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SURGICAL MANAGEMENT OF A SPHENOID WING EN PLAQUE MENINGIOMA WITH SIGNIFICANT INTRAORBITAL EXTENSION VIA FTOZ CRANIOTOMY– A CASE REPORT

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ABSTRACT

Background: Sphenoid wing en plaque meningiomas with intraorbital extension pose a significant surgical challenge due to invasion of the orbital apex and proximity to neurovascular structures. The frontotemporal orbitozygomatic (FTOZ) craniotomy is the standard approach, requiring careful balance between maximal resection and functional preservation.

Case Presentation: A 67-year-old male patient of Indian descent with 3 months of progressive left eye watering and blurred vision. Examination revealed left proptosis and no pupillary defect. MRI revealed a left sphenoid wing en plaque meningioma with significant intraorbital extension and hyperostosis. The patient underwent FTOZ craniotomy with total intracranial and near total intraorbital tumor excision along with ophthal team to preserve the optic nerve.

Results: Histopathology confirmed WHO Grade I transitional meningioma. Postoperatively, the patient had immediate visual loss that improved to counting fingers within one week with steroid therapy. Postoperative CT brain revealed pneumocephalus with postoperative changes and no tumor bed bleed. The patient was discharged neurologically stable.

Conclusion: The FTOZ approach remains crucial for managing these complex sphenoorbital tumors. A "maximal safe resection" strategy that intentionally preserves neural structures while achieving near-total resection can yield excellent functional outcomes. This case report highlights the importance of a multidisciplinary approach for optimal patient care. Longterm followup is essential given the potential for late recurrence.

KEYWORDS: Spheno Orbital Meningioma, FTOZ Craniotomy, Intraorbital Tumor, Functional Preservation, Visual Outcome, Surgical Management.

1.INTRODUCTION

Meningiomas originating from the sphenoid wing represent a formidable challenge in cranial base surgery. Among these, the en plaque variant is a distinct clinicopathological entity characterized by a carpetlike, diffuse growth pattern that infiltrates the dura and induces significant hyperostosis of the underlying bone [1]. A critical and complex progression of this disease is its extension into the orbital cavity, a phenomenon that creates a dual component lesion: an intracranial meningioma and a secondary intraorbital tumor [2]. This direct invasion into the orbit is responsible for the classic clinical presentation, which includes progressive, painless proptosis and visual deterioration due to mass effect on the orbital contents and the optic nerve [3]. The intimate relationship between the tumor and these delicate structures at the orbital apex dictates the surgical strategy and defines the risk profile of the intervention [4]. The Frontotemporal Orbitozygomatic craniotomy is the established surgical workhorse for managing these lesions. This approach provides a versatile and expansive corridor that is essential for addressing both the intracranial tumor along the sphenoid wing and its intraorbital extension through a single procedure [5]. Incorporating the orbital rim and zygoma, it facilitates a multiangled trajectory that minimizes brain retraction and offers critical access to the orbital apex and cavernous sinus region [6]. The most critical intraoperative decision often involves managing a tumor that is tenaciously adherent to the optic nerve. In this context, the principle of functional preservation must supersede radical resection; a deliberate near-total excision in the orbital apex is a justified strategy to prevent iatrogenic blindness [7].

2. CASE PRESENTATION

A 67-year-old male patient of Indian descent with no significant past medical history presented to the neurosurgical outpatient department with a three-month history of progressive, painless protrusion of the eyeball and decreased vision in the left eye. On general physical examination, the patient had been conscious, oriented, and hemodynamically stable, with a blood pressure

of 130/80 mmHg, a heart rate of 86 beats per minute, and no fever, while showing no signs of respiratory distress or systemic illness. Focused local and neurological examination had revealed a left-sided, non-pulsatile proptosis measuring 3mm on Hertel exophthalmometry. Palpation of the orbital rim and periorbital region had identified mild, nontender periorbital fullness without local warmth, erythema, or a palpable thrill. Cranial nerve assessment had confirmed a definitive positive relative afferent pupillary defect with no perception of light in the left eye. Extraocular movements had been full in all cardinal gazes. Examination of the left eye had revealed mild conjunctival injection but clear corneas, normal anterior chamber depth, and, on fundoscopic examination, optic disc pallor on the left side had been noted. The rest of the cranial nerve examination, including facial sensation, motor function of cranial nerves V and VII, and hearing, had been unremarkable. Motor system examination had demonstrated normal tone and full strength in all four limbs, with intact coordination and gait. Sensory examination to light touch, pinprick, and proprioception had been normal throughout. No meningeal signs had been present. A schematic illustration of clinical presentation, diagnostic workup, management, and outcome shown in (fig 1).

