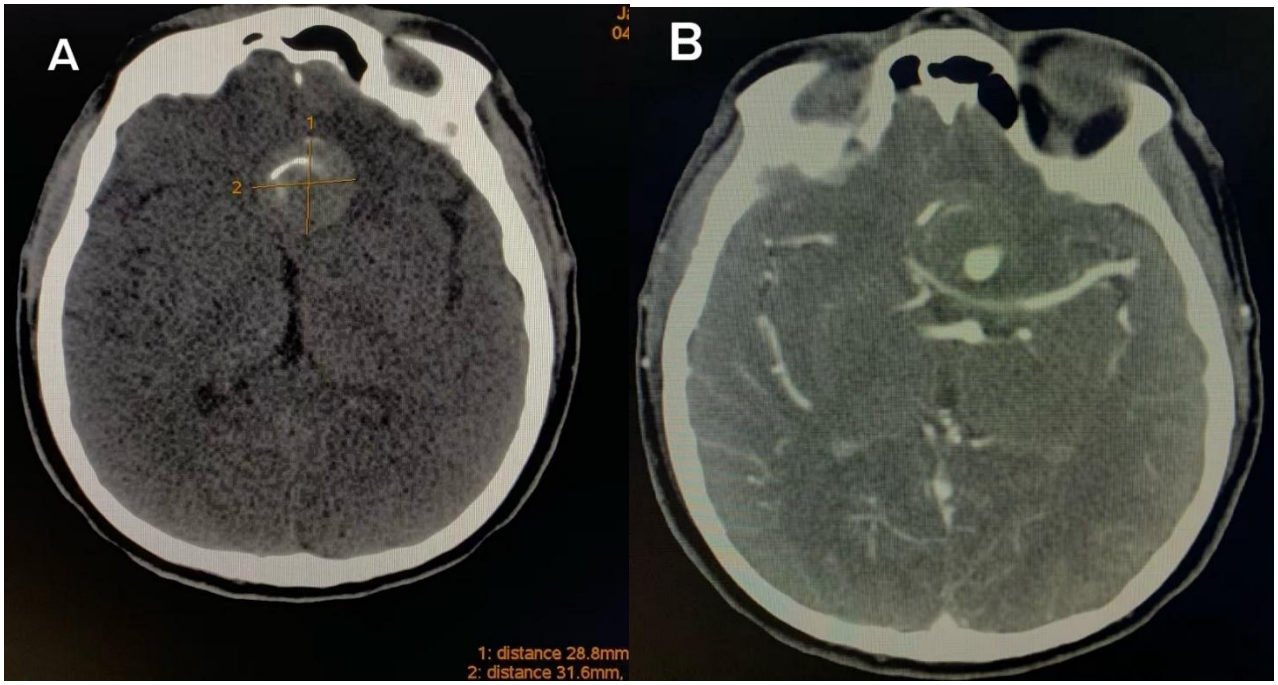


Fig. 1. Preoperative Computed Tomography. (A) Noncontrast axial CT demonstrating a hyperdense parasellar lesion, measuring approximately 28.8 × 31.6 mm, with peripheral mural calcification and marked mass effect on the sellar–suprasellar region. (B) Contrast-enhanced CT demonstrating heterogeneous peripheral enhancement with partial mural calcification.

MRI revealed a large parasellar–suprasellar mass with heterogeneous internal signal intensity and layered architecture consistent with partial thrombosis (Fig. 2A–C). The lesion caused superior displacement and mild compression of the ipsilateral optic apparatus. MRI was particularly valuable for defining neurovascular compression rather than establishing definitive vascular diagnosis.

