Approach to Corneal Trauma

David Chenoweth, Christopher Sales, Mark Greiner, Chau Pham, Erin Shriver, Kanwal Matharu

Background:

A corneal foreign body is an object adherent to or embedded in the cornea, the anterior-most portion of the eye. The cornea is one of the most densely innervated structures in the body and is incredibly sensitive to even microscopic foreign bodies.

Prompt removal of a corneal foreign body is important in preventing infection, scarring, or even perforation.

Removal of a corneal foreign body rarely requires the use of an operating room, although a well-lit clean area with appropriate instrumentation is required.

Anatomy:

The cornea is the transparent part of the eye that covers and protects the iris and pupil, allowing light to reach the back of the eye. It is an avascular tissue that functions as a structural barrier and, in conjunction with the tear film, provides the majority of the total refractive power of the eye.

The cornea is essentially a convex oval, measuring 11-12 mm in the horizontal meridian and 9-11 mm in the vertical meridian. It is thickest in the periphery, and thinnest at its center. Generally, the cornea is 550-560 microns thick in the center. The thickness is largely governed by the collagen containing stroma of the cornea.

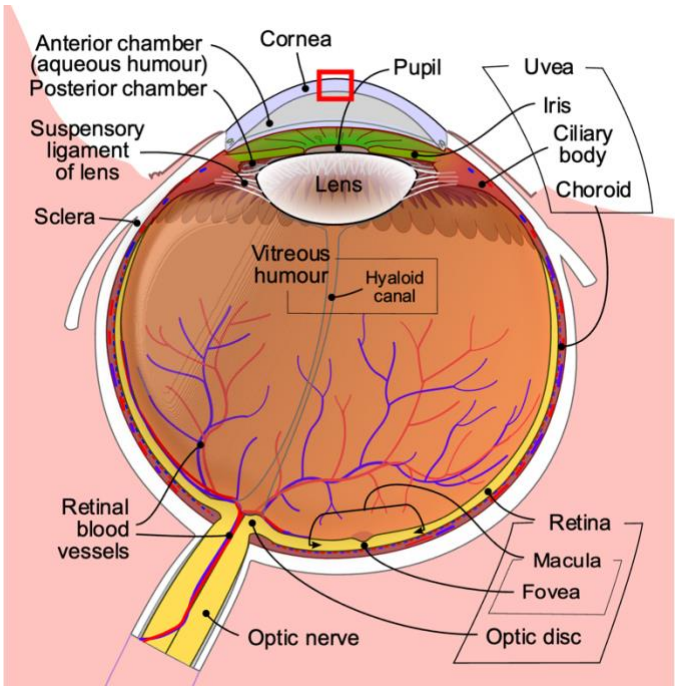
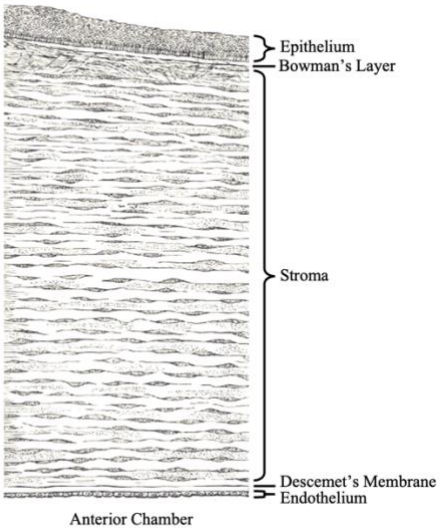


Diagram of the eye. The cornea is a convex oval on its anterior surface. Detail of the part in the Red box is shown further below. Source: Rhcastilhos. and Jmarchn https://commons.wikimedia.org/w/index.php?curid=1597930



5 layers of the cornea, close-up detail of the Red box in the previous picture. See the text below for details.

Histologically, the cornea consists of 5 layers. From anterior to posterior:

1. The corneal epithelium: a non-keratinized stratified squamous epithelium with cuboidal basal cells. This layer makes up about 1/10th of the corneal thickness. It functions to protect the surface of the eye from injury and pathogens.

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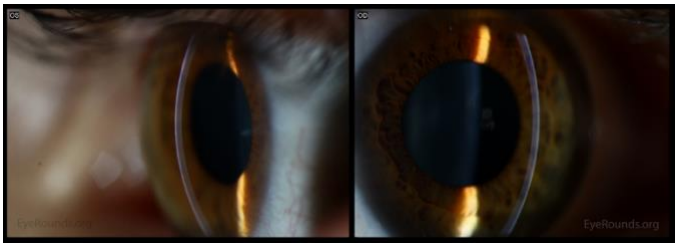
2. Bowman's layer: an anterior limiting lamina for the stroma composed of collagen fibrils.
3. The Stroma: a largely acellular layer composed of collagen and fibroblasts. The density of intertwined collagen fibrils is greatest at the periphery and anterior aspects of the cornea. This gradient of density provides the cornea with its shape. It also contributes to the mechanical weakness of the very posterior stroma, an attribute important to note prior to any instrumentation involving the stroma.
4. Descemet's membrane: A cell-free matrix that acts as a posterior limiting lamina for the stroma as well as a basement membrane for the underlying endothelium.
5. Endothelium: A single layer of squamous cells that actively transports water from the stroma into the anterior chamber in order to maintain the transparency of the corneal stroma.



