



OPHTHALMOLOGY
ON CALL

April 2023

*George Washington University
Department of Ophthalmology*

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Introduction

GW Ophthalmology On Call is a monthly case report publication presented by medical students and residents at the GW Department of Ophthalmology. The purpose of this publication series is to highlight educational content seen at the GW Department of Ophthalmology. This content is for teaching purposes only and should not be used to guide treatment. All case presentations have been written in accordance with HIPAA guidelines. Case details have been modified for patient privacy purposes.

Orbital Trauma

Madeline Rocks (MS1), Abood Salman (MS1), Braedon Murdock MD, Keith Wroblewski MD

Chief Complaint

Left eye swelling and bruising

History of Present Illness

A 25-year-old male, with an unremarkable medical history, was transferred from an outside hospital after suffering a BB gun shot to his left eye the preceding day. The patient recounted that he was standing approximately 10 feet from the BB gun. Immediately following the incident, he observed swelling and bleeding in his upper eyelid. He did not experience any alterations to his visual acuity. He denied flashes, floaters, diplopia, photophobia or ocular irritation.

At the outside hospital, he received a single dose of IV antibiotics (ampicillin / sulbactam) and was subsequently transferred for ophthalmic evaluation. He denied vision changes but reported left eye swelling and bruising. A Computed tomography (CT) scan revealed a 5 mm foreign body located at the superior medial aspect of the left orbit, approximately 9 mm from the surface of the upper eyelid. There was no evidence of an injury to the globe. Tetanus vaccinations were up to date.

Ocular History

None

Past Medical History

None

Medications

None

Allergies

No known allergies

Family History

None

Social History

No relevant social history reported

Review of Systems

All other systems intact

Ocular Exam

Physical Exam		
	OD	OS
Visual Acuity	20/20	20/20
Intraocular Pressure (mmHg)	11	10
Pupils	Round and reactive	Round and reactive
Extraocular Motility	EOMI	EOMI

Slit Lamp Exam		
	OD	OS
External	Unremarkable	Scabbed entry wound under eyebrow cilia in medial limbal distribution directly below superior orbital rim. 1+ soft tissue edema and ecchymosis of the upper eyelid.
Lids and Lashes	Normal, no lesions	Normal, no lesions
Conjunctiva/Sclera	White and quiet	White and quiet
Cornea	Clear	Clear
Anterior chamber	Deep and quiet	Deep and quiet
Iris	Round and reactive	Round and reactive
Lens	Clear	Clear

Dilated Fundus Exam		
	OD	OS
Cup to Disc	0.7	0.7
Optic Nerve	Normal	Normal
Vessels	Normal caliber and course	Normal caliber and course
Macula	Normal	Normal
Periphery	Attached 360 degrees w/no RT/RD noted	Attached 360 degrees w/no RT/RD noted. Small <1DD area of commotio retinae superonasally. No elevation/rupture/heme
Vitreous	Clear	Clear

Imaging

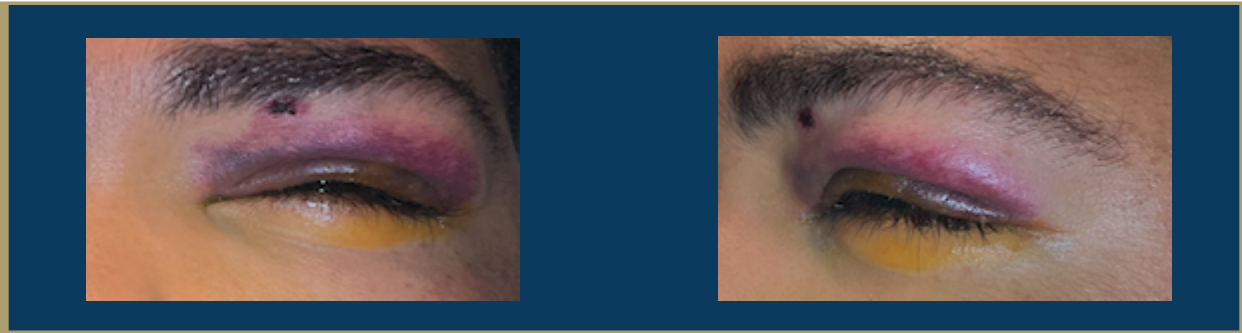


Figure 1: Emergency Department photograph of patient's left eye revealing scabbed entry wound under eye brow cilia directly below superior orbital rim.