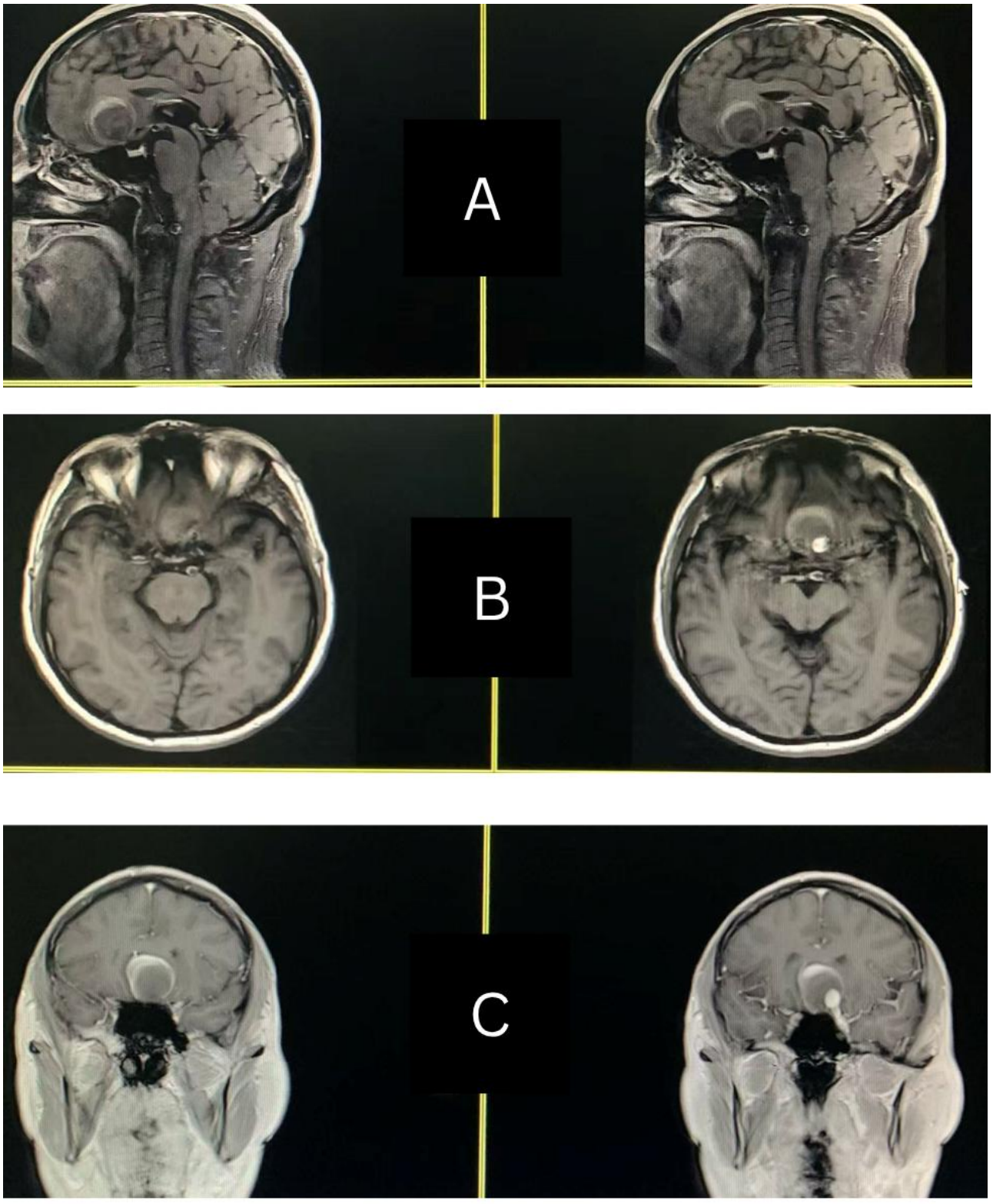


Fig. 2. Preoperative Magnetic Resonance Imaging. (A–C) Sagittal, axial, and coronal MRI demonstrating a giant partially thrombosed ophthalmic segment aneurysm with layered thrombus, heterogeneous internal architecture, and significant compression of the ipsilateral optic apparatus.

Subsequent CTA and DSA demonstrated a vascular lesion arising from the ophthalmic segment of the left ICA (Fig. 3A–C). Importantly, DSA opacified only a small residual lumen, markedly underestimating the true lesion size due to extensive organized thrombus. Three-dimensional rotational angiography confirmed a broad-necked aneurysm of the ophthalmic segment ICA (Fig. 3D), highlighting a clear discordance between angiographic lumen and cross-sectional imaging.

