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Optic disc swelling associated with retained metallic intraocular foreign body

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SUMMARY

We report a case of a man in his 40s who presented with a swollen optic disc and a metallic intraocular foreign body (IOFB) impacted on the retinal surface of the same eye. The IOFB was removed by vitrectomy and the swelling of the optic nerve slowly resolved. Literature search revealed one previous report of a retained IOFB associated with optic disc swelling as part of an ocular siderosis case series. The possibility that the optic disc swelling in our patient was as a result of a local toxic reaction to the metallic foreign body is discussed.

BACKGROUND

Delayed presentation of intraocular foreign bodies (IOFBs) is uncommon—only 3% of IOFBs reported in a British Ophthalmological Surveillance Unit study[1] presented 6 months after the initial injury. Intraocular foreign bodies presenting greater than 24 hours after initial injury have a significant association with endophthalmitis.[2–4] Ocular siderosis (OS) can develop after prolonged implantation of ferrous IOFBs and has been reported up to 20 years after penetrating trauma.[5]

Although rare, patients with a metallic IOFB can be relatively asymptomatic. A patient whose vision was preserved at 6/5 was found to have a metallic IOFB located near their optic disc on a routine eye examination. No optic disc abnormalities were seen. The initial injury was believed to have occurred 25 years previously and as there were no signs of OS, and the object was thought to be non-ferrous.[6] Very little has been documented regarding optic disc swelling as a presenting feature in a delayed presentation of retained metallic IOFB.

CASE PRESENTATION

A man felt an object hit his right eye while watching a friend chiselling a suspension unit of a car. The eye was red for 1 week. Approximately 6 months after the initial injury, vision started to deteriorate, prompting an ophthalmic review. He was seen at his local ophthalmology unit where an IOFB was identified and a vitreoretinal opinion was sought.

At presentation, right eye Snellen visual acuity was 6/19 unaided, improving to 6/9 with use of a pinhole, and intraocular pressure was 11 mm Hg. Left eye visual acuity was 6/12 unaided, improving to 6/6 with use of a pinhole, and intraocular pressure was 15 mm Hg. In the right eye, a dark foreign body fragment with some retinal atrophy in the infratemporal peripheral retina was detected, the retina was attached, but optic disc swelling was noted (figure 1). In the same eye, the cornea was clear, the lens and capsule were not disrupted, and there were no signs of ocular inflammation in either the anterior and posterior segment. No abnormality was noted on left eye examination.

A toxic reaction from the foreign body was thought to account for the optic disc swelling causing visual deterioration, so removal was planned. Four days later, the IOFB was removed by vitrectomy with sub-Tenon's local anaesthetic. Surgical steps included 23-gauge pars plana vitrectomy where a posterior vitreous detachment was induced, and core and peripheral vitrectomy were performed. The temporal sclerostomy was enlarged to a 20-gauge to accommodate removal of the IOFB with an intraocular magnet, and this scleral wound was then sutured. Endolaser was applied to 360° of peripheral retina encircling the posterior margin of the impaction site. An internal tamponade of perfluoropropane (C3F8) was inserted. Postoperative topical drops, betamethasone 0.1% four times per day, chloramphenicol 0.5% four times per day and cyclopentolate 1% three times per day, were prescribed. The IOFB fragment was sent to the Universities Material Science Department for analysis. As there were no signs of ocular inflammation or infection, a vitreous sample was not sent for analysis.

INVESTIGATIONS

Tuberculosis QuantiFERON was negative, cytomegalovirus, toxoplasma, HIV-1 and HIV-2, syphilis and *Borrelia burgdorferi* serology were all negative, excluding a systemic infective cause for the optic disc swelling. CT scan of the head and orbits identified a 2-mm calcific density within the inferior/posterior right globe, with no significant intracranial findings.

Optos widefield retinal images were performed to document findings. The optical coherence tomography (OCT) of the fovea was unremarkable, but the optic nerve head studies showed an elevated thickness profile of the right optic nerve, in keeping with the clinical findings (figure 1). The left optic nerve head was normal.

