Vision-threatening injuries

- Penetrating globe injuries.
- Blunt injury and ruptured globe.
- Loss of eyelids.
- Retrobulbar haemorrhage.
- Traumatic optic neuropathy.
- Chemical injuries.

Ocular injuries occur commonly in maxillofacial trauma, especially with injuries to the upper face and forehead. These range from simple corneal abrasions to penetrating globe injuries and optic nerve compression. It is worth remembering that the brain is not far behind or above the orbit, and is separated from it by some of the thinnest bones in the body. **Brain and eye injuries should be excluded in all high-velocity and penetrating orbital trauma.** The force required to damage the globe can leave the surrounding tissues relatively unscathed. Unless specific attention is paid to the eye, such injuries can be missed. The eye can receive the full impact of small high-velocity missiles (explosions, glass, metal-on-metal impact) at the time of accident. Ruptured globes and perforations with retained intra-ocular foreign body, need to be borne in mind. **All ocular injuries listed above require urgent ophthalmic referral.** Visual loss becomes a significant concern once the acute stage of trauma has passed, because it both impedes rehabilitation and dramatically reduces the quality of life.

**Penetrating ocular trauma**

Full-thickness penetration into the eye wall (cornea or sclera) can occur with a sharp object. There may be a retained intra-ocular foreign body. Work place accidents and interpersonal violence are the commonest causes of injury.

There is variable loss of vision, which may be accompanied by pain and bleeding, depending on size, location, and extent of injury. Associated lid laceration, bruising, and subconjunctival haemorrhage may be observed. The entry site is usually obvious and the eye looks collapsed. Uveal tissue, retina, and the vitreous gel may be prolapsing out of the eye. The lens may be damaged and cataractous. A hyphaema and vitreous haemorrhage are usually present. The intra-ocular pressure is low and aqueous fluid may be seen leaking from the wound when a fluorescein drop is instilled. In cases of small high-velocity objects (metal and glass chips) the eye may appear intact and a small entry wound overlooked. The **history is therefore important** in alerting the doctor to the possibility of an intra-ocular foreign body (IOFB). An IOFB may be visible if the view of the fundus is clear.

**Care must be taken not to apply pressure to the eye during examination, as this can further expulse ocular contents. The possibility of penetrating orbital and brain injury should be borne in mind.**

If intra-ocular blood or lid oedema prevent examination, an ultrasound or CT scan can detect intra-ocular foreign bodies, retinal detachment, and globe integrity.
Management
Analgesia and anti-emetics should be administered, as required. A hard plastic shield should be taped over the eye to stop eye-rubbing, especially in children. Tetanus status must be checked. Primary surgical repair of the globe by an experienced ophthalmologist should be performed as soon as possible. Usually the foreign body is removed at the same time. The use of oral ciprofloxacin is thought to reduce the risk of endophthalmitis. Prognosis is variable and can be very good. A good initial visual acuity carries a better prognosis. Large defects and posterior involvement are poor prognostic indicators. Corneal scarring, glaucoma, cataract, and retinal detachment are the main complications leading to poor vision.

Blunt ocular trauma
Blunt trauma can result in intra-ocular damage with an intact eyeball or cause a ruptured globe (same as seen when an orange is dropped from a height; the force may only cause bruising of the fruit or cause rupture of its skin). Antero-posterior compression of the eye during trauma expands the eye at the equator. This is the mechanism of tearing of structures within the eye leading to the clinical picture. The force of trauma may not appear to be severe but an object small enough to fit within the bony orbital rim will transmit all its energy to the eyeball. Globe rupture will be discussed in the following chapter.

In blunt trauma, visual acuity is usually reduced without an afferent pupillary defect. The patient may report floaters and that the vision has improved since the incident. This is because the intra-ocular blood has settled at the bottom of the eye with the patient in an upright posture. Associated lid laceration, bruising, and subconjunctival haemorrhage may be present. Iris sphincter muscle tears, iris dialysis, hyphaema, and a displaced lens may be observed. The intra-ocular pressure is usually high due to blood blocking the trabecular meshwork in the drainage angle. Posterior segment complications of trauma are vitreous haemorrhage, choroidal ruptures, retinal commotio, and tears leading to a retinal detachment. An ultrasound scan can detect globe rupture, retinal tears, and detachment, if the view of the fundus is poor.

**If the eye is soft in the setting of blunt trauma, a globe rupture must be excluded.**
Management
The aim of management is to control the inflammation, pain, and intra-ocular pressure, while the eye settles. Steroid, cycloplegic, and anti-hypertensive drops need to be initiated by the ophthalmologist, as required. Careful follow-up to look for complications of retinal detachment, glaucoma, cataract, and retinal membrane formation is required. Prognosis is generally good and depends on whether any of the above complications arise. Choroidal rupture and retinal detachment involving the macula carry the worst prognosis.

Ruptured globe
Ruptured globe is defined as the loss of integrity of the eyeball following blunt trauma. The bony orbit offers protection to the eye but is deficient anteriorly. This is even more relevant in individuals with prominent eyes, as they are more susceptible to blunt trauma. Interpersonal violence and falls are the commonest causes of globe rupture. There is a history of significant blunt ocular trauma, usually with an object small enough to fit within the bony orbital rim, e.g. knuckles, squash ball, or the edge of table. Previous ocular surgical history is important, as the scar is a potential site of rupture.