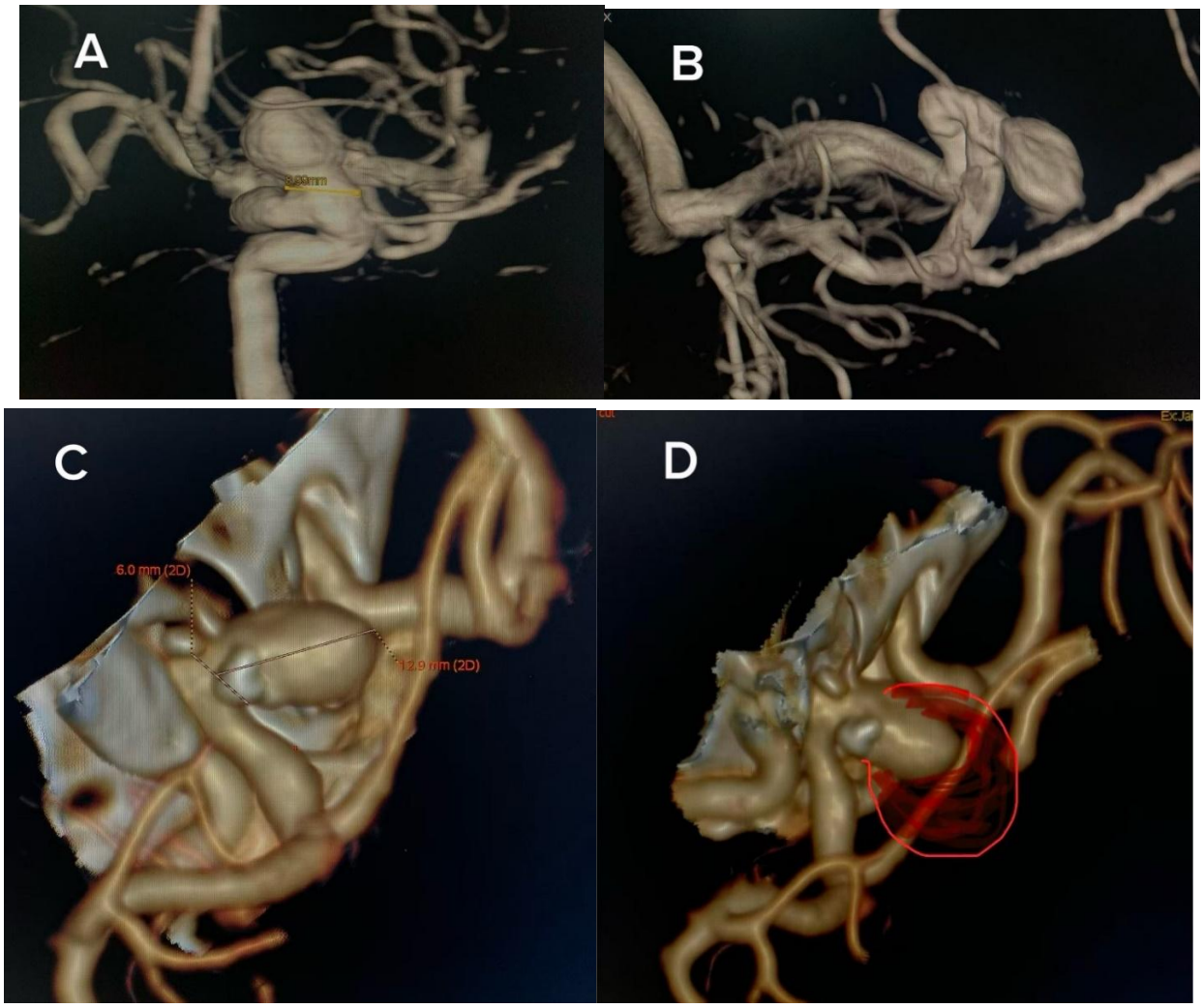


Fig. 3. Preoperative CTA and Cerebral Angiography. (A,B) DSA demonstrating contrast filling of only the residual patent lumen, markedly underestimating the true aneurysm dimensions. (C) CTA demonstrating the vascular origin of the lesion from the ophthalmic segment of the ICA. (D) Three-dimensional rotational angiography confirming a broad-necked ophthalmic segment aneurysm and illustrating the discrepancy between the angiographic lumen and the true aneurysm size demonstrated by CT and MRI.

Multimodal imaging (CT, MRI, CTA, and DSA) was integrated for operative planning. CT was essential for identifying mural calcification and mass effect, MRI for defining neurovascular compression, CTA for vascular anatomy, and DSA for assessing parent artery configuration. Special attention was directed toward the anticipated extent of anterior clinoid process drilling and optic canal decompression required to obtain an adequate opticocarotid corridor and achieve safe proximal vascular control during microsurgical reconstruction.

Given the progressive mass effect on the optic apparatus and the significant angiographic–radiological mismatch indicating extensive thrombosis, a decision was made to proceed with microsurgical treatment aimed at definitive aneurysm exclusion and immediate decompression of adjacent neurovascular structures.

OPERATIVE TECHNIQUE

Under general anesthesia, the patient was positioned supine with the head fixed in a three-pin Mayfield system, rotated approximately 30° contralaterally and slightly extended to optimize access to the left opticocarotid region. Given the anticipated need for proximal vascular control in a giant partially thrombosed aneurysm, a cervical exposure of the common carotid artery, ICA, and external carotid artery was first performed.

A left pterional craniotomy with Dolenc skull base extension was then carried out. Extradural anterior clinoidectomy was performed to expose the paraclinoid ICA, followed by optic canal unroofing to enhance the opticocarotid corridor. Opening of the distal dural ring allowed additional mobilization of the ICA and improved access to the aneurysm neck region, which was expected to be distorted by thrombosis and calcification (Fig. 4A).

Intradural exploration revealed a giant partially thrombosed ophthalmic segment ICA aneurysm with compression of the optic apparatus. The aneurysm wall was densely calcified and rigid, and the true neck was obscured by organized thrombus, significantly limiting direct anatomical identification (Fig. 4B).

After securing proximal and distal vascular control at both cervical and intracranial levels, the aneurysm dome was opened. Staged internal decompression was performed using microsurgical suction and ring curettes to evacuate organized thrombus (Fig. 4C–D). This maneuver resulted in progressive collapse of the aneurysm sac, which was critical for identifying the true neck–parent artery interface that had been obscured by mass effect and thrombotic burden.