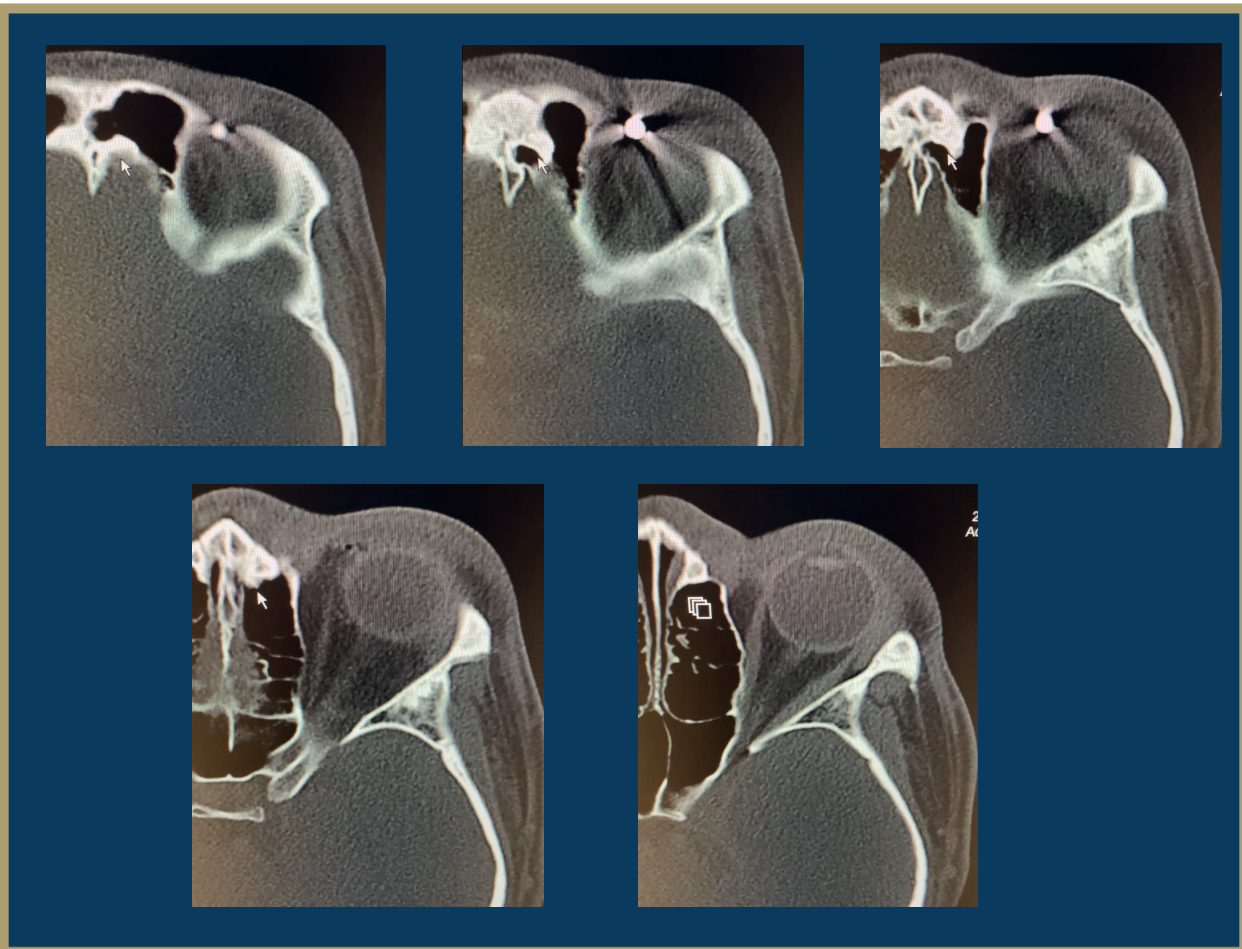


Figure 2: Non-contrast CT scan of the orbit revealing a 5 mm metallic foreign object located in the superomedial left orbit, approximately 9 mm from the surface of the upper eyelid. Concurrent edema of the left periorbital region. No discernible injury to the extraocular muscles or evidence of bony fractures.

Differential Diagnosis

Left intraorbital metallic foreign body
Left intraocular metallic foreign body
Globe rupture
Orbital fracture

Clinical Course

A 25-year-old male patient with no past medical history presented one day following trauma to the left eye after being shot by a gas-powered airsoft gun from 10 feet away with a metal BB. A CT scan revealed a 5 mm foreign object located at the superomedial aspect of the patient's left orbit, approximately 9 mm from the surface of the upper eyelid. His visual function remained intact and there was no demonstrable evidence of an injury to the globe. The patient was prescribed a ten day course of Augmentin and erythromycin 0.5% ointment applied to the entry wound four times daily. The foreign body was ultimately removed without complications

Discussion

An orbital foreign body can be defined as any extraneous object, either wholly or partially, occupying the orbital space. A comprehensive incidence study involving eye injuries treated in American Emergency Departments ascertained that foreign bodies were the leading causative agents, attributing to 44.3% of all cases.¹ The foreign object may be present with or without globe penetration or perforation. Furthermore, the orbital foreign body can be categorized as either purely orbital or transorbital.

Injury to the orbital region due to foreign bodies is most commonly traumatic; however, instances of iatrogenic injuries have been documented, especially as a result of surgical orbital implants. A history of trauma, encompassing sport-related incidents, violence, battlefield injuries, or industrial accidents, is a significant risk factor for the occurrence of orbital foreign bodies. Studies also suggest a higher prevalence of these injuries among younger men.²⁻⁸

