Out of Sight! A pictorial review of the computed tomographic appearances of sight-threatening orbital emergencies.

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Learning objectives

Drawing on a large experience of orbital trauma cases from a level one trauma centre, the aim of this educational exhibit is to

1) Discuss the epidemiology of orbital trauma in order to establish its significance to current radiological practice

2) Highlight the salient anatomy of the orbital structures in relation to traumatic injury

3) Increase awareness of the multidetector computed tomographic (MDCT) imaging appearances of various traumatic sight-altering lesions that can affect the orbit (See Fig. 1) and which can be readily identified (but are frequently overlooked) on emergent radiological evaluation by the reporting radiologist

4) Explore the patterns of facial bone injury that are frequently associated with intra-orbital damage which, if detected, can prompt a closer examination of the orbital contents

Images for this section:
Fig. 1: Axial CT study demonstrating intraocular emphysema secondary to penetrating gunshot with associated pre and post septal oedema.
Background

Worldwide an estimated 1.6 million people have been blinded as a result of orbital trauma. Ocular injuries in association with major trauma are particularly important because they may be easily overlooked at a time when life-threatening injuries may take priority. As such, vision-threatening injuries may go undetected in the intubated unconscious patient for hours or even days. A significant part of the diagnostic onus may therefore lie with the reporting radiologist on-call. Knowledge of the different types of potential orbital injury and recognition of the associated radiological findings is paramount and might expedite sight-saving as well as life-saving treatment.

Road traffic accidents (RTAs) and falls from a height are by far the commonest causes of orbital trauma. In one retrospective review of 2,985 patient's attending a level one trauma centre with polytrauma Georgouli et al found that RTAs were responsible for 61% of the 181 cases with orbital injuries (Georgouli 2011). Falls from a height and assaults account for the next most frequent aetiologies (Guly 2006, Georgouli 2001). Alcohol consumption is an important risk factor for orbital injury. A Korean study analysing the association between alcohol consumption and the risk of ocular trauma found that alcohol was responsible for one in four attendances with sight-threatening injury (Han 2011). Young to middle aged men (aged 21-40 yrs) are by far the most likely to present with orbital trauma.

ANATOMY

The bony orbit is a conical space with its base facing anterolaterally and its apex facing posteromedially. The cone is made up of seven bones including the ethmoid, frontal, lacrimal, maxillary, palatine, sphenoid and zygomatic bones (See Fig. 2). The posterior third of the orbit, known as the orbital apex, is composed of the optic canal, superior orbital fissure and the inferior portion of the inferior orbital fissure (See Fig. 3 and Fig. 4). For a pictorial review of the nerves and vessels that traverse the orbital apex please refer to Figure 5.

The pre-orbital soft tissues are separated from the orbital contents by a physical barrier formed by a sheet of collagenous tissue called the orbital septum. Anatomical pre-septal and post-septal spaces are thus created.

The normal globe is nearly spherical and lies anteriorly in the orbit. The globe (apart from the cornea) is enveloped by a dense connective tissue layer called Tenon's capsule (fascia bulbi). The capsule fuses with the optic nerve sheath at the optic disc. Three layers of fascia envelope the globe: 1) A fibrous outermost layer formed by the sclera and
cornea; 2) A vascular middle uveal tract comprised of the ciliary body anteriorly and the choroid plexus posteriorly; 3) A sensory innermost layer called the retina (See Fig. 6).

The sclera is separated from Tenon's capsule by an episcleral cleft (spatium intervaginale) filled with loose areolar connective tissue. The lens divides the globe into an anterior compartment and a posterior compartment, containing aqueous and vitreous humour, respectively. (See Fig. 6). The iris, which resides in the anterior compartment, further divides this space into an anterior chamber and a posterior chamber.

Posterior to the globe, six extraocular muscles form a conical space dividing the postseptal region into an intraconal compartment and an extraconal compartment (See Fig. 7). The intraconal compartment contains the neurovascular structures including the optic nerve (within the optic nerve sheath), the ophthalmic artery, the superior ophthalmic vein, smaller vessels, lymphatics and fat (See Fig 5).