Macroscopic examination of the IOFB found a hard black fragment which was attracted to a magnet. Energy dispersive X-ray spectroscopy analysis, which is an X-ray technique used to identify the elemental composition of materials, was conducted and showed elemental peaks for iron, phosphorus, oxygen and sodium. The ratio of the peaks suggested that the fragment may have originated from a phosphate protective coating or paint applied to steel or other ferritic surfaces.[7 8]

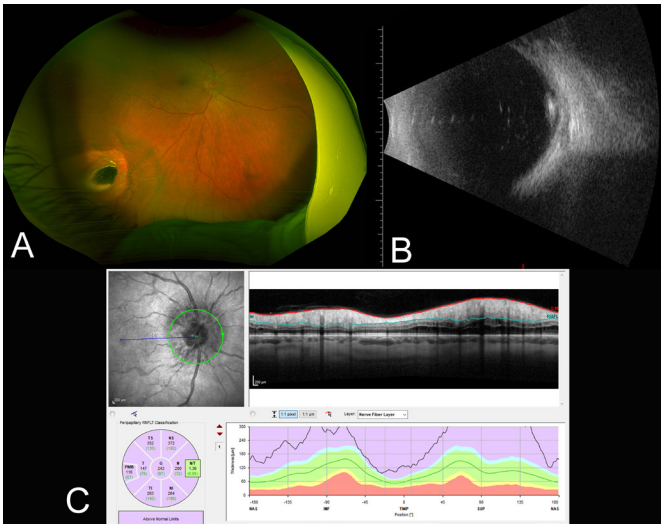

Figure 1 Compilation of images from investigations performed at presentation to the vitreoretinal department. (A) Optos wide field retinal image of the right eye shows optic nerve swelling and a dark foreign body fragment with some retinal atrophy in the infratemporal peripheral retina. (B) B-scan image of the right eye showing a highly reflective object on the retinal surface. (C) Optical coherence tomography image of right optic nerve head showing increased thickness of the retinal nerve fibre layer.

OUTCOME AND FOLLOW-UP

The patient showed good recovery at each subsequent post-operative review. Vision improved to 6/5 4 months following surgery, but optic nerve swelling was still present, so a neuro-ophthalmology review was sought. At this review, it was noted that pupils were equal and reactive with no relative afferent pupillary defect. MRI of the orbits with contrast excluded any other coincidental optic nerve pathology. An electroretinogram (ERG) was not requested as there was good visual function and a normal retinal ganglion cell layer seen on OCT.

Vision subsequently reduced in the right eye to 6/9 due to the development of a cataract and uneventful cataract extraction occurred 18 months after initial vitrectomy. Vision improved to 6/7.5 with no signs of retinal toxicity or optic nerve compromise at the first cataract postoperative review (figure 2).

Initially after vitrectomy, the global retinal nerve fibre layer thickness measurements increased, which was thought to be a response to surgery in an already inflamed optic nerve (figure 3) but with time this improved. Slight asymmetry between the eyes remained at the final visit, but as visual function was unaffected and no other cause was found for the optic nerve swelling, the patient was discharged to their local unit. Thoughts were that this slow improvement would continue.

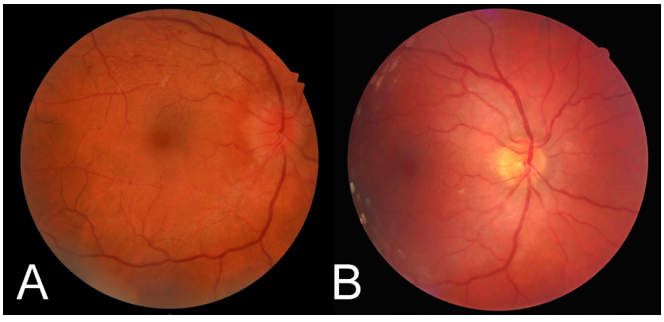

Figure 2 Kowa retina images of right optic nerve comparing optic nerve 4 months after presentation (A) and final visit (B), showing optic nerve swelling had clinically resolved by the final visit.