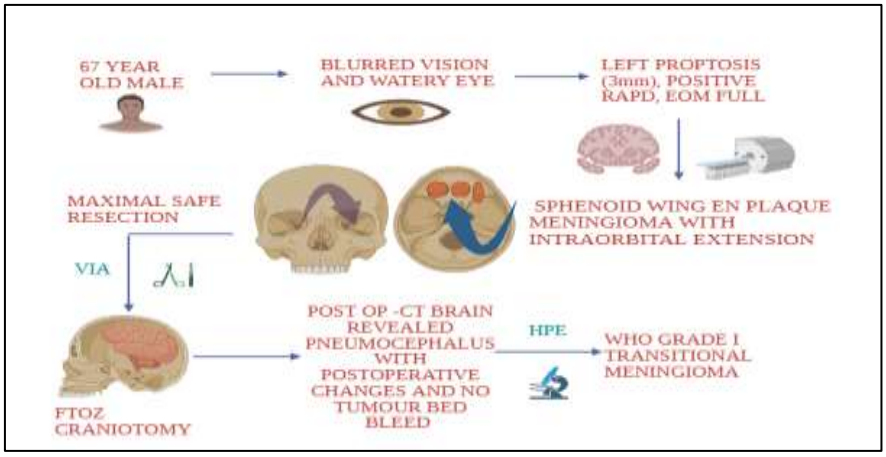

Fig 1. A schematic illustration of clinical presentation, diagnostic workup, management, and outcome.

Before surgical intervention, the patient had undergone a comprehensive evaluation by specialist departments to ensure fitness for a major skull base procedure. A cardiology evaluation had been obtained regarding cardiac fitness for surgery, and the patient had been cleared with no contraindications to anesthesia. Ophthalmology consultation had been secured to document baseline visual status and plan for intraoperative collaboration, resulting in a joint surgical plan with the neurosurgery team. Diagnostic imaging, including Magnetic Resonance Imaging of the Brain with Contrast performed on 18/09/25, had demonstrated a diffuse, enhancing lesion involving the left sphenoid wing with characteristic hyperostosis, extending into the left orbital apex, findings typical of an en plaque sphenoorbital meningioma. A subsequent Computed Tomography scan of the Brain Plain from 02/11/25 had provided critical bony detail, confirming hyperostosis of the greater wing of the left sphenoid bone and precisely localizing a softtissue density lesion measuring 1.7 × 1.9 × 2.3 cm in the posterosuperior extraconal space of the left orbit, where it had abutted the superior surface of the lateral rectus muscle, the inferolateral surface of the superior rectus muscle, and the optic nerve medially. All preoperative laboratory investigations, including a euthyroid profile, had been within normal limits. Preoperative contrast-enhanced MRI further delineated the tumor soft-

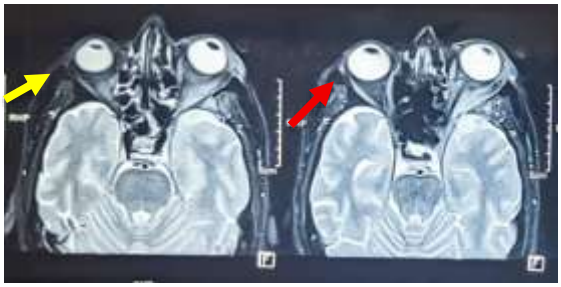

Fig 2. The yellow arrow indicates the sphenoid tumor and red arrow shows the intraorbital tumor.