CT IMAGING IN ORBITAL TRAUMA

CT is the imaging modality of choice in orbital trauma, particularly in the emergency setting. Thin-section axial datasets are acquired from dedicated protocols or retrospective reconstructions can be rendered from the volume CT head dataset. Thicknesses of 0.625-1.25mm are optimal. At our institution, the CT head study is performed as part of a standardised traumogram incorporating a non-contrast CT head volume-acquisition (from which facial and orbital images can be reconstructed) and cervical spine study followed by a post contrast chest, abdomen and pelvis. Our Neuroradiologists strongly advocate the liberal use of multiplanar reformats, including oblique formats.

Ultrasound and magnetic resonance imaging studies, while useful in the diagnosis of orbital pathology, are not appropriate in the imaging of acutely injured unstable patients.

Images for this section:
Fig. 1: Axial CT study demonstrating intraocular emphysema secondary to penetrating gunshot with associated pre and post septal oedema.
Fig. 2: Bony anatomy of the left orbit.
**Fig. 3:** Anatomy of the medial wall of the orbit. Key: ALC, anterior lacrimal crest; LF, lacrimal fossa; PLC, posterior lacrimal crest; LP, lamina papyracea; AEF, anterior ethmoidal foramen; PEF, posterior ethmoidal foramen; OC, optic canal; MES, maxilloethmoidal suture.
Fig. 4: Anatomy of the lateral wall of the orbit. Key: GWS, greater wing of sphenoid; SOF, superior orbital fissure; FZS, frontozygomatic suture; FSS, frontosphenoid suture; ZSS, zygomaticosphenoid suture; ZB, zygomatic bone; ZFF, zygomaticofacial foramen; LT, lateral tubercle.
**Fig. 5:** The anatomy of the orbital apex. Key: LPS, levator palpebrae superioris muscle; SR, superior rectus; LR, lateral rectus; IR, inferior rectus; MR, medial rectus; SO, superior oblique muscle; SOV, superior ophthalmic vein; III_{sup}, superior division of oculomotor nerve; III_{inf}, inferior division of oculomotor nerve; IOF, inferior orbital fissure.
Fig. 6: Anatomy of the Eyeball IMAGE #: 4627 USAGE: PowerPoint / Academic Institutions In a radiology poster at the European Congress of Radiology
Fig. 7: Axial CT study of the orbits demonstrating the anatomy of the chambers, intraconal and extraconal compartments of the left eye. Proptosis, preseptal swelling and vitreous haemorrhage on the right side were secondary to a firework accident.
Imaging findings OR Procedure details

INTRA-OCULAR INJURY

The CT imaging features of various traumatic intra-ocular pathologies are described below including hyphaema, lens subluxation and dislocation, globe rupture, ocular detachment and intra-orbital haemorrhage. Penetrating injuries involving metal, glass, wood and plastic foreign bodies will be portrayed. In addition, the appearance of optic nerve damage and globe dislocation will be detailed. Pearls and pitfalls of reporting orbital trauma will be included under each heading. The different patterns of facial bone fracture that are known to be associated with infraorbital trauma will be reviewed. Finally, an imaging checklist will be listed to ensure satisfaction of search when reporting acute orbital trauma.

ANTERIOR CHAMBER INJURY/HYPHAEMA

Hyphaema is defined as haemorrhage into the anterior chamber of the globe. Haemorrhage is caused by local disruption of blood vessels in the ciliary body and iris. These injuries tend to be associated with corneal laceration secondary to penetrating trauma (Go et al. 2002).

CT findings of hyphaema include one or more of the following:

1) An increase in the attenuation of the anterior chamber when compared to the uninjured side (see Fig 8).

2) Widening of the antero-posterior (AP) distance between the lens and the anterior margin of the globe. This measurement depends on an intact cornea.