DISCUSSION

Injuries sustained by an IOFB are rare and can be associated with a poor visual prognosis. UK's annual incidence has been reported as 0.24 per 100 000, with 22% achieving a final visual acuity of 6/60 or worse.[1] The majority of IOFB injuries occur in young males of working age and are of metallic composition.[1 9 10] Visual loss related to IOFB can occur as a result of the direct trauma, infection and/or toxicity in the case of metallic IOFBs. The predictors of poor visual outcome have been documented: poor visual acuity at presentation, development of endophthalmitis, retinal detachment, prolapse of intraocular tissue, large size of IOFB,[1] posterior segment location of IOFB[11] and the extent of initial damage to the eye. The extent of injury depends on the size, material and route the IOFB takes to penetrate the eye. Therefore, a good history, clinical examination and the use of appropriate imaging techniques are vital.

Optic disc swelling is an extremely rare presenting feature of a retained IOFB. Literature search revealed an OS case series which included one patient presenting with disc swelling, which also resolved after IOFB removal.[12] This patient presented 11 months after initial injury and had clinical features of siderosis, iris heterochromia, mydriasis, cataract and reduced b-wave on ERG. The IOFB was located at the pars plana and was removed via sclerotomy and forceps; cataract extraction was not performed. The presenting visual acuity was 6/9 and the reported final visual acuity was 6/12. Light microscopy of the pars plana histology showed iron deposition and swelling of the non-pigmented epithelium, and there was no analysis of the metallic fragment documented. The aetiology of disc swelling was unknown but was unrelated to hypotony or vitreous inflammation. The authors also theorised that it may be due to a direct toxic effect of iron. Our case differs as the optic nerve swelling with reduced vision was the only presenting clinical feature associated with the metallic IOFB.

Fragment analysis of the metal extracted from our patient identified elemental peaks for iron, phosphorus, oxygen and sodium. Iron phosphate coatings are used as crystalline conversion coatings for steels as a treatment prior to further coating or painting to increase corrosion protection. The high sodium content is, however, less consistent with this, although sodium phosphate is used as a dispersing agent in emulsion paints. There are some reports of sodium phosphate coatings applied to aluminium which have a very similar surface morphology to that observed.[7 8] The metal analysis is consistent with the clinical history. What is less clear is the origin of the metallic fragment, suspension unit or chisel tip. While some hand tools can be conversion coated, the chemical analysis of the fragment was nevertheless inconsistent with that expected for a tool made of steel, implying the origin of the fragment was most likely from the suspension unit. Unfortunately, neither the car part nor the chisel was available for analysis to confirm.

The literature was reviewed to look for cases describing IOFB with similar composition (Medline (OVID)). Searches for IOFB and iron are detailed, but IOFB and phosphorus/oxygen/sodium revealed no clinical articles. Ocular Siderosis describes a range of ocular manifestations resulting from retained ferrous material within the eye, which can lead to permanent and severe vision loss. The most frequent clinical signs are iris heterochromia, pupillary mydriasis, iron pigmentation on the endothelium/