The axial and coronal T1-weighted contrast-enhanced magnetic resonance images demonstrate a diffuse, enhancing en plaque meningioma involving the left sphenoid wing with marked hyperostosis and significant extension into the left orbital apex, compressing the optic nerve medially. After multidisciplinary evaluation and surgical clearance, the patient had been scheduled for a left frontotemporal orbitozygomatic craniotomy, a specialized skull base approach designed to provide a wide, multiangled surgical corridor. This FTOZ procedure involved a single-piece orbitozygomatic osteotomy, wherein the orbital rim, zygomatic arch, and a portion of the sphenoid wing were removed en bloc following a frontotemporal craniotomy. This maneuver effectively removed the lateral and superior bony barriers of the orbit and middle fossa, creating a shallow surgical

trajectory that minimized brain retraction and provided simultaneous, unobstructed access to the anterior and middle cranial fossae, the orbital contents, and the cavernous sinus region critical for addressing both the intracranial sphenoid wing tumor and its intraorbital extension through a single exposure. The Intraoperative photograph shows the completed FTOZ craniotomy exposure, illustrating the wide surgical corridor to the sphenoid wing and orbital apex (Fig 3).

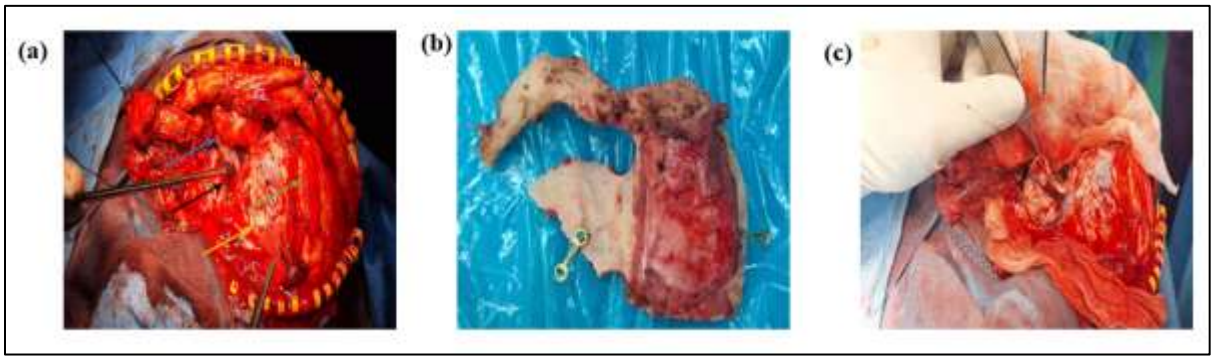

Fig 3. (A) Single-piece FTOZ, where the blue arrow represents the eyeball, the green arrow shows the temporal bone, the black arrow shows the sphenoid ridge, and the yellow arrow shows the frontal bone, **(B)** Eyeball with periorbital fat, sphenoid ridge, frontal, and temporal dura, and **(C)** En plaque Meningioma after opening the duramater.

This report elucidates the surgical management of a patient with a left sphenoid wing en plaque meningioma and a significant intraorbital tumor component. The focus is placed on the technical execution of the FTOZ craniotomy, the intraoperative decision-making process that balanced oncological radicality with functional preservation, and the comprehensive management of significant postoperative complications.

3. POST OPERATIVE COMPLICATIONS

This surgical intervention yielded a multifaceted outcome, defined by a significant postoperative complication, a subsequent recovery phase that demonstrated neurological resilience, and definitive histopathological confirmation. In the immediate postoperative period, the patient manifested two primary complications. First, a profound and immediate deterioration in visual function had been observed, with the left eye demonstrating no perception of light upon emergence from anesthesia, which indicated significant compromise at the level of the optic nerve or its vascular supply. Second, a postoperative computed tomography scan of the brain, acquired on 04/11/25, had revealed a substantial volume of intracranial air, or pneumocephalus, localized predominantly within the left frontal convexity.