A slit lamp photo depicting a normal cornea. The curved, sharp blue line represents the epithelium and the thick, faded blue line highlights the stroma.

Principles:

Symptoms of a corneal foreign body include a foreign body sensation, pain, tearing, light sensitivity and vision changes.

Should a patient's presentation raise concern for a corneal foreign body, it is important to ascertain the suspected material as well as the mechanism of injury.

Different materials carry different infection and chemical injury risks. Soil and plant material are associated with bacterial and fungal infections. Metal material, particularly iron, carries the risk of oxidative injury to the stroma resulting in a "rust ring" if not removed within several hours; however, these "rust rings" will typically self-resolve over time or can be manually shaved away as the stroma regenerates. Infections and rust rings increase the risk of permanent corneal scarring. Cement, particularly wet cement, can cause alkaline burns when it reacts with water in the tear film. Any concern for a chemical burn in the eye should prompt emergent irrigation.

The mechanism can be critical in determining the risk of globe perforation. Dense materials moving at high speed carry a high risk of globe perforation. These patients require careful slit-lamp examination, and if possible, ultrasound or CT imaging. MRI must be avoided if there is suspicion of metal involvement.

After obtaining a history, the patient should have a complete 8-point eye exam: best corrected vision, measurement of intraocular pressure, pupils, extraocular motility and alignment, confrontation visual fields, external examination, fundoscopic examination, and a thorough slit lamp examination including eversion of the eyelids and sweeping of the fornixes to reveal any additional foreign bodies.

A careful slit lamp exam is pertinent to detail the location, size, and depth of the foreign body. The slit lamp is an instrument consisting of a high-intensity light source combined with a bimicroscope, that is focused to shine a thin sheet of light into the eye as the clinician visualizes the structures of the anterior and posterior segments. If a slit lamp is unavailable, it is reasonable to examine the eye under the highest magnification that is available, such as surgical loupes or a magnifying glass.

A slit lamp allows a clinician (Left) to view details of the eye under magnification with a thin sheet of focused light. Source: Ralf Roletschek
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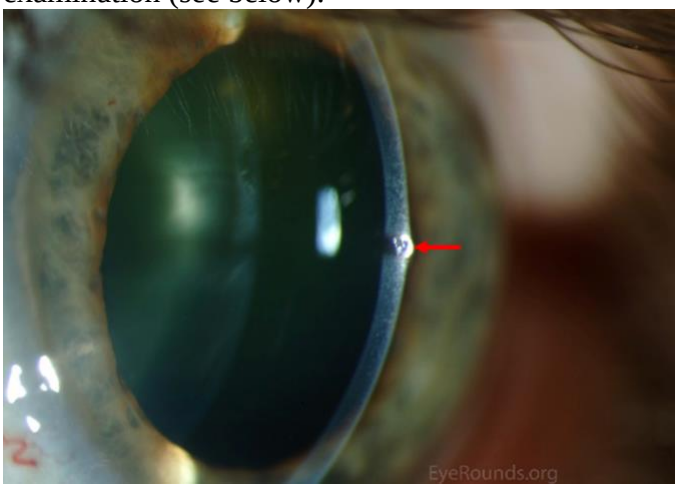
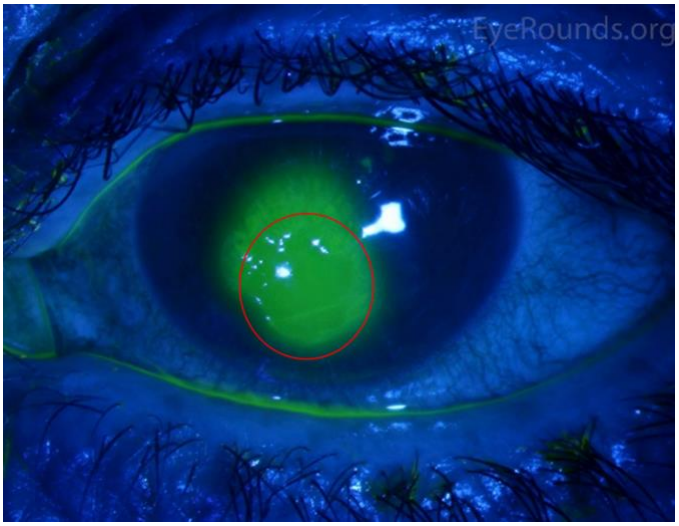
Fluorescein stain under cobalt blue light is useful in highlighting epithelial defects and can aid

in the identification of small foreign bodies in both the cornea or eyelid. If resources allow, a Seidel test should be performed at the time of slit lamp examination (see below).

