Corneal Foreign Bodies, Injuries and Abrasions

This article covers superficial injuries to the cornea: corneal foreign body (FB), arc eye (welder's eye) and corneal abrasion. For other eye injuries, see separate Eye Injuries article.

Note that immediate action is required for acid or alkali injury (chemical burn) - start copious irrigation immediately. For management, see also separate article Eye Injuries article.

Presentation[1]

Corneal injuries may be physical, chemical, environmental (eg, ultraviolet (UV) damage) or infective. They are common and painful and patients present early and in discomfort which can be severe. The eye is typically red and watering; patients may be unable to keep the eye open. Topical anaesthesia may be required before the eye can be properly examined.

- Partial-thickness injuries (abrasions) are common. There is usually a history of minor trauma from a scratch, grit or contact lens. Corneal abrasions may also arise if the eyelids do not close properly - eg, where there is neuropathy, proptosis, or ectropion or in unconscious patients.
- Superficial keratitis may occur in response to UV injury (photokeratitis), or to chemical injury (eg, from tear gas).
- Corneal FBs usually cause marked irritation, redness and watering, often with pain and a repeated blink reflex. Patients are usually very good at localising the FB[2]. Some corneal FBs can cause significant damage if they are not removed quickly.
- Full-thickness injuries impair the integrity of the globe may be associated with intraocular FB (IOFB). These injuries can go unnoticed at the time but they can have rapidly serious consequences.
- If there is no clear mechanism of injury, consider corneal infection such as herpes simplex, or chemical injury.

History

The first priority in evaluating a corneal injury is to include or exclude a full-thickness injury and therefore a ruptured globe.

When a patient presents with corneal injury or pain, a detailed history is essential to avoid missing sight-threatening conditions. In the case of young children or unconscious patients, history from a witness may be helpful and if serious or penetrating injury cannot be ruled out then urgent referral will be needed.

A detailed, accurate history is important: how the injury was sustained is crucial, as any history of high-velocity injury raises the possibility of penetrating injury. Forceful blunt injuries, such as a punch, raise the possibility of blowout injury. The circumstances of the injury should be recorded.

Where no clear history is available from the patient, full assessment to exclude ocular emergencies is essential.
History
This should include:

- Time elapsed since injury.
- Circumstances of injury:
  - Establish what the patient was doing at the time.
  - Consider whether this could be a high-velocity injury with risk of open globe injury or IOFB (eg, power tools, metal on metal work, hammer and chisel, grinding, lawn mowing, glass injuries, explosion).
  - Note whether glasses or goggles were worn and what type they were (eg, hugging the eye or with a space where an object could have entered).
- Mode of injury:
  - Physical, chemical, thermal.
  - Nature and size of object: sharp or blunt.
  - Speed of impact.
  - Possible FB (on the surface or penetrating).
- Other injuries sustained.
- Treatment received so far.
- Previous acuity (even if just a rough estimate) and any existing eye problems.
- Current symptoms - pain, reduced vision, diplopia, flashes/floaters, FB sensation.
  - If there is severe eye pain with progressive visual loss ± proptosis, consider retrobulbar haemorrhage - see separate Eye Injuries article.
- Past medical history, tetanus immunisation, medication and allergies.

Symptoms suggesting superficial corneal abrasion or corneal FB

- Redness, pain, watering.
- FB sensation.
- Blurred vision.
- Photophobia.
- Pain on eye movement.
- There may be no symptoms if the FB is below the surface of the conjunctival epithelium. (Over a few days the epithelium may grow over small corneal FBs, with reduction in pain.)
- There is much less pain if the object is not over the cornea but over the sclera.
- Note that the degree of pain or visual impairment in ocular trauma does not necessarily correlate with the seriousness of the injury[3].