3) Decreased volume of the anterior chamber with a reduction in the AP distance if there is associated corneal laceration or iris prolapse (See Fig 9).

Pearl: A decrease in the AP distance between the lens and the anterior globe margin is a subtle sign. If a direct comparison is not made between the injured and uninjured side this diagnosis can be missed.

Pitfall: Subluxation of the lens anteriorly rather than corneal laceration or iris prolapse may also lead to a decrease in the AP distance.

LENS SUBLUXATION AND DISLOCATION
Rapid equatorial expansion of the globe can lead to disruption of the zonular fibres which hold the lens in position. The lens will then sublux or completely dislocate out of its normal position (See Fig. 10). This injury is typically secondary to blunt force trauma and is often associated with orbital wall fractures. Subluxation is more common than dislocation. The iris tends to limit anterior dislocation and as such, dislocation of the lens in the posterior direction is more commonly identified.

The CT study may demonstrate an abnormal position or angulation of a hyperdense lens. Alternatively, the lens may not be visualised at all as in cases of lense rupture (See Fig. 11 and 12).

Pearl: Spontaneous lens dislocation associated with connective tissue disorders such as Ehlers-Danlos Syndrome should be suspected if bilateral dislocation is evident in the absence of a history of trauma.

GLOBE TRAUMA/RUPTURE

Globe injury (open-globe injury) may occur if there is laceration or perforation of the globe with leakage of vitreous humour. This is a sight-threatening injury. In cases of blunt trauma, globe rupture is more likely to occur at the insertion points of the ocular muscles where the sclera is thinnest. It is often difficult to assess these patient’s clinically and as such, they should be referred for CT scanning.

Unfortunately, the sensitivity of CT for the diagnosis of open-globe injury is limited, varying between 56-77%.

CT imaging may demonstrate:

1) Assymetrical alteration of globe contour (See Fig. 13).
2) Assymetrical reduction of globe volume known as the "flat-tyre’ sign (See Fig. 14).
3) Stranding in the retrobulbar fat plane.
4) Scleral discontinuity.
5) Asymmetric alteration in anterior chamber depth.

- A decrease in depth will occur if there is corneal rupture whereas an increase in depth is seen if there is scleral injury.

- In scleral rupture there is an increase in anterior chamber depth due to posterior decompression of vitreous humour. This process allows the lens to sink backwards.
6) Intra-ocular air

7) Intra-ocular foreign body

The chronic sequelae of globe rupture are involution and calcification of the globe. This process is called phthisis bulbi (See Fig. 15).

Pitfalls: There are a number of iatrogenic and non-traumatic mimics for some of the features of open-globe injury.

- Iatrogenic: Surgical ophthalmological treatments for retinal detachment can lead to intra-orbital gas (e.g. therapeutic pneumatic retinopexy), high density within the globe or an alteration of globe contour. For example, injection of perfluoropropane gas into the vitreous humour, placement of high attenuation silicone sponges and insertion of high density scleral bands.

- Non-traumatic: Congenital deformities of the globe such as coloboma and staphyloma can alter the contour of the globe giving the false impression of rupture.

Traumatic dislocation of the globe can occur either medially into the sinonasal region (See Fig.16) or posteriorly into the anterior cranial fossa.

OCULAR DETACHMENTS

Four intra-ocular layers can become detached thereby creating three potential spaces into which haemorrhagic fluid can accumulate.

A) Posterior hyaloid detachment:

The vitreous humour is a compressible gel bounded by both anterior and posterior hyaloid membranes. Vitreous humour is firmly attached to the retina but is most adherent at the ora serrata anteriorly and at the margin of the optic disc posteriorly. If the vitreous shrinks (liquefies), it produces traction on the posterior hyaloid membrane which results in posterior hyaloid detachment. This process is also called posterior vitreous detachment.

Causes of vitreous liquefaction include trauma, significant myopia, previous ophthalmological surgery, laser eye treatment, intra-ocular inflammation and persistent hyperplastic primary vitreous.