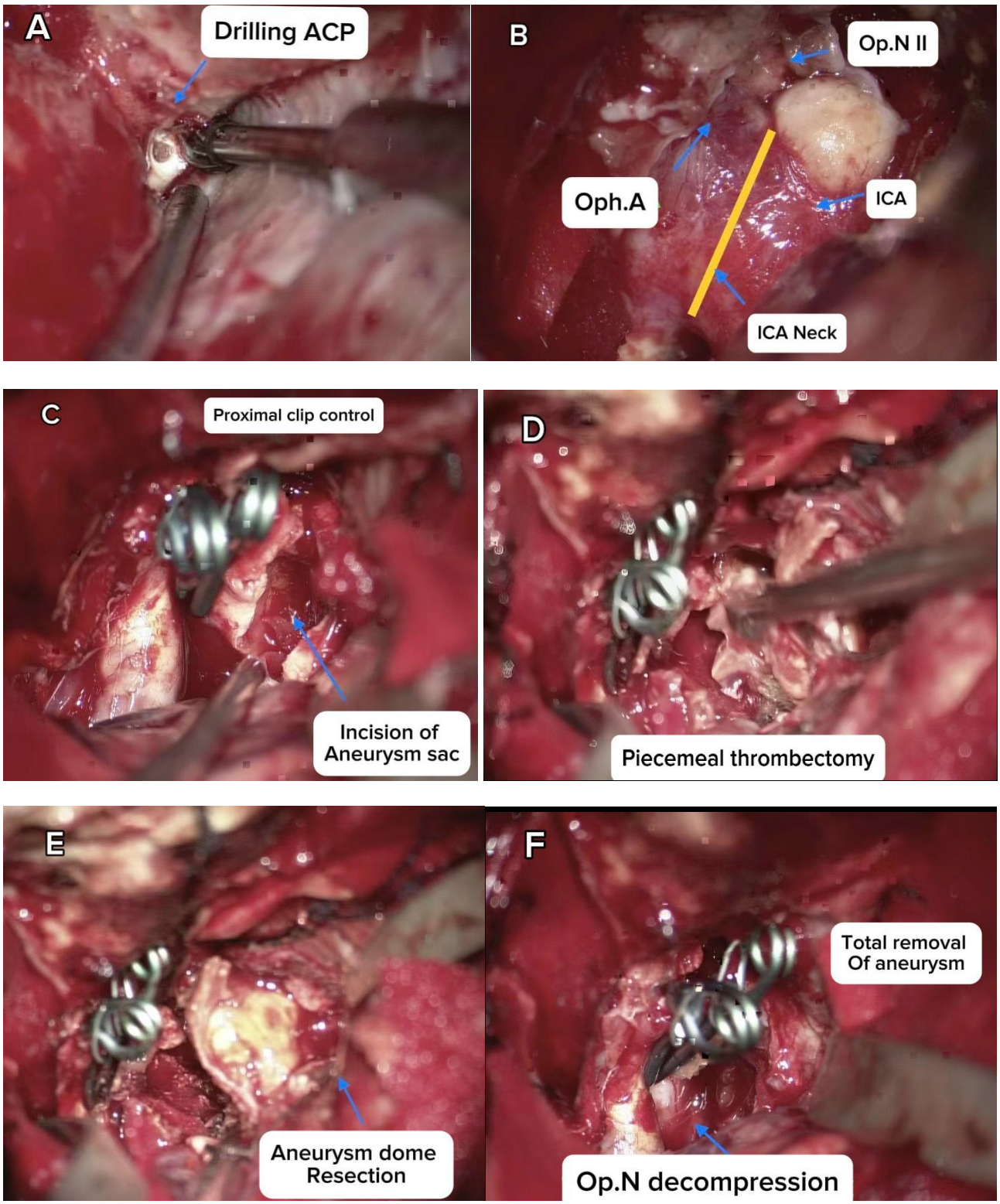


Fig. 4. Intraoperative Microsurgical Procedure. (A) Extradural anterior clinoidectomy. (B) Optic canal unroofing exposing the ophthalmic segment of the ICA. (C) Exposure of the giant partially thrombosed aneurysm under temporary vascular control. (D) Opening of the aneurysm dome with staged intraluminal thrombectomy. (E) Clip reconstruction of the aneurysm neck after internal decompression. (F) Final microsurgical appearance demonstrating preservation of the parent ICA and ophthalmic artery.

Following adequate decompression, definitive clip reconstruction was achieved using fenestrated and curved clips to reconstruct the ICA while preserving flow through the ophthalmic artery (Fig. 4E–F). Intraoperative indocyanine green videoangiography (ICG-VA) confirmed complete aneurysm exclusion with preserved patency of both the ICA and ophthalmic artery (Fig. 5).

