



## Case Report

# Oscillopsia following orbitotomy for intracranial tumor resection

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## ABSTRACT

**Background:** Oscillopsia is a visual phenomenon in which an individual perceives that their environment is moving when it is in fact stationary. In this report, we describe two patients with pulsatile oscillopsia following orbitocranial approaches for skull base meningioma resection.

**Case Description:** Two patients, both 42-year-old women, underwent orbitocranial approaches for resection of a right sphenoid wing (Patient 1) and left cavernous sinus (Patient 2) meningioma. Patient 1 underwent uncomplicated resection and was discharged home without neurologic or visual complaints; she presented 8 days later with pulsatile oscillopsia. This was managed expectantly, and MRA revealed no evidence of vascular pathology. She has not required intervention as of most recent follow-up. Patient 2 developed trochlear and trigeminal nerve palsies following resection and developed pulsatile oscillopsia 4 months postoperatively. After patching and corrective lens application, the patient's symptoms had improved by 26 months postoperatively.

**Conclusion:** Oscillopsia is a potential complication following skull base tumor resection about which patients should be aware. Patients may improve with conservative management alone, although the literature describes repair of orbital defects for ocular pulsations in traumatic and with some developmental conditions.

**Keywords:** Meningioma, Orbital osteotomy, Orbitocranial, Orbitopterional, Oscillopsia, Skull base tumors

## INTRODUCTION

Oscillopsia is a visual phenomenon in which an individual perceives that the stationary environment is moving.<sup>[2,26]</sup> This can be caused by loss of the vestibulo-ocular reflex or instability of the extraocular muscles, leading to rapid shifts of images across the retinal surface.<sup>[2,26]</sup> It is a disabling condition associated with decrements in visual acuity, postural instability, and vertigo.<sup>[23,26]</sup> Oscillopsia may occur as a sequela of meningitis or traumatic brain injury.<sup>[2]</sup> In this report, we detail the development of oscillopsia after craniotomy for resection of anterior skull base meningiomas in two patients.

## CASE DESCRIPTIONS

### Patient #1

A 42-year-old woman with no significant medical history presented to an outside facility with progressive right eye proptosis and diplopia on the left gaze over 2 years. An MRI demonstrated a

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right sphenoid wing mass with extension into the temporalis muscle and orbit. She was found to have normal visual acuity, no evidence of optic neuropathy, restricted right ocular motility, and proptosis on the right of 5 mm compared to her left eye. She was fully oriented with intact cranial nerves, normal ocular alignment, motor, and sensory function throughout. Gait was normal. She underwent a right orbitocranial approach for resection of the mass, requiring complete removal of the greater wing of the sphenoid and the lesser wing lateral to the anterior clinoid process. Her postoperative course was unremarkable and she was discharged home on postoperative day 4. Postoperative MRI demonstrated gross total resection of the mass and a superior orbital wall defect [Figure 1]; pathology was consistent with a WHO Grade I meningioma. She followed up in clinic on postoperative day 8 complaining of diplopia when both eyes were open, which was treated with patching. On ophthalmologic evaluation, she was noted to have oscillopsia related to orbital pulsations synchronous with her cardiac cycle. She underwent magnetic resonance angiography, which was negative for carotid-cavernous fistula. At the last follow-up 21 months postoperatively, the patient continues to experience pulse synchronous oscillopsia.

#### Patient #2

A 42-year-old woman with hypothyroidism presented to our clinic with several months of lip and tongue tingling. MRI revealed an anterior skull base meningioma with extension into the left cavernous sinus. She did not undergo ophthalmologic evaluation preoperatively, as she did not have any visual complaints. She underwent a left one-piece orbitopterional craniotomy with complete removal of the sphenoid wing and lateral orbital wall and partial resection of the superior orbital wall and was brought thereafter to the



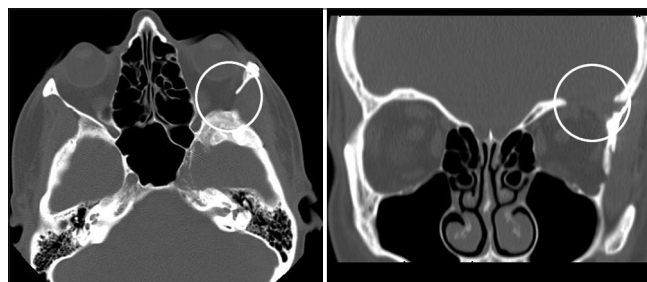
**Figure 1:** Coronal section of a postoperative T2-weighted MRI brain demonstrating a defect in the right superior orbital wall (encircled).

Neuro ICU, where she was found to have a left trochlear nerve palsy, resulting in double vision, and hypoesthesia in CN V2-V3 distribution. Her postoperative course was complicated by seizures, requiring treatment with levetiracetam for 6 months. She was discharged home on postoperative day 4. At her initial postoperative visit, her diplopia had improved, and on ophthalmologic evaluation 4 months later, she was found to have oscillopsia related to orbital pulsations synchronous with her cardiac cycle [Video 1]. A CT scan of the orbits demonstrated postsurgical defects in the superior and lateral orbital walls [Figure 2]. The patient was enrolled in school, and this prevented her from being able to read. At the last follow-up, 26 months after surgery, the patient's oscillopsia had resolved and her residual diplopia was amenable to corrective lenses with prism.

#### DISCUSSION

Orbitocranial approaches are a critical part of the armamentarium for skull base surgeons to provide access to lesions involving the parasellar region, cavernous sinus, anterior and middle fossa floors, and the orbital apex. These approaches can be tailored to the lesion through various modifications, including the one-piece, two-piece, and supraorbital variations.<sup>[1,3,10,21]</sup> Oscillopsia is a potentially debilitating postoperative complication. Surgeons considering approaches to skull base tumors which include orbital or sphenoid osteotomy should be aware of this counsel their patients accordingly. Our second patient was not able to read for school and had to temporarily withdraw until her symptoms eventually resolved.