CT (and MRI) demonstrates a detached posterior hyaloid membrane within the vitreous cavity. The membrane will be completely separated from the disc posteriorly, or only
partially attached (by a thin band) and connected anteriorly at the ora serrata. Fluid will be identified in the retrohyaloid space.

B) Retinal detachment:

The retina is firmly attached at its anterior margin, the ora serrata and posteriorly at the optic disc. Detachment occurs when the retina separates from the underlying choroid where it is less closely adherent. This is a sight-threatening injury.

Causes of retinal detachment include trauma, inflammation, infection and neoplasm. CT (and MRI) demonstrate a typical V-shaped configuration of sub-retinal high density haemorrhage extending from the optic disc to the ora serrata (See Fig. 17 and Fig. 18). Over the coming weeks, the haemorrhage matures and appears less dense on subsequent studies. If this diagnosis is discovered in an infant, non-accidental injury should be excluded.

C) Choroidal detachment:

The choroid is part of the pigmented vascular layer called the uveal tract, and runs from the optic nerve to the ora serrata. The potential space between the choroid and the overlying sclera is known as the suprachoroidal space. Fluid collections, either transudate or frank haemorrhage, in this space tend to be lentiform in appearance. The choroid is firmly attached to the sclera at the optic nerve and also where the posterior ciliary vessels and nerve enter the eye anteriorly. In addition, the choroid is tethered to the sclera where the vortex veins exit the globe.

CT (and MRI) appearances are characteristic, with the posterior margin of the choroid extending some distance away from the optic disc. This distance is typically one-third of the length between the posterior margin of the globe (where the vortex veins penetrate) and the choroid. Anteriorly, detachment can extend beyond the ora serrata to the ciliary body. See Fig. 19 for an image of choroidal detachment.

Causes of choroidal detachment other than trauma include choroidal tumour, inflammation, accidental perforation and iatrogenic injury.

INTRA-ORBITAL HAEMORRHAGE

Post septal haemorrhage can be retrobulbar (intraconal or extraconal) or intra-ocular.

a) Retrobular haemorrhage
This type of haemorrhage may be related to the dura surrounding the optic nerve (See Fig. 20). More specifically, it may be subdural or extradural, appearing as a tram-track density paralleling the optic nerve on CT scans. Alternatively, the haematoma may surround the optic nerve and appear as a 'three- or four-leaf clover' structure.

Haematoma seen between the Tenon capsule and the sclera is called subTenon haemorrhage. This form of haematoma appears as a curvilinear hyperdensity conforming to the contour of the posterior globe and extending from the ciliary body anteriorly to the optic nerve head posteriorly. This condition is an ophthalmological emergency and requires an urgent canthotomy to relieve intra-orbital pressure and preserve vision. Fig. 21 reveals the imaging findings of a patient who did not receive help in time to prevent permanent optic nerve damage.

b) Extraconal haemorrhage

The most common form is a subperiosteal haematoma. The periosteum which covers the bony orbit is adherent to the underlying bone but relatively loosely attached along the roof. This haemorrhage is seen as a curvilinear hyperdense collection, typically along the orbital roof on CT (See Fig. 22). The haematoma matures over time into a chronic haematocyst, also known as a cholesterol granuloma.

c) Intra-ocular haemorrhage

Typically occurs within the vitreous humour of the posterior chamber. Other than as a consequence of direct orbital trauma, this form of haematoma can also occur spontaneously in patients with subarachnoid haemorrhage and/or intra-axial parenchymal haemorrhage and is then entitled Terson Syndrome. The mechanism of intra-orbital bleeding may be due to raised intracranial pressure.

CT reveals hyperdense blood within the posterior chamber (See Fig. 23).

*Pitfalls:* Many iatrogenic treatments such as prosthetic devices and silicone injection for the treatment of retinal detachment appear as hyperdensity within the globe on CT. This increased opacification should not be mistaken for haemorrhage in the setting of acute trauma. (See Fig. 24 and Fig. 25).