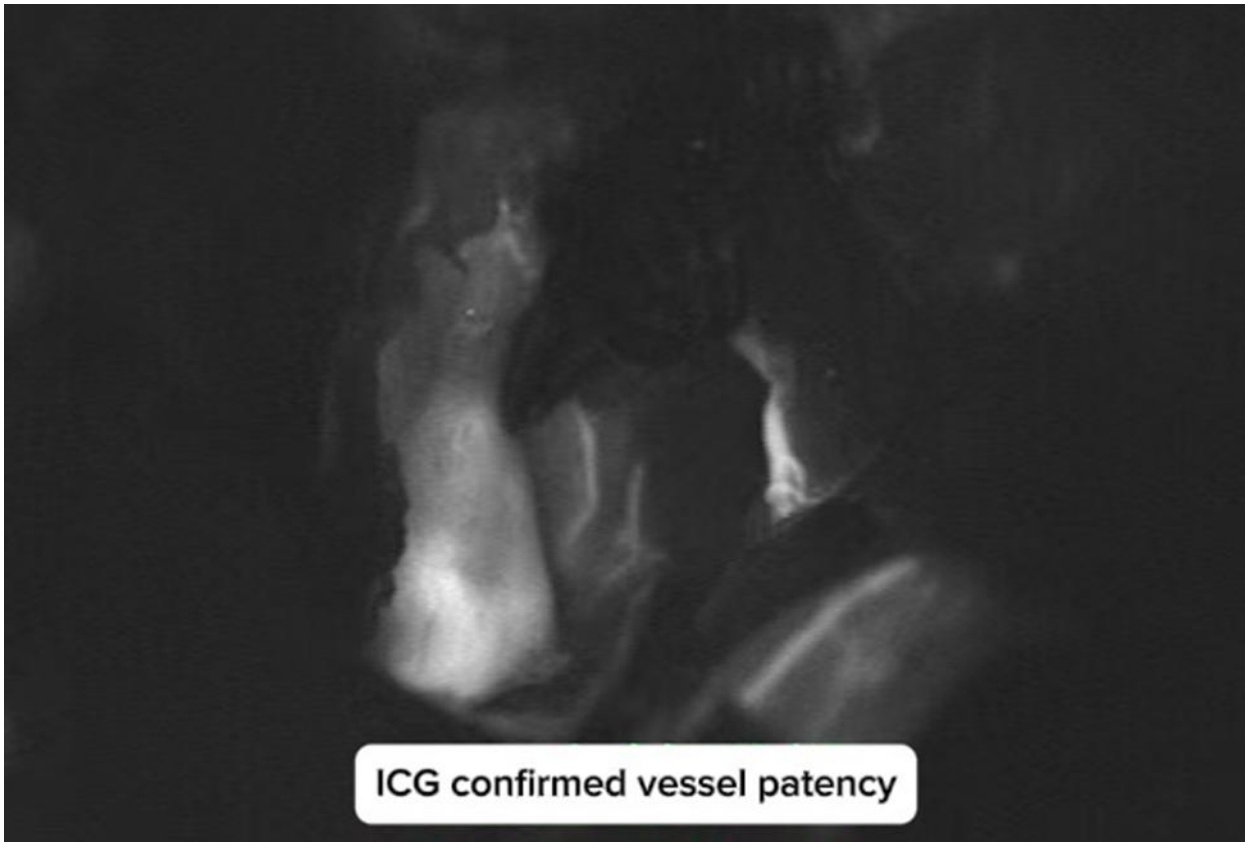


Fig. 5. Intraoperative ICG Videoangiography. ICG-VA confirming complete exclusion of the aneurysm with preserved flow through the ICA and ophthalmic artery after clip reconstruction.

Given the preoperative optic apparatus compression, partial resection of the residual aneurysm wall was performed after clipping to achieve additional decompression of the optic nerve and surrounding structures. Gross examination of the excised specimen confirmed that the true aneurysm size substantially exceeded angiographic estimation, consisting of a heavily calcified wall with extensive organized thrombus (Fig. 6).

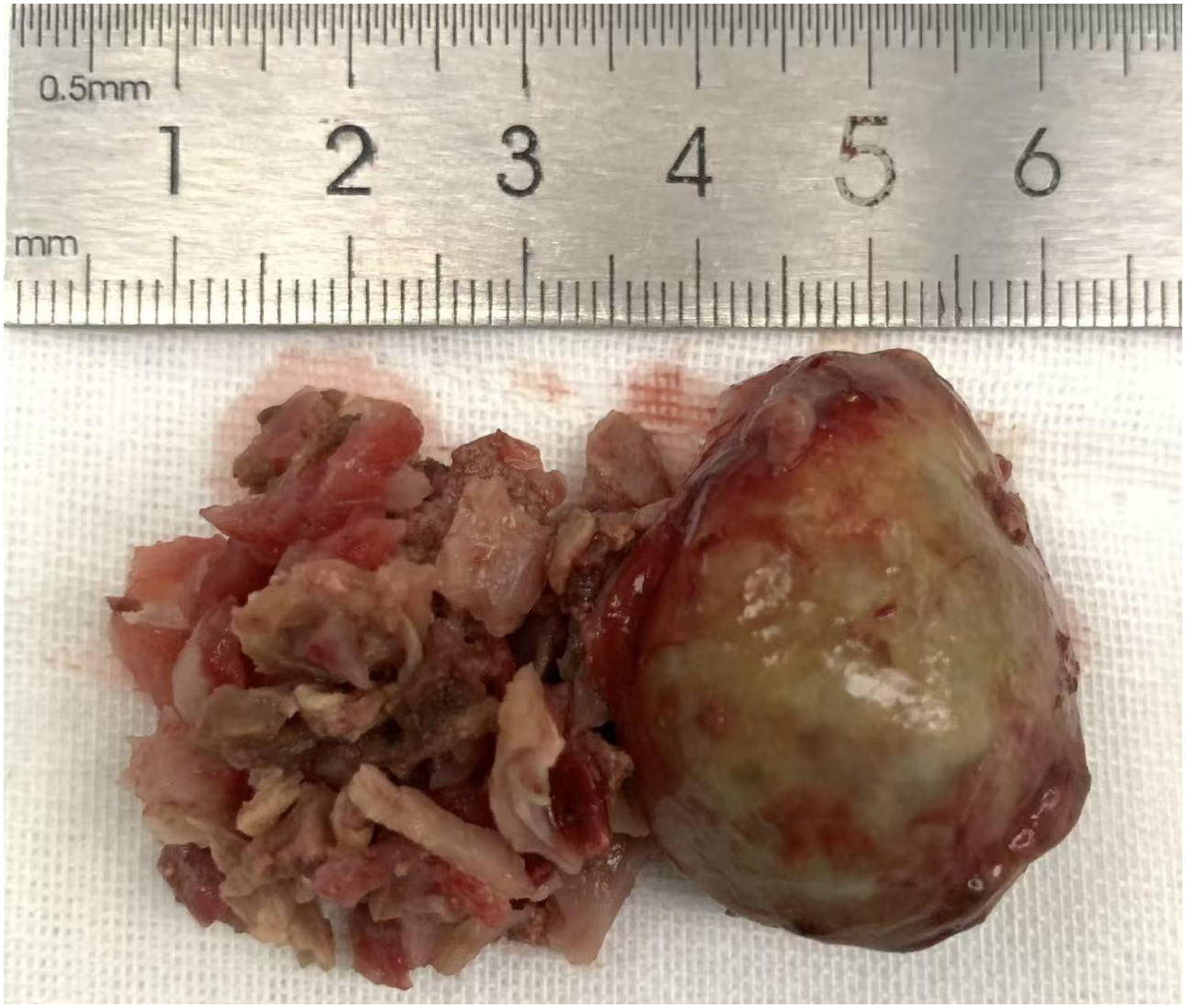


Figure 6. Resected Aneurysm Specimen.
Gross specimen demonstrating a giant partially calcified thrombosed aneurysm with organized thrombus occupying the majority of the aneurysm sac.

Fig. 6. Resected Aneurysm Specimen. Gross specimen demonstrating a giant partially calcified thrombosed aneurysm with organized thrombus occupying the majority of the aneurysm sac.