Patients present with severe and sudden loss of vision with pain. Visual acuity is usually down to perception of light with afferent pupillary defect. Associated lid laceration and bruising may be observed. A subconjunctival haemorrhage is invariably present. Uveal tissue, retina, and the vitreous gel may be prolapsing out of the eye. The eye is collapsed, and if the rupture is posterior, the anterior chamber looks very deep. The lens may be displaced and a hyphaema is usually present. The intra-ocular pressure is very low and the eye movements are reduced.

If severe lid bruising and oedema is present, it will be difficult to examine the eye. Care must be taken not to press on the eye in an attempt to open the lids, as this will further expulse ocular contents. If severe lid oedema prevents examination and a rupture is suspected, then an ultrasound or CT scan can detect globe integrity.

Management
Analgesia and anti-emetics should be administered, as globe injuries can be painful and vomiting is common. Uncontrolled vomiting can further expulse ocular contents. A hard plastic shield should be taped over the eye to stop eye-rubbing, especially in children. Tetanus status must be checked. Primary surgical repair of the globe by an experienced ophthalmologist should be performed as soon as possible. Many advocate use of oral ciprofloxacin to prevent endophthalmitis. Prognosis is generally poor and depends on the site and extent of rupture. Posteriorly positioned and large defects carry the worst prognosis.

Eyelid lacerations
In eyelid lacerations, assessment and management of the underlying ocular damage is more important than that of the eyelid. Visual acuity, fields, colour vision, ocular movement, pupillary defect, and the fundus should be examined. Conjunctival, corneal, and scleral
lacerations, hyphaema, lens dislocation, and globe rupture must all be excluded. The position, length, and depth of eyelid lacerations should then be documented under local anaesthesia, if required. **Upper-lid injuries may affect the levator muscle** and its function should be noted. Full neurological examination is required if penetrating brain injury is suspected or in the presence of altered consciousness.

**Failure to detect damage to underlying structures is the main source of error when evaluating lid lacerations.** Penetrating globe, orbital, and cranial injuries must be excluded in all penetrating lid lacerations. Small lid laceration may conceal a large retained foreign body. Globe rupture and blow-out orbital fractures are likely with blunt injuries.

**Plain orbital X-rays may reveal fractures and retained foreign bodies but CT scan is the investigation of choice if the history suggests a significant risk of the above.**

Any associated injury must be treated accordingly and the tetanus status checked. Especially in the unconscious patient, **eyelid lacerations can compromise the cornea**, which dries very quickly and loss of vision can ensue. Until the defect is repaired, eyelid remnants should be pulled over to provide corneal cover (a traction suture may be required for this). Plenty of chloramphenical or artificial-tears ointment should be administered and the whole area covered with a wet gauze swab.

Simple lacerations can be explored and cleaned under local anaesthesia and closed in layers as with any laceration. **Care must be taken to ensure suture ends do not rub the cornea and cause abrasions.** Many shallow cuts appose with no sutures; they scab over and heal extremely well, as the lid is very vascular. Complex lacerations (including any involving the lid margin, lateral and medial canthal regions, medial-third of the lids, and levator muscle) must be referred to an ophthalmologist for repair. These lacerations can disrupt the lacrimal drainage system.
and functional integrity of the lid and require detailed understanding of the functional and cosmetic anatomy of the region. As the lid is very vascular, even necrotic-looking tissue can survive and thus no tissue should be excised. Adequate cosmetic and functional results can be achieved but it may require further operations. Unsightly scars, watering, exposure of the cornea, and loss of vision are complication of lid lacerations.

**Retrobulbar haemorrhage**

Retrobulbar haemorrhage results from bleeding and associated oedema behind the orbital septum. It is effectively a form of compartment syndrome. Blood can collect within or outside the cone formed by the recti muscles, the former being more severe. As the pressure rises, it rapidly compromises the orbital and retinal vessels, with a concomitant increase in the intra-ocular tension. Left unchecked, blindness and ophthalmoplegia can result. These changes are irreversible in a few hours. Classically, the onset of symptoms is within a few hours of injury, but there are documented cases occurring after several days. Key symptoms are:

- severe pain;
- progressive loss of vision;
- proptosis;
- ophthalmoplegia;
- development of a fixed dilated pupil.

The combination of pain, proptosis, and loss of vision are the cardinal diagnostic features. However, the unconscious or agitated patient may not complain of pain, nor may it be possible to assess the visual acuity. A tense proptosis with resistance to retropulsion of the eye and a dilated pupil with an afferent defect may be the only clues to the presence of a retrobulbar haemorrhage. Again, it is essential to maintain a high index of suspicion and frequently review the patient. CT scanning will demonstrate severe proptosis with stretching of the optic nerve and a tented posterior sclera as the eye is forced anteriorly. Very often the diagnosis of retrobulbar haemorrhage is clinical, as treatment needs to be instituted as soon as possible.