Consistent with our patient's case, ocular trauma primarily affects males, with a male-to-female ratio reported at approximately 6:1.⁴ The mean age of patients with ocular trauma varies, though one study reported it to be 36.0 ± 20.0 years.⁴ Most ocular injuries occur at home or within the workplace, with metal, glass, explosions, and intraocular foreign bodies being the common causes. It is estimated that about one-third of all ocular injuries could be preventable, with domestic accidents and children being the primary contributors.⁸

Factors associated with poor visual outcomes in ocular trauma cases include female gender, advanced age, specific injury types (e.g., zone III injury, eyelid injury), and the presence of intraocular foreign bodies.⁴ Post open globe injury repair, potential complications such as wound leak and endophthalmitis have been identified. Factors such as stellate-shaped wounds and delayed presentation contributed to wound leaks, while delayed presentation, microbial keratitis, and lens capsule breach were associated with an increased risk of endophthalmitis.

Maxillofacial computed tomography (CT) scan is the preferred imaging modality for evaluating and diagnosing intraocular foreign bodies.¹² It's crucial to remember that while CT scans can help assess the presence of globe rupture, they should be seen as a supplement to an ophthalmic evaluation rather than a replacement for a physical exam.¹³ In situations like our present case where there's ferromagnetic ocular trauma, MRI is firmly contraindicated. Similarly, ultrasound is generally not employed to assess globe rupture due to concerns that direct pressure on the globe could exacerbate the injury.¹¹ It should be noted that in select cases, ophthalmologists may elect to carefully perform ultrasonography without compressing the globe to complete the exam in a suspected globe rupture.