Postoperatively, the patient remained neurologically stable without ischemic or hemorrhagic complications. Repeat bedside neurological assessment demonstrated preserved full extraocular movements, intact pupillary light reflexes, and no new visual complaints. Postoperative CT showed expected postoperative changes without hemorrhage or infarction (Fig. 7A–D).

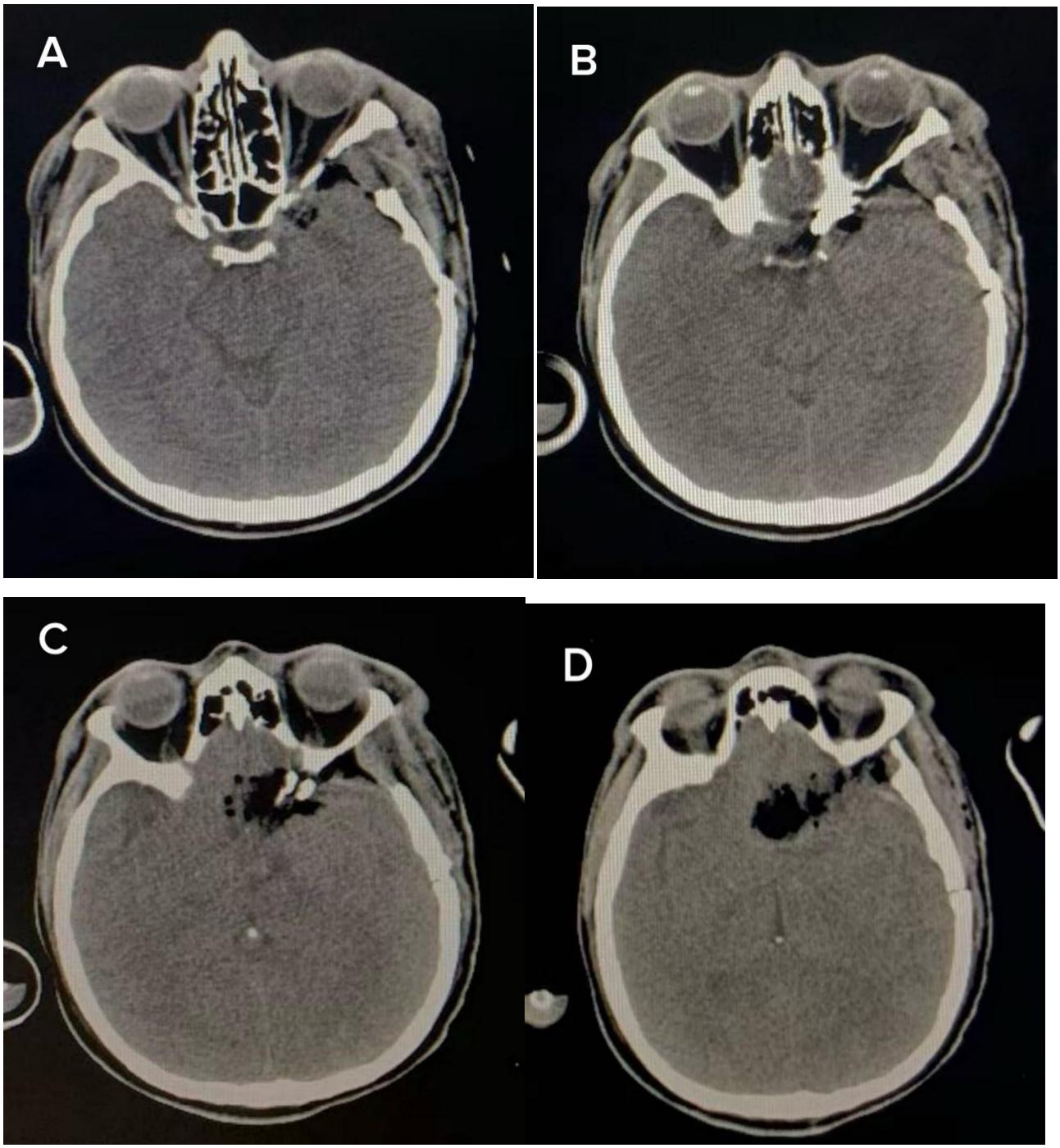


Fig. 7. Postoperative CT. (A–D) Postoperative CT demonstrating expected postoperative changes following microsurgical clipping and thrombectomy without hemorrhage, infarction, or residual mass effect.

At the 6-month follow-up, cerebral angiography (Fig. 8A–D) and DSA (Fig. 9A–B) demonstrated stable clip reconstruction with complete aneurysm obliteration, preserved patency of the ICA and ophthalmic artery, and no evidence of aneurysm recurrence or parent vessel stenosis. Clinically, the patient remained neurologically intact, reported improvement of headache symptoms, maintained normal ocular motility without new visual deterioration, and was functionally independent with a modified Rankin Scale score of 1.

Fig. 9. Six-Month Follow-up Digital Subtraction Angiography. (A,B) DSA confirming complete aneurysm obliteration with preserved patency of the ICA and its major intracranial branches after clip reconstruction.

isual deterioration, and was functionally independent with a modified Rankin Scale score of 1.