**PENETRATING INJURIES AND FOREIGN BODIES**

Aetiologies of penetrating injury include occupational accidents (for example, glass workers, carpenters, steel factory workers and builders), criminal assault and self-inflicted trauma (for example, stabbings and gunshot wounds), sports injury (for example, racket
sports, hockey, mountain biking and shooting), motor vehicle accidents (for example, glass and metal fragments injuring drivers, passengers and bystanders), warfare and terrorist attack injuries (for example, penetrating shrapnel related to blast injuries).

The CT appearances of metal, glass, wood and plastic foreign bodies are described below.

i) Metal

Radiodensity on CT with a HU > 1500 (See Fig. 26). Streaks created by metal beam hardening artefact allows for distinction of metal from other types of foreign body (See Fig. 27) (Offiah, C et al. 2012). Fragments 1mm in width can be reliably identified. Complications of retained metallic foreign bodies include inflammation, infection and optic neuropathy secondary to optic nerve impingement. Of all types of metal foreign body, copper is least well tolerated by orbital tissues.

ii) Glass

CT is more sensitive in the detection of glass fragments than US or MRI (MRI is contraindicated in these patients). The higher the density of the glass, the more likely it is to be visualised. Green beer bottle glass is the highest density glass and is easily identified (See Fig. 28). The size of the fragments and their location will also determine their ease of detection. Fragments within the anterior chamber are readily identified (Offiah, C et al, 2012). However, shards on the corneal surface can be difficult to distinguish. Retained glass fragments are relatively well tolerated by the orbital tissues.

iii) Wood

Wood often appears as low density on CT and can be mistaken for air (See Fig. 29). There is usually a geometric margin to the low density (See Fig. 30) (Offiah, C et al, 2012). The water content of the wood affects its density so that dry wood has a HU of -650 while fresh wood has a HU of -25. Organic material can excite an inflammatory reaction in the orbit leading to cellulitis, abscess formation, granulomatous reaction, orbitocutaneous fistula formation or osteomyelitis. This reaction is a clue to the makeup of the foreign body material. Wood fragment is generally poorly tolerated by the orbital soft tissues.

iv) Plastic

Plastic, depending on its composition, also appears as a hypodense structure on CT. If the penetrating object is hollow, a geometric area of low density air will be indentified conforming to the outline of the object (See Fig. 31). Plastic is relatively well tolerated by the orbital tissues (Singh, V 2004) unlike wood, which can have a similar appearance.
OPTIC NERVE INJURY

Direct trauma due to penetrating injury or indirect trauma secondary to fractures of the orbital apex or bony optic canal can cause compression, laceration or transection of the optic nerve (See Fig. 32). This sight-threatening ophthalmological emergency is known as orbital apex syndrome (Winegar et al 2013). Transient distortion of the bony and orbital contents can put the optic nerve under traction. The vascular supply of the optic nerve can also be compromised in this manner leading to secondary optic nerve necrosis. Ischaemia will be revealed as an area of increased signal on T2 MRI sequences but can only be performed if there are no contraindications (Refer back to Fig. 21).

FACIAL FRACTURES ASSOCIATED WITH INTRA-ORBITAL INJURY

Certain patterns of facial bone injuries are more likely to predispose to intra-orbital trauma. Of particular concern are fractures extending through the superior orbital fissure at the confluence of the greater wing of sphenoid, lesser wing of sphenoid, orbital plate of the maxilla and the zygoma. This injury can lead to superior orbital fissure syndrome. Affected individuals present with ophthalmoplegia or diplopia and ptosis owing to disruption of the 3rd, 4th, 5th (V1) and 6th cranial nerves as they enter the orbit (Winegar, 2013). For a summary of fractures predisposing to intra-orbital injury refer to Table 2.