The decision to surgically remove intraorbital foreign bodies is driven by several considerations. The presence of a large or sharp-edged foreign body, indicative of potential further harm, necessitates removal. Signs of infection or inflammation, such as endophthalmitis, call for surgical intervention to manage the infection. Conditions like proptosis, restricted eye movement, chemosis, palpable orbital mass, and optic nerve compression are also strong indications for surgical removal. If imaging reveals an abscess or an enhancing foreign body, surgery becomes a requirement. Foreign bodies composed of wood, vegetable matter, or copper, given their higher risk of complications, should be removed. Fistula formation also mandates surgical intervention. These indications serve as guiding principles when deciding on the removal of intraorbital foreign bodies, although each case should be evaluated individually considering the patient's condition and the healthcare providers' expertise.¹

The final visual outcome is prognosticated by the presenting visual acuity.^{11,14} Several other factors, including longer wound length, relative afferent pupillary defect vitreous prolapse, vitreous hemorrhage, posterior globe involvement, retinal detachment, endophthalmitis, and hyphema, have been associated with poorer post-injury visual acuity.¹⁵⁻¹⁸ Ophthalmologists treating a patient with severe ocular trauma can utilize the Ocular Trauma Score (OTS) to predict the prognosis of their post-injury visual acuity. The OTS scores range from 1 (most severe) to 5 (least severe) and take into account the factors mentioned earlier, with the initial (raw) score originating from the patient's presenting visual acuity.¹⁹

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Persistent Pupillary Membrane

Alain Greenwald (MS1), Siddhanth Iyer (MS1), Masumi Asahi DO, Keith Wroblewski MD

Chief Complaint

Bilateral blurry vision

History of Present Illness

A 35 year-old male presented to the ophthalmology clinic with progressive worsening of his blurry vision for the past year. The patient reported experiencing sensitivity to bright lights and difficulty driving at night. However, he denied any ocular pain and only endorsed experiencing mild itching in both eyes. The patient reported no recent episodes of new flashes or floaters in his visual field.

Ocular History

None

Pertinent Past Medical History

None

Medications

None

Allergies

No known drug allergies

Family History

None

Social History

No relevant social history reported.

Review of Systems

Noted in HPI, otherwise negative

Ocular Exam

Physical Exam		
	OD	OS
Visual Acuity at Presentation	20/30-1	20/40
Refraction	Plano + 0.75 x0.90	+1.00 +0.50 x120
BCVA	20/30	20/25-1
Intraocular Pressure (mmHg)	22	21
Pupils	Round and reactive	Round and reactive
Extraocular Motility	EOMI	EOMI

Slit Lamp Exam		
	OD	OS
External	Unremarkable	Unremarkable
Lids and Lashes	Normal, no lesions	Normal, no lesions
Conjunctiva/Sclera	White and quiet	White and quiet
Cornea	Clear	Clear
Anterior chamber	Deep and quiet	Deep and quiet
Iris	Round and reactive, perilimbal nodules	Round and reactive, lattice-like iris changes 6-11 o'clock
Lens	Clear	Clear

Dilated Fundus Exam		
	OD	OS
Cup to Disc	0.3	0.3
Optic Nerve	sharp disc	sharp disc
Vessels	Normal caliber and course	Normal caliber and course
Macula	Normal	Normal
Periphery	Flat, media clear, no other inflammatory or retinal findings	Flat, media clear, no other inflammatory or retinal findings
Vitreous	Clear	Clear