Symptoms suggesting penetrating corneal injury

- History of sudden onset or onset after specific event such as a road traffic accident.
- Activity at the time of injury may suggest the presence of high-velocity particles - eg, welding, grinding, hammering, mowing.
- Deep eyelid laceration.
- Multiple lacerations or injuries should raise suspicions (the penetrating injury may be very small.)
- All injuries caused by glass, knives, thorns, darts, or pencils.
- The eye is usually painful, red and watering.
- Tiny FBs may cause few if any symptoms.
- Penetration of the globe via the sclera rather than the cornea may be very difficult to detect, as symptoms may be mild.

Examination[4]
Examination will be dictated by the patient’s ability to co-operate - level of consciousness, pain, intoxication, age. Children as young as 3 or 4 years can manage a slit lamp in the right conditions.

If a peri-ocular haematoma develops the eye may close quickly and not re-open for several days, impeding eye examination. If unable to examine fully, refer. See also separate Examination of the Eye article.

If open globe (penetrating) injury is suspected, stop the examination and refer immediately. DO NOT apply any pressure to the eye. See separate Eye Injuries article.

Examine the eye from front to back, doing as much as your equipment allows (you may need to use local anaesthetic if the patient cannot open their eyes).

Functional eye examination

- Visual acuity (VA) for both eyes must always be documented in the case of corneal injury. The patient can often give an indication of whether the current acuity is broadly normal for them.
- Preferably use a Snellen chart; if this is not possible, document what the patient can see - eg, finger counting and light perception (if the eye cannot be opened, check light perception through closed lids).
- Acuities of 6/6 do not necessarily exclude serious problems.
- Ask about diplopia; check visual fields.
- Check pupillary reflexes.
- Test for relative afferent pupillary defect if possible.
General inspection

- Look for signs of infection - purulent discharge, an opaque base of a corneal surface defect, cells or pus in the anterior chamber.
- Intraocular pressure (IOP) should be assessed if possible, unless open globe injury is suspected.

Orbits and lids

- Look for lacerations, subcutaneous emphysema, bruising, deformity of the orbital rim, oedema.
- If fracture is suspected, measure the medial intercanthal distance (this should be 35-40 mm in adults).
- Where there is bilateral periorbital bruising, consider the possibility of a base of skull fracture rather than an eye injury.
- Evert the lids (unless lacerated) to look for FBs.

Conjunctiva

- Look for haemorrhage and lacerations (small lacerations may show up on staining with fluorescein) - these can indicate an open globe injury. Document size, shape and position of any defect.

Cornea

- Lacerations may be small and missed.
- Perform a Seidel's test - outlined below - to assess for leakage from the cornea.
- Assess for corneal abrasion with dilute fluorescein.
- After fluorescein staining of the cornea, an abrasion will appear yellow under normal light and green in cobalt blue light\(^5\).
- Look for corneal and conjunctival FBs.

Anterior chamber

- Look for hyphaema (a fluid level of blood in an upright patient).
- Look for signs of injury beyond the cornea.

Iris and pupils

- Check the shape and size and whether reactive and equal.
- Any pupil or iris damage is a serious sign.

Fundus

- Loss of red reflex could be due to blood in the vitreous or a large retinal detachment.
- If possible, examine with a slit lamp for corneal oedema, epithelial disruption, or anterior chamber penetration.
Seidel's test\[3\]
This should be performed if penetrating injury is a possibility. Apply 10% fluorescein (this is dark orange - a moistened fluorescein strip will do) to the suspicious area, asking the patient not to blink. Observe using a slit lamp with cobalt blue light source, or a Wood's light. If aqueous fluid is leaking through a corneal laceration, a stream of clear or paler fluid will be seen in the pool of dye, as the aqueous leaks out and dilutes it. If found, treat for open globe injury (see under 'Examination', above).

A negative Seidel's test does not rule out a penetrating injury, as it may occur with small or spontaneously sealing lacerations of the cornea.