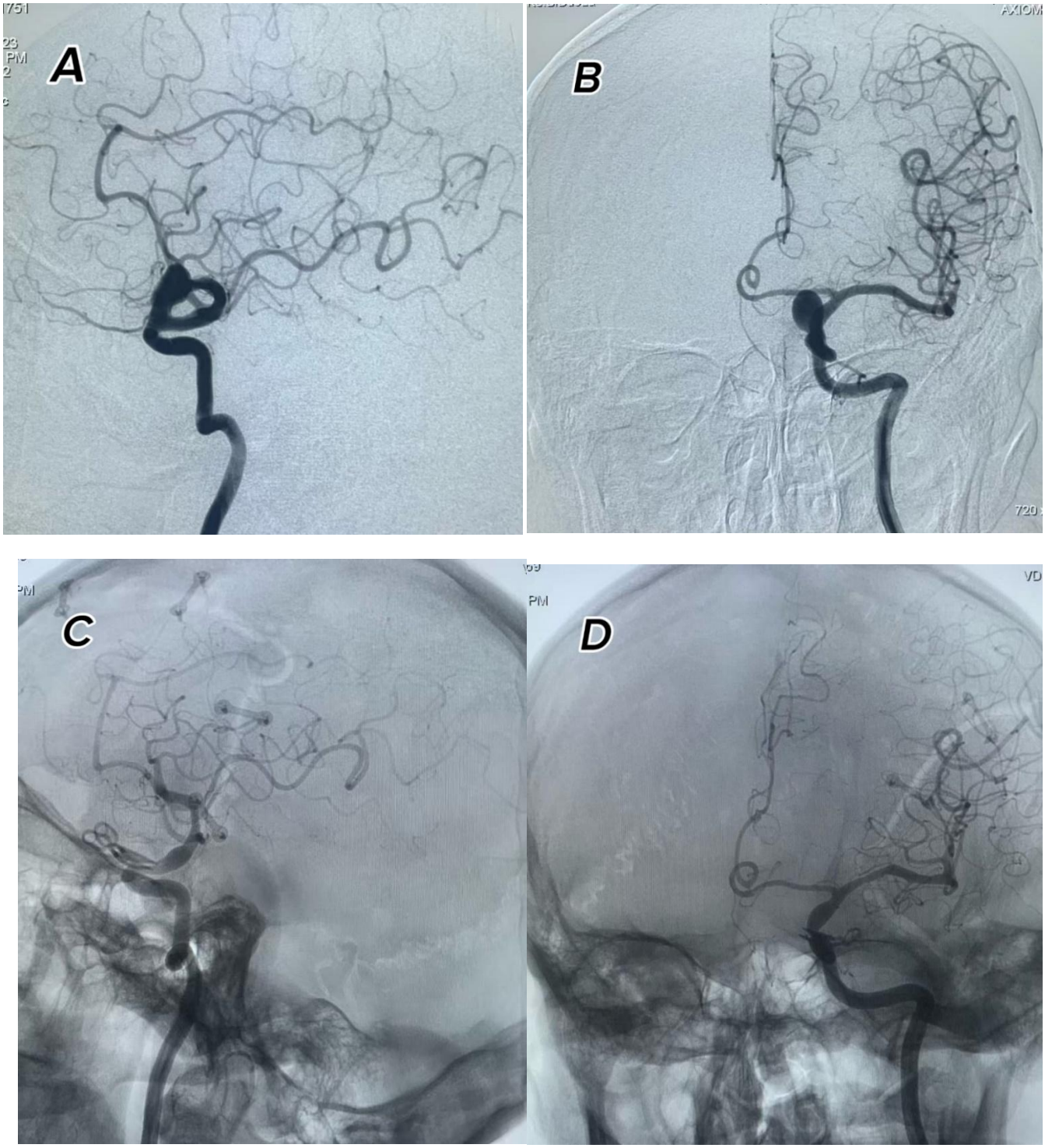


Fig 8. Six-Month Follow-up Cerebral Angiography. (A–D) *Multiple angiographic projections demonstrating durable aneurysm occlusion without residual filling or parent vessel compromise.*