Imaging

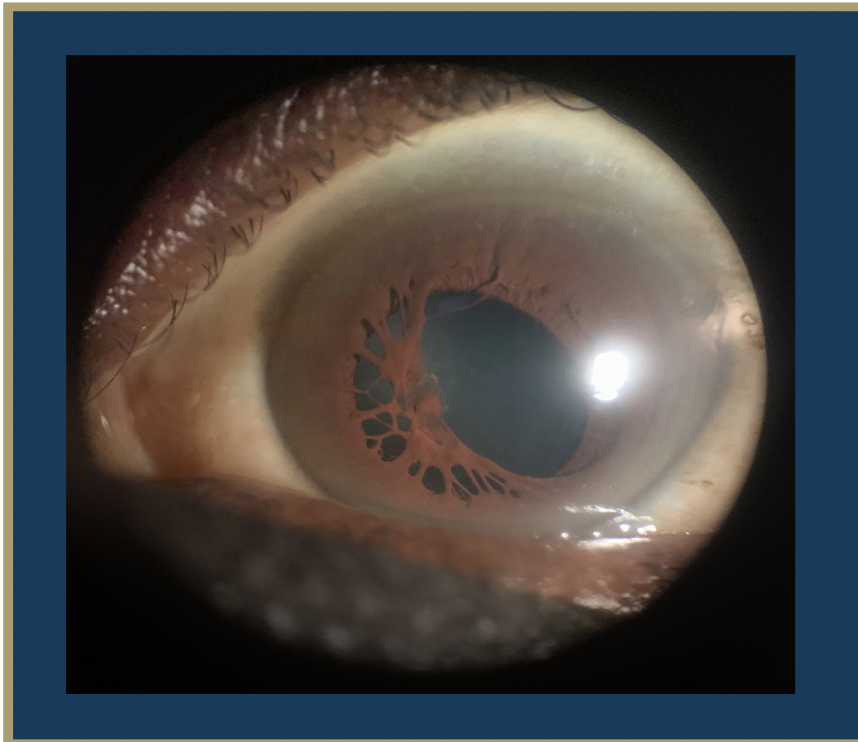


Figure 1: Slit lamp photo of left eye showing lattice-like iris changes from 5-11 o'clock

Differential Diagnosis

Post-inflammatory synechiae
Persistent Pupillary Membrane
Congenital idiopathic microcoria

Clinical Course

A 35-year-old male presented to the ophthalmology clinic with worsening blurry vision for the past year. Refraction was performed and provided moderate visual improvement. Slit lamp exam revealed perilimbal iris nodules in the right eye and peripupillary lattice-like iris changes in the left eye. The anomalous iris changes were determined to be a persistent pupillary membrane. The patient's reported nyctalopia was noted to be secondary to the iris changes.

Discussion

Persistent Pupillary Membrane (PPM) are congenital iris strands in the pupil. These strands are remnants of the anterior tunica vasculosa lentis which plays a critical role in delivering nutrients to the eye's lens during the initial six months of fetal development. The hyaloid vascular system, a vessel network formed during embryonic development to nourish the eye, usually dissolves around the third trimester. However, the failure of this natural process leads to PPM. It's noteworthy that these cases rarely remain vascularized, with only 0.3% exhibiting such traits.

PPMs hold the distinction of being the most frequent congenital anomaly, observed in nearly 95% of newborns, as per Tanzer's study in 1997.¹ There's no identified demographic specifically prone to PPM. Since it generally doesn't affect visual acuity, there's no defined age for reporting this finding to an ophthalmologist. A unique case report has recently explored the connection between tetralogy of Fallot and PPM.²

Symptomatically, PPM varies from no discernable impact to significant reduction in visual acuity, particularly in bilateral cases. Pupillary apertures smaller than 1.55 can potentially disrupt light reaching the retina. Persistent vessels may degrade visual acuity by shrinking the pupillary aperture, as noted by Banigallapati in 2018.³ Additionally, PPM's association with other ocular anomalies such as cataracts, amblyopia, strabismus, and anterior segment abnormalities can also hinder visual acuity.⁴ If not addressed early, PPM can lead to amblyopia or 'lazy eye' due to a discrepancy between the brain and eye function.⁵

PPM are typically discovered during slit lamp examination. The examining ophthalmologist can observe a variety of types; from a few strands to a dense membrane reaching across the pupil and connecting at the collarette, a defining sign of PPM. Collarette refers to the iris line separating the central pupillary zone from the peripheral ciliary zone. Despite PPM, intraocular pressures generally remain within normal limits, with no other systemic findings observed.³ Optical coherence tomography imaging doesn't reveal any unusual findings as PPM primarily involves the pupil and iris. Other diagnostic tools including retinoscopy and iris angiography are useful to identify focal lens opacities and, in rare cases, vascular perfusion.