Signs

Penetrating injury
- Distorted globe.
- Subconjunctival haemorrhage.
- Conjunctival laceration.
- Black protruding uveal tissue.
- Distorted iris or pupil.
- Hyphaema.
- Bulbar conjunctiva injected with prominent blood vessels.
- Fattened cornea due to loss of aqueous humour from the anterior chamber.
- Air bubbles under the cornea.
- Iris protrusion through the cornea.
- Positive Seidel's test.

Abrasion
- Conjunctival injection (redness) or ciliary injection.
- Epithelial defect that stains with fluorescein.
- Linear or multiple abrasions suggest a subtarsal FB.

Corneal foreign body
- Visible FB (easily missed at the limbus).
- Rust ring, especially if a ferrous FB has been embedded for hours or more.

Photokeratitis (arc eye)\[6\]
- History of UV light exposure without protective goggles - from welding, sunbed use or snow fields.
- Symptoms start 6-12 hours after exposure: a gritty sensation, pain or irritation, watering, photophobia and reduced visual acuity.
- Lid edema and conjunctival redness (variable).
- Diffuse corneal haze (severe cases).
- Superficial punctate keratitis: slit-lamp examination and fluorescein stain reveal superficial punctate epithelial surface irregularities, which usually cover the entire surface of the cornea.
- If the patient's eye was partially closed during the exposure, a line demarcates normal from damaged cornea.

Red flag and serious signs
These all suggest significant injury to the globe:
- Deep lid laceration: there may be damage underneath it.
- Subconjunctival haemorrhage/conjunctival laceration: in the context of eye trauma, can indicate open globe injury, especially if there is severe or diffuse haemorrhage. If it tracks posteriorly, it may indicate fracture.
Pupil, iris or fundal abnormalities:
- Hyphaema, irregular pupil or decreased IOP suggest that an object has gone at least into the anterior chamber. Hyphaema indicates significant eye injury.
- Teardrop-shaped pupil indicates open globe injury.
- Vitreous haemorrhage suggests injury to the posterior segment of eye.
- Positive Seidel's test (see below) - indicates open globe injury.
- Abnormalities of eye movements, proptosis or enophthalmos - indicate damage in the orbital area or to extraocular muscles.

Differential diagnosis

- Open globe injuries (penetrating injury).
- Corneal ulcer (microbial keratitis) - suspect this in contact lens users or if there is no clear history of trauma.
- Dendritic ulcer (herpes simplex infection).
- Acute glaucoma.
- Uveitis.
- Scleritis.
- Chlamydial conjunctivitis.
- Herpes zoster ophthalmicus.
- Orbital cellulitis.
- Other causes of red eye:
  - Conjunctivitis
  - Episcleritis

Investigations

- Investigations are not required if you can be sure that the injury is superficial.
- CT scan is usually the first choice for evaluating orbital trauma and orbital fractures and for detecting IOFBs.
- Plain X-rays are rarely used for orbital injuries, although they can be used to rule out known radiopaque foreign bodies if there is a clear history of hammering metal and an apparently superficial wound to the eye.
- MRI is less used and is contra-indicated if a metallic FB is suspected.

Management

Management must be dictated by the worst case scenario.