The patient had a remarkable recovery in the post-operative period, with perception of light from the second post-operative period itself. Post- op scan was satisfactory without any tumor bed bleed. The patient was managed with steroids, antibiotics, and serial ophthalmic evaluation. This air collection had tracked posteriorly into the interhemispheric fissure and had been quantified as causing a mass effect sufficient to displace the midline cerebral structures by 4.5 mm towards the right hemisphere, a condition known as tension pneumocephalus that carries inherent risks of cerebral ischemia and neurological decline. In response, a rigorous, multimodal conservative management protocol was immediately implemented within the neurosurgical intensive care unit. The cornerstone of this management had been the administration of a high-dose intravenous corticosteroid regimen, dexamethasone initiated at a loading dose and meticulously tapered over fourteen-days to aggressively reduce perilesional cerebral edema and, critically, inflammation surrounding the surgically manipulated optic nerve. This had been synergistically combined with intravenous levetiracetam for prophylactic control of potential post-craniotomy seizures, a course of broad-spectrum intravenous antibiotics to mitigate infection risk in a surgical field exposed to the paranasal sinuses, and a structured multimodal analgesic plan to ensure patient comfort without obscuring the neurological exam. The patient's neurological status, with particular emphasis on visual acuity, pupillary reflexes, and limb strength, had been serially assessed every four hours, while daily formal Snellen chart and confrontational visual field evaluations had been conducted by the ophthalmology team. The initial state of no light perception had begun to recede within 48 hours, evolving first to perception of hand movements, and subsequently to the accurate counting of fingers held at a distance of one foot by postoperative day seven, which represented a substantial, though incomplete, recovery of functional vision. The final and definitive diagnostic cornerstone had been provided by histopathological examination of the resected tumor specimen. Microscopic analysis had confirmed the diagnosis of a Transitional Meningioma, World Health Organization Grade I. The histology had been characterized by classic syncytial whorls of uniform epithelioid cells with oval nuclei, interspersed with collagen bundles. Immunohistochemical staining had yielded strong, diffuse positivity for epithelial membrane antigen and vimentin, supporting the meningothelial origin as shown in (Fig 4).

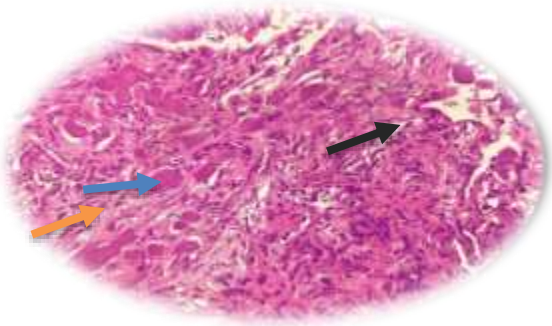

Figure 4. represented as, Whorled pattern of cells (Blue arrow), psammoma bodies (Green arrow), Syntical growth pattern of meningioendothelilal cells (yellow arrow), forming sheets of closely packed cells with indistinct cell borders.

A prominent whorled pattern is observed, characterized by concentric arrangements of tumor cells. Additionally, Psammoma bodies are present, seen as round concentrically laminated calcified structures. By postoperative day four, the patient had achieved a state of neurological stability. He had been fully alert and oriented, ambulating independently without assistance, and his left eye had exhibited a full range of extraocular motility. While a persistent relative afferent pupillary defect had indicated residual optic nerve dysfunction, his corrected visual acuity had stabilized at counting fingers at one foot. He had been subsequently discharged from inpatient care with a comprehensive plan for close outpatient follow-up with both neurosurgery and neuro ophthalmology, and instructions to complete the tapering oral steroid course. This clinical course, from complex presentation to functional recovery, substantiated the efficacy of the FTOZ approach for maximal safe resection and highlighted the critical importance of a multidisciplinary approach and a vigilant postoperative management in optimizing outcomes following high complexity skull base surgery.

4. DISCUSSION

The management of sphenoid wing en plaque meningiomas with intraorbital extension has represented one of the most intricate challenges in contemporary skull base surgery. The Centrality of the FTOZ Approach in Modern Skull Base Surgery, the frontotemporal orbitozygomatic craniotomy has firmly established itself as the gold standard approach for accessing lesions involving both the sphenoid wing and orbital apex. In this case, the FTOZ approach had been indispensable for achieving the surgical objectives [7]. By incorporating the orbital rim and zygoma into the craniotomy, the procedure provided the multiangled trajectory necessary to address two anatomically distinct but pathologically connected compartments: the intracranial component along the sphenoid wing and the intraorbital extension within the posterosuperior orbit [8].