The majority of PPMs are asymptomatic, but if they fail to atrophy within the first year of life, they can cause visual impairment. In instances where they persist, surgical excision may be warranted. Mild PPM cases can be managed conservatively with mydriatics, refractive correction, and patching for amblyopia.⁶ More severe cases demand surgical excision of the pupillary membrane. However, this approach carries risks such as intraoperative bleeding and potential infection. Microsurgical scissors require a smaller working space in the anterior chamber and offer an edge over micro Vannas scissors in mitigating intraoperative complications. A retrospective study investigating long-term complications of surgical excision for treating PPM using vitreous scissors found that only 2 out of 24 patients exhibited long-term lens opacity.⁷

The Nd:YAG laser, which targets and destroys abnormal tissue, has also demonstrated effectiveness.⁸ The procedure involves disrupting the adhesion between the membrane strands and the normal iris collarette using an Nd:YAG laser, effectively displacing the membrane downward and clearing the visual axis.⁹ However, this method is not suitable for younger children or those with thicker pupillary membranes. Some studies recommend the Argon laser as an alternative to the Nd:YAG laser, citing the latter's propensity for causing pain, pigment dispersion, and bleeding.¹⁰

Femtosecond Laser-assisted Cataract Surgery (FLACS) has also been proven effective in addressing PPM in patients also suffering from cataracts (Kim JY, 2022).¹¹ This procedure involves a three-step process: corneal arcuate incision, anterior capsulotomy, and lens fragmentation. It is considered superior to conventional cataract surgery due to its increased accuracy and reduced risk of intraoperative complications. A case study involving a 61-year-old female patient showed an improvement in corrected distance visual acuity (CDVA) from 0.3 preoperative to 1.0 one month postoperative, with no intraoperative complications reported.

The visual prognosis following early surgery is generally excellent, especially when complemented with visual rehabilitation. Researchers recommend early intervention and timely visual rehabilitation to achieve the best visual prognosis in patients with PPM.⁵ Although Vannas Scissors are effective, they carry the risk of general anesthesia, intraoperative bleeding, intraocular infection, and potential cataract induction if the lens is inadvertently damaged during pupillary membrane removal. This is why Vitreous Scissors, posing fewer risks to the patient, are the preferred choice.¹²

While the Nd:YAG laser has shown effectiveness in treating PPM, it carries risks of cataract formation, iritis, and pigment dispersion.³ A retrospective study on patients with hyperplastic PPM found that, out of 39 eyes in 24 patients, the average best corrected vision at the final appointment was 20/40, with only 5 eyes reaching a best vision of 20/70. Anisometropia, a condition characterized by asymmetric refraction between the two eyes, was found in only 11 of the 24 patients.⁷ Another potential complication is damage to the anterior lens capsule if the membrane adheres to the lens during PPM removal.⁴ Although PPM treatment is generally considered safe, these potential complications should be clearly communicated to patients.

In conclusion, Persistent Pupillary Membrane (PPM) is a common congenital anomaly characterized by fetal iris strands in the pupil. While most cases are asymptomatic, PPM can lead to visual impairment if it persists beyond the first year of life. Diagnosis is typically made through slit lamp examination, and treatment options range from conservative management to surgical excision. Different surgical approaches, such as microsurgical scissors, Nd:YAG laser, and Femtosecond Laser-assisted Cataract Surgery (FLACS), have been used, each with its own benefits and potential complications. Early surgical intervention combined with visual rehabilitation yields excellent visual outcomes, and ongoing research aims to further enhance PPM management.

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