Indications for urgent referral to an ophthalmologist

- All high-velocity injuries and injuries caused by glass, knives, thorns, darts, or pencils. These should be treated as penetrating injuries until proved otherwise.
- All chemical injuries: commence emergency management while awaiting transfer to secondary care (see below).
- FBs that cannot be removed. Those in or near the centre of the cornea increase risk of visual impairment.
- Pain which is not relieved by topical local anaesthetic should be assumed to be due to something more serious than a superficial corneal injury (eg, corneal ulceration, iritis, acute glaucoma).
- A reduction in visual acuity (suggests intraocular pathology).
- Large abrasions (over more than 60% of the cornea).
- Corneal opacities.
- Rust rings that remain after removal of a metallic foreign body.
- Hyphaema (blood in the anterior chamber), as it is associated with a risk of further haemorrhage.
- Distorted pupil (may be associated with a penetrating injury).
- Suspected damage to the retina.
- Deep laceration of the orbit (may indicate intraorbital and ocular penetration, and retained FBs).
- Subconjunctival haemorrhage which tracks posteriorly, if there is a history consistent with a possible orbital fracture.
- Marginal lacerations, as the lacrimal ducts may be damaged.
- Signs of infection - suspected microbial keratitis (corneal ulcer).
- Difficulty in making a full assessment - eg, if there is unclear history, lids are swollen, it is a young child, or there is a reduced level of consciousness.
- Patients with persistent symptoms after 72 hours.
- Patients with worsening symptoms.
- A corneal abrasion which shows no improvement on a daily basis.
- Refer if this is the patient's only seeing eye.
- Contact lens users:
  - Microbial keratitis (corneal ulcer) can be mistaken for a corneal abrasion. Consider urgent referral for contact lens wearers who have a red, painful eye with a corneal epithelial defect.

Corneal abrasion

- Goals of treatment include pain control, prevention of infection, and healing. Pain relief may be achieved with topical non-steroidal anti-inflammatory drugs or oral analgesics.
- Refer large abrasions (>60%).
- Topical cycloplegics are not usually indicated for uncomplicated corneal abrasions.
- Patching is not recommended, as it does not improve pain and has the potential to delay healing.
Although evidence is lacking, topical antibiotics are commonly prescribed to prevent bacterial superinfection. Topical antibiotic is usually prescribed for seven days:

- Chloramphenicol first-line (ointment may be preferred, as it lubricates the cornea).
- Fusidic acid (twice daily) as an alternative (where the patient is pregnant, where treatment four times a day is impractical (eg, children or elderly people), or where there is personal/family history of blood dyscrasias).
- Contact lens-related abrasions should be treated with antipseudomonal topical antibiotics.

Follow-up may not be necessary for patients with:

- Small (4 mm or less), uncomplicated abrasions.
- Normal vision.
- Resolving symptoms.

All other patients should be re-evaluated in 24 hours.

Referral is indicated for any patient with:

- Symptoms that do not improve or that worsen.
- A corneal infiltrate or ulcer.
- Significant loss of vision.
- A penetrating eye injury.

Prevent secondary infection:

- Tetanus prophylaxis as for any superficial wound.

Patients should avoid use of contact lenses until the cornea has completely healed and 24 hours after topical antibiotic use. Some guidelines suggest avoiding contact lens wear for two weeks.

Refer urgently if the abrasion is not reducing in size or has not healed within 72 hours, or if there are any worsening symptoms.

**Corneal FB**

- Only remove a corneal FB if you are confident and experienced with this procedure - otherwise, refer.
- Use a topical anaesthetic (refer if the topical anaesthetic does not remove the pain - this indicates a more serious problem).
- Ensure the patient is comfortable with their head well supported (correctly positioned at the slit lamp or with the head supported, for example, on the examination couch).
- Irrigate the eye with water, or remove the FB with a cotton wool bud or a triangle of card. A wetted cotton bud is preferable to a dry one, as it is less likely to abrade the eye.
- If this is unsuccessful, and only if you are experienced, carefully lift the FB using the tip of a sterile 25-gauge needle.
- Evert the upper lid to locate and remove a subtarsal FB. This is important if there are vertical corneal scratches or a feeling that the FB is still there.

After removal, examine and treat for a corneal abrasion as above (fluorescein stain, analgesia, topical antibiotic and tetanus prophylaxis; avoid use of contact lenses until healed).

**Rust rings**

- These can develop within hours, from iron in a metallic FB. They are removed using a rotating sterile burr (doing this requires a slit lamp). This is the quickest, safest and most precise form of treatment. It enables complete removal of the corneal rust at a single treatment and leaves a smooth crater that is no larger than the original rust ring. Pain relief is more rapid after electric drill removal; this is probably related to the complete removal of the rust. Epithelial and stromal healing are marginally faster than after manual removal.
- Removal may be deferred for a day to allow the ring to become more superficial.
- Antibiotic ointment may help to loosen the ring.