Management is essentially surgical, although medical measures may be used while preparing the patient for theatre. The aim of treatment is to decompress the orbit. A lateral canthotomy with lateral canthal tendon division may be performed as a temporary measure. Lignocaine 1% with adrenaline (1 in 200 000) is injected into the lateral canthal area of the affected eye and the lateral canthus is incised to the orbital rim and the identified canthal tendon cut. The lower eyelid is then pulled forward and its lateral attachment to the orbital rim divided. This allows the globe to translate forward, so partially relieving the pressure by increasing the retrobulbar volume. If necessary, the same procedure can also be applied to the upper eyelid, laterally. This is usually a temporary measure to buy time, while preparing for surgery. Formal decompression is carried out under a general anaesthetic. The orbital and intra-conal space is entered allowing the blood and oedema to escape via a drain left in situ. Various approaches are possible, the infra-orbital approach is the most commonly used. In addition, high-dose intravenous steroids, acetazolamide (250–500 mg) and mannitol (1 g/kg) are often utilized before and after surgery until the globe pressure is seen to be falling.
Traumatic optic neuropathy occurs when there is disruption around the optic canal resulting in either compression of the optic nerve, shearing forces to the nerve as it passes through the canal, or haematoma formation within the nerve itself. Untreated it can render the patient blind and the diagnosis needs to be made early to allow the best chance of visual recovery. The signs that suggest an optic nerve injury include: decreased visual acuity, decreased colour vision, poorly reactive pupil, and an afferent papillary defect with a relatively normal ocular examination. This is an ophthalmic emergency and should be referred accordingly.
Treatment of optic nerve compression is controversial and again may be either medical or surgical. The options include: observation, IV corticosteroids, and optic nerve decompression. Medical treatment aims to reduce the oedema and inflammation that contributes to nerve damage. Time is of the essence; best results are obtained if steroids are given within 8 h of the injury. The surgical option is carried out via either a craniotomy approach or lateral facial approach.

Chemical injury
Chemicals that have a pH different to that of the eye (pH = 7.4) can cause a burn. Domestic and industrial accidents and assault are the commonest causes. **Alkalis cause more damage than acids, as they breakdown lipid membranes and penetrate deeper.** Many household cleaning detergents contain sodium hydroxide. Damage is caused by ischaemia and necrosis of the ocular surface with loss of epithelial stem and goblet cells. Loss of vision results from severe dry eyes and scarring. More severe cases result in cataract, glaucoma and uveitis as well.

Patients present with severe pain, blepharospasm, watering, and variable reduction in vision. Try to obtain the pH of the offending chemical and establish the baseline pH of both eyes. **All eyes must be given local anaesthetic drops, pH assessed, and irrigation with copious amounts of saline (litres) started immediately.** This must continue until the pH is normal before anything else is done (it is not unusual to need more than 5 l). Note vision, epithelial defects, corneal clarity, cataract, and residual particulate matter. Immediate referral to ophthalmology is then made, once the pH has come back to normal. Further management with intensive antibiotics, steroids, potassium ascorbate, cycloplegia, and vitamin C usually requires admission.

The prognosis can be extremely poor. This depends on the pH of offending chemical and the extent of initial damage. **Hence the first-aid treatment received on site and in casualty is vitally important if the patient is to have a good prognosis.**

Abrasion
This is an area where the corneal epithelium is deficient. The patient complains of pain, watering, and has a foreign-body sensation. They have difficulty keeping the eye open. Usually there is a history of trauma or contact lens wear. The eyelids may be in spasm and the conjunctiva is injected. With topical anaesthesia, the vision is normal. The area of abrasion stains with fluorescein.

Chloramphenical drop or ointment should be prescribed four times daily for 5 days. Although an eye-pad is not essential, it helps keep the eye closed and patients tend to feel more comfortable. It can be kept on for 1 day. The abrasion heals rapidly and the patient should be a lot more comfortable in 2 days. No contact lens should be worn for 2 weeks and after the patient has seen his/her own optician. If the patient is very distressed, cycloplegic drops given stat and oral analgesia will provide some relief until abrasion heals.

Refer only if a secondary corneal ulcer or a recurrent erosion syndrome develops. The latter develops if the epithelium does not adhere properly to the underlying Bowman’s membrane. It therefore is
likely to be scraped off by the upper eyelid first thing in the morning when the patient opens their eyes or in response to minor trauma and eye-rubbing. The problem may manifest itself months after the original trauma and at first presents with minor foreign-body sensation in the morning, which resolves completely in a few hours. Treat the acute abrasion as above. Long-term use of lubricating eye ointments, bandage contact lens, and occasionally surface treatment by needle puncture or laser may be required.

Ensure that there is no opacity of the cornea (which indicates a secondary infection of the underlying stroma) and there are no foreign bodies.

**Arc eye**

This is a specific condition caused by ultraviolet injury from welding, tanning lamps, and high-altitude snow. Ultraviolet light injury causes oedema and sloughing of the corneal epithelium leading to punctate erosions or abrasions. Patients complain of pain, tearing, blepharospasm, photophobia, and blurred vision several hours after exposure. Treatment is as with an abrasion.