<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Bones Involved</th>
<th>Muscle/nerve involvement</th>
<th>Ocular complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Naso-orbitoethmoid</td>
<td>Medial wall of orbit, nasal bone and</td>
<td>Injury to the attachment</td>
<td>Exophthalmos due to decreased</td>
</tr>
<tr>
<td>complex</td>
<td>ethmoid sinuses</td>
<td>of the medial canthal</td>
<td>intra-orbital volume</td>
</tr>
<tr>
<td>2) Zygomaticomaxillary</td>
<td>Disrupts all three or four zygomatic</td>
<td>None specifically</td>
<td>Enophthalmos secondary to increased</td>
</tr>
<tr>
<td>complex</td>
<td>sutures. Lateral wall of orbit</td>
<td></td>
<td>orbital volume</td>
</tr>
<tr>
<td></td>
<td>angulated outwards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Fracture Type</td>
<td>Location</td>
<td>Symptoms</td>
</tr>
<tr>
<td>-----</td>
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<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3)</td>
<td>Orbital blowout</td>
<td>Floor of the orbit (maxilla)</td>
<td>Herniation of the inferior extra-ocular muscles. Entrapment of the inferior orbital nerve.</td>
</tr>
<tr>
<td>4)</td>
<td>Paediatric trapdoor fracture</td>
<td>Floor of orbit (maxilla)</td>
<td>Muscle belly herniates into maxillary sinus but bony fragment returns to normal anatomical position.</td>
</tr>
<tr>
<td>5)</td>
<td>Orbital roof fracture</td>
<td>Frontal bone</td>
<td>Injury to superior extra-ocular muscles. Other complications: dural tear, CSF leak and brain herniation into te orbit.</td>
</tr>
<tr>
<td>6)</td>
<td>Type III Le Fort</td>
<td>Medial and lateral walls of orbit. Disrupted nasofrontal and maxillofrontal sutures and the zygomatic arch. Pterygoid.</td>
<td>Extra-ocular muscle injury</td>
</tr>
</tbody>
</table>

**Facial Fractures Predisposing to Intra-Orbital Injury (Adapted from Winegar et al 2013)**

**Images for this section:**
Fig. 8: Axial CT study of a 44 yr old male presenting following an assault. There is increased density of the fluid in the anterior chamber in keeping with hyphaema with associated preorbital, preseptal soft tissue swelling. Vitreous haemorrhage is also seen in the posterior chamber.
Fig. 9: Axial soft tissue CT study of a 20yr old builder presenting with penetrating injury to the right eye. The man was not wearing protective eyewear while cutting tile. There is loss of anterior chamber volume with an associated corneal laceration.
**Fig. 10:** Axial CT study of a 54yr old man attacked with a spade to the eye. There is complete dislocation of the lens of the right eye into the posterior compartment.
Fig. 11: Axial CT study of a 76yr old female who presented with a fall onto her right eye. On the soft tissue window there is preseptal soft tissue swelling, proptosis and intraocular haemorrhage within the anterior and posterior compartments. In addition, there is possible corneal rupture. The lens is not visible and had been ruptured.
Fig. 12: Axial CT study of an elderly male who presented after a fall with no memory of the event. There is evidence of lens rupture on the left side with associated vitreous haemorrhage.
Fig. 13: Axial CT study of a young male who was the victim of a shooting. There is orbitocranial penetrating injury due to gun shot pellets with evidence of globe rupture. Associated findings include contusion of the medial rectus muscle, medial orbital wall
fracture disruption, bullet fragments in the intra-orbital space with further penetrating track intracranially.
Fig. 14: Axial CT scan of a young male who was stabbed in the right eye. There is complete loss of globe volume 'flat-tyre' sign secondary to globe rupture.
**Fig. 15:** Axial CT scan in a 53yr old patient with a longstanding history of orbital trauma who attended for investigation of chronic sinusitis. Incidental finding of heavy dystrophic intraocular calcification on the left side (phthisis bulbi).