**Photokeratitis (arc eye)**

- Local anaesthetic will completely relieve pain (temporarily).
- Treat similarly to corneal abrasion (as above):
  - Oral analgesia - eg, paracetamol or ibuprofen.
  - Topical short-acting cycloplegic.
  - Topical antibiotic - eg, chloramphenicol ointment for three days.
  - Optional eye pad.

- Do not prescribe topical anaesthetic to take home (it delays healing).
- Advise that symptoms should resolve within 24-48 hours - if not, instruct the patient to seek help, and refer.

**Recurrent corneal abrasions**

- These usually occur at night when there is little secretion of tears and the epithelium may be torn off by the blinking eyelid. See separate Recurrent Corneal Erosion Syndrome article.

**Penetrating corneal injuries**

These require immediate referral to specialist care.

- Do not touch, manipulate or pad the eye.
- Do not check IOP.
- If a foreign body is present, do not remove it (this could cause prolapse of eye contents).
- Use a rigid eye shield to protect the eye - if not available, make one from the bottom of a polystyrene cup. Do not touch the eye or attempt to pad it. The shield is usually shaped so that one end rests more easily adjacent to the nose, and fixed with tape.
- Refer immediately - will need antibiotic cover and surgery.
- Make the patient nil by mouth.
- Avoid any increase in pressure on the eye:
  - Tell the patient not to blow the nose, cough, strain or bend over.
  - Provide adequate analgesia and antiemetics (important to prevent vomiting which puts pressure on the globe).

- Treat as a high tetanus risk wound.
- Further management depends on the nature and location of the FB. Organic and most metal FBs require urgent surgical removal. Some inert objects may be allowed to remain in the eye.

**Chemical burns**[1]

Acid and alkali burns represent potentially blinding ocular injuries and are an ocular emergency requiring immediate treatment and specialist referral (in that order). Other chemicals, including CS gas, pepper spray and mustard and chlorine gas, produce intense eye irritation. CS gas should be evaporated off the eye using a cool hair dryer or fan, whereas pepper spray and chlorine (which damages the cornea but as chlorine and as hydrochloric acid) should be copiously irrigated.

For detailed information on the management of chemical burns, see separate Eye Injuries article.
Patching the eye
Traditionally, an eye with a corneal abrasion following an FB was patched for 24 hours in order to relieve pain and protect the cornea. However, evidence suggests patching is of no benefit for simple abrasions of <10 mm$^2$ (larger abrasions were not included in this research$^{[12]}$). Many departments no longer advise patching, or suggest a short period of patching only (eg, overnight). Patched patients should not drive.

How to patch
Prepare two sterile surgical eye pads and adhesive tape. Fold one pad in half and place it over the closed eye (it works best with the fold edge up and the curved side pointing down). Place the second pad over the first and apply the tape. A single pad will not keep the eye shut and will cause more discomfort.

Complications and prognosis
- Corneal abrasions usually heal well.
- If they are on the visual axis, there is potential loss of VA due to corneal scarring.
- Recurrent corneal abrasion syndrome can occur if the corneal epithelium is disrupted.

Prevention
This hinges on the use of appropriate eye protection for hazardous occupations, involving power tools, DIY, in sport, and against UV light exposure.

A leaflet for the public on preventing eye injuries is available$^{[13]}$.

Further reading & references
- Snellen Chart; Living Well with Low Vision
- The Wills Eye Manual
- Clinical Management Guidelines on Photokeratitis; The College of Optometrists, 2015
- Day A, Carp C; Response to Thyagarajan et al's audit: "An audit of corneal abrasion management following the introduction of local guidelines in an accident and emergency department." Emerg Med J. 2006 Dec;23(12):959.
- Vision Safety; Canadian Ophthalmological Society

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