While oscillopsia is often observed in patients with vestibular damage, the primary mechanism of retinal slip in our patients is a mechanical oscillopsia for which the vestibulo-ocular reflex cannot compensate.<sup>[26]</sup> Oscillopsia has been described in other conditions which result in violation of the walls of the orbit. Masticatory oscillopsia has been reported in up to a third of patients following orbital decompression resulting from transmission of temporalis contractions to the globe through the resultant orbital defect.<sup>[6,17]</sup> Patients who undergo traumatic orbital



**Figure 2:** Axial (left) and coronal (right) sections of a postoperative CT head demonstrating defects in the lateral and superior orbital walls (encircled).

wall fracture may develop orbital meningoencephalocele and experience ocular pulsation.<sup>[7]</sup> Particularly salient to the cases described above, Mettu *et al.* described two cases of tumor-related oscillopsia. One patient had undergone frontotemporal-orbitozygomatic craniotomy for sphenoid wing meningioma resection and later presented with masticatory oscillopsia; the other had a tumor causing bony erosion causing communication between the temporal fossa and the orbit, leading to masticatory oscillopsia.<sup>[13]</sup> Emerick *et al.* described pulsatile exophthalmos in a patient with an intraorbital dermoid cyst invading through the lateral wall of the orbit.<sup>[5]</sup> Saito *et al.* described that pulsatile exophthalmos has also been described in middle fossa arachnoid cysts causing orbital compression.<sup>[20]</sup> Nguyen *et al.* described a patient with pulsatile exophthalmos due to a spontaneous middle fossa pseudomeningocele.<sup>[14]</sup> Talacchi *et al.* described a patient undergoing sphenoid-orbital meningioma resection who developed pulsatory exophthalmos postoperatively.<sup>[25]</sup> Some neurofibromatosis type 1 patients with sphenoid wing dysplasia may present with pulsatile exophthalmos and proptosis.<sup>[12,15,18]</sup>

One of the patients in our study had spontaneous resolution of her oscillopsia. A similar course was observed by Fayers *et al.* following lateral orbital decompression.<sup>[6]</sup> The exact mechanisms for this resolution are unclear. One possibility is the formation of scar tissue separating the orbital contents from the intracranial contents may act as a barrier, preventing the transmission of intracranial pulsations to the orbit. Ha *et al.* described surgical repair of orbital blow-in fractures with resultant orbital encephalocele and progressive pulsatile exophthalmos.<sup>[7]</sup> While patients with sphenoid wing dysplasia may be managed surgically to address communication between CSF and orbital spaces, to our knowledge, no report of such management in patients with oscillopsia following tumor resection exists. While neither patient in our report required operative intervention for their oscillopsia, surgical management could be required in patients for whom symptoms are persistent or incapacitating or if neurologic function is compromised.<sup>[7]</sup>

The extent of bony work is an important consideration in orbital osteotomy. It is generally accepted that at least a third of the orbital roof and lateral wall should be preserved to avoid postoperative pulsatile enophthalmos.<sup>[11]</sup> DeMonte *et al.* found that resection of more than two-thirds of two or more orbital walls was associated with an increased rate of postoperative ocular complications, including enophthalmos, exophthalmos, and ectropion.<sup>[4]</sup> Preservation of at least two-thirds of the lateral orbital wall has been associated with low rates of postoperative pulsatile enophthalmos, while higher rates have been seen with radical sphenoid wing resection.<sup>[22,24]</sup> Thus, the degree of osteotomy undertaken in turning an orbitozygomatic craniotomy should likely include only what is absolutely necessary to avoid ocular complications.

While considered unnecessary by some authors, the practice of intraoperative orbital reconstruction to avoid postoperative enophthalmos and oscillopsia and to minimize cosmetic defects in patients with sphenoid wing or sphenoid-orbital meningioma has been described and is associated with good outcomes.<sup>[8,16,19]</sup> Pace *et al.* described a series of 20 patients with sphenoid-orbital meningioma who underwent orbital reconstruction during resection; none of these patients developed postoperative oscillopsia.<sup>[16]</sup> Leake *et al.* reported no cases of postoperative ocular pulsations following orbital reconstruction after sphenoid wing meningioma resection.<sup>[9]</sup> However, no randomized or controlled data exist regarding the utility of orbital reconstruction exists, however, and the reconstruction itself may prolong surgery and lead to further complications like ocular adherence to the implant.<sup>[16,25]</sup> Given how debilitating oscillopsia can be, it seems prudent that the decision to remove the orbital wall should not be taken lightly. In cases where it is necessary, orbital reconstruction should be considered.

## CONCLUSION

Oscillopsia is the visual perception of movement of a stationary visual field; it may occur due to vestibular dysfunction, neurovascular compression, or mechanical pressure on the orbit itself. Pulsatile oscillopsia is a rare, but debilitating complication following orbital osteotomy for intracranial mass resection. This should be taken into consideration when deciding whether or not to remove the orbit. If orbital osteotomy is necessary, then patients should be counseled appropriately. While symptoms may resolve spontaneously, reconstruction of orbital defects during tumor resection may help prevent the development of this condition.

## DECLARATIONS

### Ethics approval and consent to participate

No ethics committee approval for this retrospective study.

### Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analyzed during this study.

### Authors' contributions

Dr. Goethe primarily drafted the article and obtained data from patient records. Drs. Hartford and Foroozan helped critically revise the article. Dr. Patel critically revised the article, supervised its submission, and approved the final draft.

## Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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