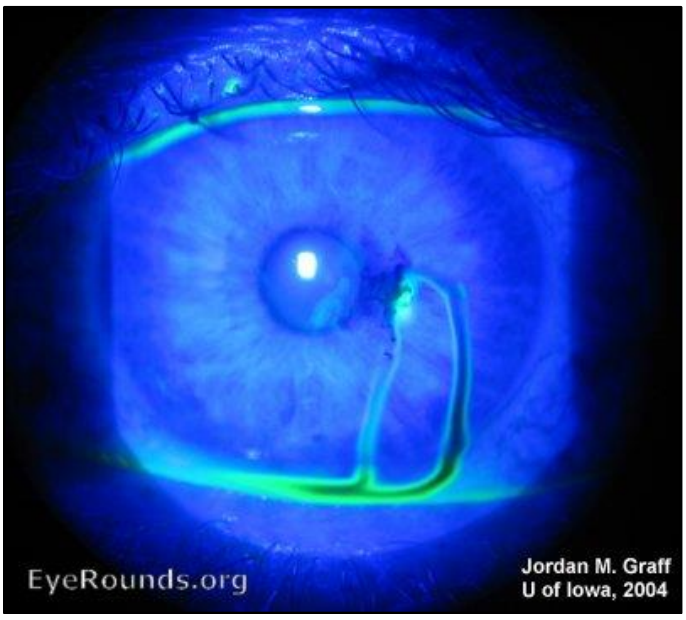


Slit lamp photo demonstrating a metallic corneal foreign body (Red arrow).



Slit lamp photo demonstrating a corneal epithelial defect (Red circle) highlighted with the application of fluorescein dye under cobalt blue light.

A Seidel test can reveal occult perforations, signifying an open globe. This test is performed by applying fluorescein with a strip of filter paper to the injury site and observing the area under cobalt blue light at a slit lamp. In a positive Seidel test, aqueous humor leaking from the injury will dilute the normally green stain producing a dark blue stream from the site of perforation. These patients frequently require surgery in an operating room. See the chapter on open globe repair.



Slit lamp photo demonstrating leaking aqueous humor from a corneal injury, a positive Seidel test under cobalt blue light.

Decision Making:

Most corneal foreign bodies are superficial and can be removed at the slit lamp with a pair of Jeweler's forceps. Delaying removal can result in migration of the foreign body deeper into the stroma and can even result in delayed perforation. Incomplete removal of foreign bodies causing chemical injuries can result in irreversible damage.

Attempts to remove deeply imbedded foreign bodies risks perforation, therefore removal of a deeply penetrating foreign body should be performed in the operating room. However, it may not be necessary to attempt removal of all full thickness or intra-ocular foreign bodies. Objects that do not pose significant chemical or infectious risk, such as plastic or glass, are considered inert. Inert foreign bodies may be managed conservatively with serial examinations.

Before attempting removal, the patient's ocular surface should be anesthetized. With the eye anesthetized the patient will be asked to fixate on a target while the surgeon uses a small needle to lift the foreign body from the stroma. Once free of the stroma the foreign body can be safely removed with a pair of small forceps, a cotton tipped applicator, or even a magnet depending on the material of the foreign body. This procedure is described in more detail in the next chapter.

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After foreign body removal the cornea should be reexamined for any residual foreign material. An assessment of the epithelial defect should be made including a final Seidel test.

Patients should receive broad-spectrum topical ophthalmic antibiotics for at least one week. Typical antibiotics used to cover corneal foreign bodies include polymyxin B/trimethoprim drops, or a polysporin ointment. In cases of a large epithelial defect, the ointment formulation provides additional lubrication that reduces discomfort. If the mechanism of injury involves contact lens wear, organic matter, or a fingernail, then the patient should be placed on a topical fluoroquinolone and followed closely for the development of microbial keratitis. Topical steroids are typically avoided due to increased risk of infection.

Depending on the size and proximity to the center of the cornea, the patient should be evaluated within 1 to 7 days to assess the epithelial defect and monitor for signs of infection. It is reasonable to discontinue antibiotics once the epithelial defect has closed.

Unfortunately, if the foreign body penetrates Bowman's layer, scar formation is likely. If centrally located, these scars may affect vision. Otherwise, the cornea is resilient, and most patients' long-term vision is unaffected.

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https://eyerounds.org/#gsc.tab=0&gsc.q=corneal%20foreign%20body%20removal&gsc.sort=

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