**Fig. 16:** Axial CT study demonstrating complete dislocation of the right globe into the sinonasal region following blunt force trauma.
**Fig. 17:** Axial CT study of a 63 yr old male presenting with facial injury following a fireworks accident on New Year’s Eve. There is traumatic retinal detachment in the right eye as evidence by a V-shaped area of high density haemorrhage in the subretinal space. Preseptal soft tissue swelling is also demonstrated.
**Fig. 18:** An adult male presenting with facial injuries after falling down a set of stairs. V-shaped hyperdensity is identified in the globe in keeping with retinal detachment. Fat stranding and soft tissue swelling is also identified in the post septal space.
Fig. 19: Axial CT study of an elderly woman who fell out of a wheelchair injuring her right eye. There is lentiform-shaped high density within the suprachoroidal space in keeping with the sequale choroidal detachment.
Fig. 20: Axial CT study of a 30yr old male with Von Willebran’s disease presenting two weeks following an assault with decreased vision in his left eye. There is a retrobulbar haematoma with traction on the optic nerve and preseptal soft tissue swelling.
**Fig. 21:** Axial T2 fat saturated MRI study performed on the same patient as in Fig. 20 demonstrating increased signal in the left optic nerve in keeping with ischaemia.
**Fig. 22:** Coronal CT study of a 29yr old presenting with a head injury following a RTA. There is a subperiosteal haematoma under the frontal bone on the left side with an associated orbital roof fracture.
**Fig. 23:** Axial CT study of a 20yr old male stationary driver in a car who was shot through the car window. Glass and metallic gunshot are embedded in the orbits. There is associated orbital emphysema and vitreous haemorrhage on the right side. No intracranial injury was detected.
Fig. 24: Axial CT of a 60yr old female with a past medical history of enucleation for intraocular melanoma. Hyperdense prosthesis noted in the right orbit on this follow up study.
Fig. 25: Coronal CT study of a 74yr old male who underwent previous silicone injection into the right globe to treat retinal detachment. The is increased opacification in the right globe which could easily be mistaken for blood in the acute traumatic setting.
Fig. 26: Axial CT (bone window) of a 34yr old builder presenting with penetrating foreign body to the left eye after an occupational accident. There is a high density metallic foreign body in the left globe with associated scleral globe rupture.
**Fig. 27:** Axial CT study in a young male presenting with gunshot injuries to the head and neck. There are multiple metallic foreign bodies demonstrating prominent streak artefact in the right orbit and sinonasal region.
Fig. 28: Axial CT (bone windows) of a 20yr old man shot through a car window. There are glass fragments in the right orbit. Notice the relative absence of streak artefact.
Fig. 29: Sagittal CT study (bone windows) of a 31yr old male presenting with penetrating injury to the left orbit by a tree branch while mountain biking. There is a geometric pattern of low density gas in the orbit consistent with organic material (wood).
**Fig. 30:** Axial CT study (bone windows) of the same patient as in Fig. 29. Once again, a geometric pattern of low density is identified in the left orbit (more subtle on this projection). In addition, there was traumatisation of the inferior rectus muscle, globe displacement, sclera laceration, and impingement of the optic nerve in the retrobulbar compartment (images not shown).
**Fig. 31:** Saggital CT (bone windows) of a young child presenting with penetrating injury to the left eye with a plastic pen. The hyperdense tip of the pen has penetrated the trochlea and lies intracranially. The superior oblique muscle was displaced by the hypodense, conical, gas-containing plastic shaft. The pen missed the globe completely.
Fig. 32: Axial CT study of a 24 yr old patient stabbed in the eye with a broken drinking glass. There is a hyperdense fragment lodged at the optic nerve head with associated intra-ocular haemorrhage.
Conclusion

Orbital injury is common in the context of polytrauma patients. The diagnostic onus often lies with the radiologist to detect sight threatening orbital problems in unconscious, intubated patients who cannot be assessed fully at the time of admission. A detailed understanding of the anatomy of the orbit aids image interpretation when there are complex patterns of ocular injury. In addition, an awareness of the imaging features of orbital trauma and of the potential complications of orbital damage may allow the radiologist to diagnose sight-threatening problems before they lead to permanent visual loss. CT is the first-line imaging modality of choice in these patients.

References


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