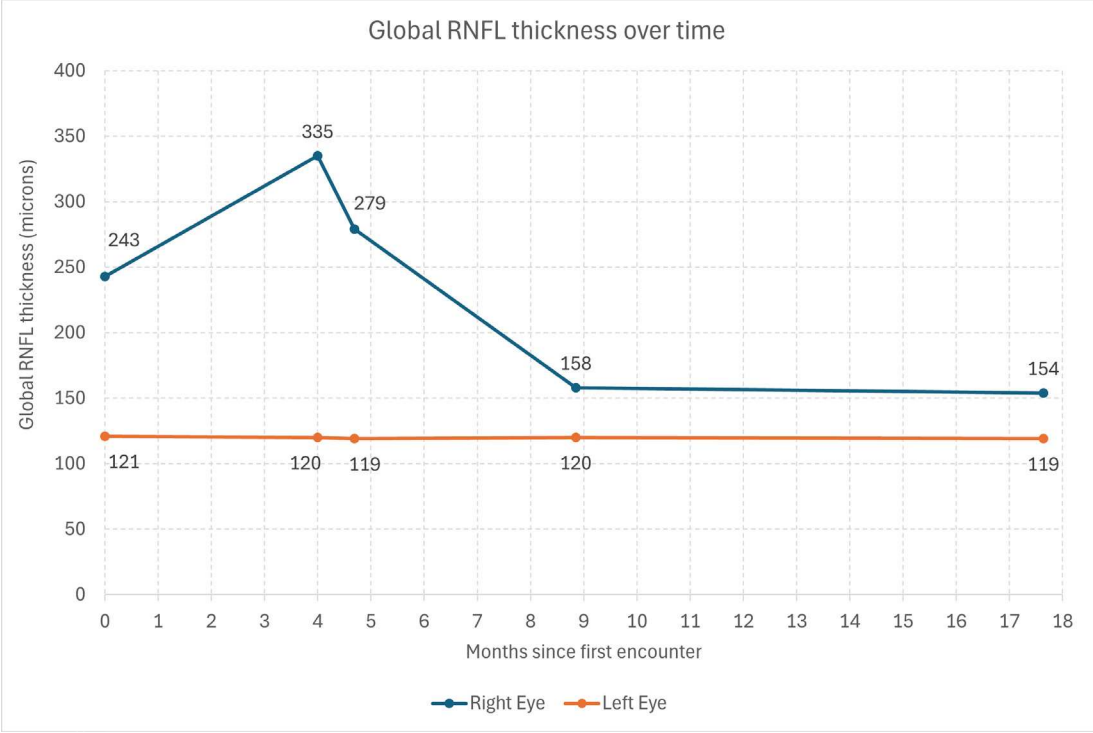

Figure 3 Global retinal nerve fibre layer thickness plotted for right and left optic nerves against time.

lens capsule, cataract development, retinal arteriolar narrowing with pigmentary retinal degeneration[12 13] and secondary glaucoma.[14 15] ERG changes, in particular b-wave amplitude reduction, arise earlier than clinical signs and help to direct treatment options.[12 13] Iron particles interact with proteins, interfering with enzymatic activity causing lysosome breakdown, leading to photoreceptor and retinal pigment epithelium degeneration, and inner retinal oedema. Rods are more susceptible than cones to this process. The indirect route of iron toxicity has been suggested by several pathways, spread via Müller cells, through vitreous, damage to retinal vessels, penetration of trabecular meshwork, which allows iron ions to reach the suprachoroidal space and diffuse to the choroid and Bruch's membrane.[13] This explains the variable clinical presentation of OS and why it is difficult to predict.

Cases have been reported where presumed ferrous fragments have been left within the eye. A case described a presumed iron IOFB (patient worked in an iron works) embedded completely in the right optic nerve. Vitrectomy cleared the vitreous haemorrhage, but removal of the IOFB was considered too risky to the optic nerve, so it was left in situ. No signs of OS were seen 2 years after injury. The authors suggest that the iron foreign body was not connected to subretinal or subchoroidal space and completely embedded in the solid tissue of the optic nerve, and this potentially prevented iron particle diffusion.[16] In another case report, an IOFB was identified coincidentally on head imaging. CT confirmed a 3.5-mm metallic IOFB located immediately nasal to the optic disc. Based on the size and shape, it was thought to be a metallic pellet from a ball bearing high-velocity rifle. These pellets commonly contain an iron core accompanied by a coating of either zinc or copper. The patient was being investigated for developmental delay, and neither the patient nor the parents gave any history of IOFB. As the ERG was normal with good vision at 6/6, surgical removal was not performed.[17]

Our case is only the second published report of delayed presentation of an IOFB associated with optic disc swelling. Although optic disc swelling is a rare presenting feature of OS, we advise exclusion of an IOFB in cases of optic disc swelling where no other aetiology has been identified.

Learning points

- Optic disc swelling related to a retained intraocular foreign body (IOFB) has only been described in one historic case series previously. That case had classic clinical features of ocular siderosis alongside the optic disc swelling, unlike in our patient.
- If a history of potential trauma and optic disc swelling is seen, a thorough examination must be undertaken to exclude an IOFB. As our case shows, there can be few other signs to its presence.
- Our case highlights the importance of wearing eye protection if an individual is performing or observing a task, which could produce high-velocity fragments, such as hammering or chiselling.

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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