The Maximal Safe Resection Paradigm: Balancing Oncological and Functional Outcomes, the intraoperative decision-making process in this case had centered on one critical anatomical relationship: the tumor's dense adherence to the optic nerve sheath at the orbital apex. This had presented a classic neurosurgical dilemma where the pursuit of radical oncological resection had directly conflicted with the imperative of functional preservation [9]. The decision to perform a neartotal excision, intentionally leaving a small tumor fragment adherent to the nerve, had embodied the contemporary principle of "maximal safe resection". This philosophy had prioritized neurological function and quality of life, particularly when dealing with benign or tumors like WHO Grade I meningiomas [10]. This outcome had aligned with emerging literature suggesting that functional preservation, even at the expense of radiographic total resection, yields superior long-term quality of life in patients with skull base meningiomas [11].

Pathophysiological Considerations in Postoperative Visual Recovery, the patient's dramatic visual recovery warranted specific consideration of the underlying pathophysiological mechanisms. The immediate postoperative visual loss had likely resulted from a combination of surgical manipulation, perineural edema, and transient vascular compromise to the optic nerve microvasculature [12]. The rapid improvement following corticosteroid administration had supported the hypothesis that reversible inflammatory and compressive factors had predominated over permanent structural damage. This finding had reinforced the importance of aggressive steroid management in the perioperative period for skull base surgeries involving the optic apparatus, as steroids effectively reduce edema and potentially mitigate ischemic injury through anti-inflammatory and membrane-stabilizing effects [13].

Postoperative Complication Management: Conservative Versus Surgical Intervention, the development of significant pneumocephalus with mass effect has represented a well-recognized complication following extensive skull base procedures, particularly those involving exposure of air sinuses or creation of large intracranial dead space. The management of this complication had illustrated an important principle in postoperative care: the distinction between radiographic significance and clinical urgency [14]. Despite the concerning 4.5 mm midline shift on imaging, the patient had remained clinically stable without neurological deterioration beyond the expected visual deficit. This stability had permitted successful conservative management with serial imaging and close neurological monitoring, avoiding the risks associated with additional surgical interventions such as ventriculostomy or reexploration. The complete resolution of pneumocephalus within one week demonstrated that even substantial postoperative air collections could be managed nonoperatively in carefully selected patients, provided they were closely monitored in an appropriate critical care setting [15]. This comprehensive approach had

extended beyond mere preoperative clearance; it had represented an integrated care model where each specialty contributed uniquely to the patient's overall management strategy. The value of this model had been particularly evident in the postoperative period, where joint management between neurosurgery and ophthalmology had facilitated optimal visual monitoring and timely.

5. CONCLUSION

This case reaffirms the FTOZ craniotomy as the definitive approach for complex sphenoid wing meningiomas with orbital invasion. This strategy, prioritizing optic nerve preservation over radical excision, was validated by significant postoperative visual recovery. This outcome underscores the critical role of multidisciplinary planning and protocol-driven postoperative care. Mastery of advanced surgical techniques, combined with judicious intraoperative judgment, remains paramount in skull base surgery. Functional preservation and quality of life must guide surgical decisions in eloquent neuroanatomical regions. This report contributes to the evolving paradigm where anatomical conquest is balanced with neurological stewardship.

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Authors' contributions

Mohamed Jaavidh Abdulgani: Writing the original draft, Methodology & Investigation, **Sri Rahul PG:** Formal analysis & Data curation, **Jeyaselva Senthil kumar TP:** Conceptualization, **Kalaivani Amitkumar:** pathology Investigation, **Nivetha U:** Formal analysis & Data curation, **Manojkumar Perumal:** Manuscript review & editing, and **Mohamed Naleer:** Supervision & Project administration.

Availability of data and materials

Not Applicable

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Ethics approval and consent to participate

This study was approved by the Institutional Ethics Committee of SRM Medical College Hospital & Research Centre [ ]. Written informed consent was obtained from the patient for participation in this study.

Consent for publication

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.

Conflict of interest

The authors declare that they have not received any financial support for the conduct of this research or the preparation of this manuscript. Furthermore, there are no conflicts of interest to disclose by any of the authors. In this study, Artificial General Intelligence (AGI) has been utilized to enhance the readability of the paper.

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