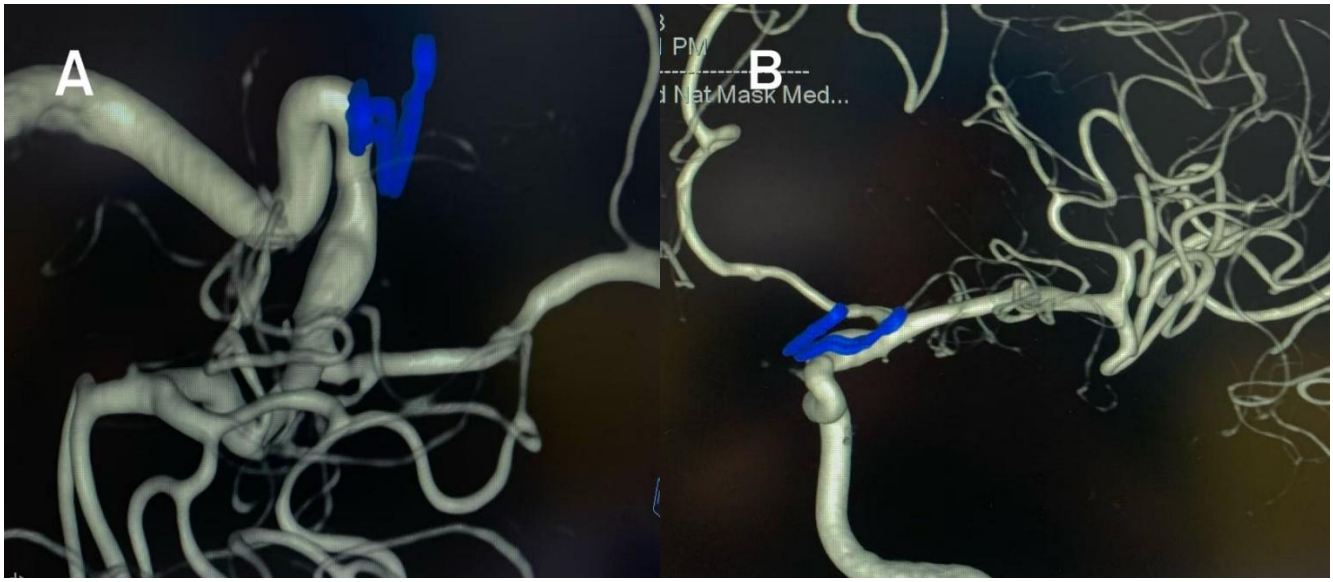


Fig 9. Six-Month Follow-up Digital Subtraction Angiography.
(A,B) *DSA confirming complete aneurysm obliteration with preserved patency of the internal carotid artery and its major intracranial branches after clip reconstruction.*

DISCUSSION

Giant partially thrombosed aneurysms of the ophthalmic segment of the ICA represent a complex subgroup of intracranial aneurysms characterized by progressive mural degeneration, intraluminal thrombosis, and frequent calcification.[14] These pathological features lead to distortion of the parent vessel and adjacent skull base structures, particularly the optic nerve and optic canal, making both diagnosis and surgical management technically challenging.[15]

A major challenge in the management of such lesions is the frequent discordance between DSA and cross-sectional imaging. Although DSA remains the standard modality for evaluating the vascular lumen and parent artery anatomy, it inherently reflects only the patent lumen and may significantly underestimate the true size of partially thrombosed aneurysms.[16–17] In the present case, DSA demonstrated a small residual lumen, whereas CT and MRI revealed the true extent of the lesion, including extensive thrombotic and calcified components.[18–19] This discrepancy is not merely a radiological limitation but has direct implications for operative planning, particularly regarding the extent of skull base exposure and vascular control.[20]

In this context, multimodal imaging plays a critical role in operative planning. CT is essential for defining calcification and bony relationships of the ACP and optic canal, while MRI provides superior delineation of thrombus burden and optic apparatus compression. DSA, despite its limitations, remains indispensable for defining residual flow and parent vessel configuration.[21–22] The combined interpretation of these modalities led to a decision to perform an extended skull base approach with extradural anterior clinoidectomy and optic canal decompression, rather than a limited microsurgical exposure.[23–24] Thus, imaging discordance directly influenced the extent of anterior clinoid removal, the need for cervical proximal control, and the decision to perform staged intraluminal thrombectomy prior to clip reconstruction.[25–26]

Although giant thrombosed aneurysms may demonstrate radiological features resembling skull base tumors, including heterogeneous enhancement and peripheral calcification, this appearance should not be interpreted as diagnostic uncertainty in the modern imaging era.[27] Rather, it reflects advanced mural degeneration with organized thrombus formation.[28] The clinical importance of this phenomenon lies in its potential to obscure the true surgical extent of the lesion, thereby influencing operative planning rather than diagnostic classification.[29]

From a therapeutic perspective, the management of giant ophthalmic segment aneurysms remains controversial. Although flow diversion has become an established endovascular option for paraclinoid aneurysms, its effectiveness is limited in lesions with large thrombus burden, calcification, and significant mass effect.[30–31] Moreover, delayed aneurysm occlusion after flow diversion does not provide immediate decompression of the optic apparatus, and transient or persistent visual deterioration has been reported in selected cases.[32] In contrast, microsurgical reconstruction provides immediate aneurysm exclusion and direct decompression of neural structures, making it particularly suitable for symptomatic giant thrombosed aneurysms.[33–34]

A key technical aspect in the present case was staged intraluminal thrombectomy, which significantly reduced aneurysm volume and facilitated safe visualization of the neck–parent artery interface. This step was critical, as dense thrombus and calcification initially obscured the aneurysm neck.[35] Extradural anterior clinoidectomy and optic canal decompression further improved exposure of the paraclinoid ICA and allowed early optic nerve decompression. Combined cervical and intracranial proximal control enhanced intraoperative safety, particularly in the context of complex morphology and potential rupture risk.[36–37]

A particularly important intraoperative finding was that the true aneurysm dimensions significantly exceeded those predicted by preoperative DSA.[38] This observation reinforces the well-recognized limitation of angiography in giant thrombosed aneurysms and highlights the necessity of integrating cross-sectional imaging into surgical decision-making.[39] Failure to recognize this discordance may result in underestimation of operative complexity and inadequate preparation for skull base exposure, increasing the risk of intraoperative complications.[40–41]

The favorable surgical outcome in this case further supports the value of individualized microsurgical strategy. The combination of staged thrombectomy, skull base decompression, and clip reconstruction achieved both immediate relief of optic apparatus compression and durable exclusion of the aneurysm from the circulation while preserving the parent ICA and ophthalmic artery.[42–43] This integrated approach is particularly relevant in symptomatic patients in whom rapid neurological preservation and decompression are essential.

Although limited by its single-case design, this report emphasizes several clinically important principles. First, DSA alone may underestimate lesion size in giant partially thrombosed aneurysms. Second, multimodal imaging is essential for accurate characterization and surgical planning. Third, imaging discordance should be interpreted as a key determinant of operative strategy rather than a purely descriptive radiological finding. Finally, microsurgical reconstruction remains a definitive and durable treatment option when guided by comprehensive radiological–anatomical correlation.

PATIENT CONSENT

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

ETHICS APPROVAL

This case report was conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. Institutional review board approval was obtained from Xinjiang Medical University for the publication of this case report.

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