**Corneal Abrasion**

A self-assessment module (SAM) by the American Board of Optometry, based on an online continuing education course from Optocase (<https://optocase.com>).

This SAM provides an opportunity to 1) review the anatomy and principals of wound healing relevant to corneal abrasions, 2) review various treatment modalities for corneal abrasions, and 3) review issues related to follow-up of corneal abrasions and potential complications.

The following references provide overviews of the topics covered in this SAM and are recommended for review prior to the assessment. Additional references are provided in the individual sections of the SAM.

Vollmer, L. No insult to injury: treating corneal trauma. Review of Optometry; 2016 Apr 15. <https://www.reviewofoptometry.com/article/no-insult-to-injury-treating-corneal-trauma>

Verma, A. Corneal abrasion treatment & management. Medscape; 2017 Dec 29.

<https://emedicine.medscape.com/article/1195402-treatment#d16>

**Question 1**

What is the most common cause of corneal abrasion?

1. Idiopathic
2. Iatrogenic
3. Trauma
4. Recurrent corneal erosion

Answer C: Trauma

A corneal abrasion is a disruption in the integrity of the corneal epithelium usually caused by mechanical injuries involving the ocular surface. It is the most common ocular injury and usually heals rapidly within 24-72 hours without significant sequelae. It is more common in males than females, and more common in working age individuals. Treatment involves pain management and avoiding secondary complications such as infection while the ocular surface heals.

Most commonly corneal abrasions are a result of trauma to the ocular surface (mechanical or chemical) and usually patients recall the specific mechanism of injury. Other etiologies of abrasion include:

* **Spontaneous**: Spontaneous abrasion is rare in the setting of a healthy cornea, however in the setting of ocular surface disease (e.g. dry eye, anterior basement membrane dystrophy) and/or abnormally weak attachments of basal epithelial cells to the stroma, no traumatic event may be recalled. Patients with eyelid abnormalities (e.g. CN VII palsy) are also at risk of spontaneous abrasion.
* **Foreign bodies**: Corneal foreign bodies as well as their subsequent removal are a common cause of corneal abrasions. Foreign bodies underneath the eyelids may also cause corneal abrasions- often these abrasions will be in a vertical pattern consistent with the location of the foreign body.
* **Contact lens use:** Corneal abrasions are not uncommon in the setting of contact lens wear and may occur during lens insertion or lens removal, as well as with an overworn, improperly cleaned, or poorly fitting lens. Abrasions are more common with rigid lenses, but can also occur in poorly fitted soft lenses due to acute epithelial hypoxia that impairs attachment of the epithelium to Bowman’s layer.
* **UV keratitis:** Patient usually presents with a clear history of UV exposure.
* **Iatrogenic**: A number of iatrogenic causes may lead to corneal abrasion. These include diagnostic testing (e.g. A scan probe, tonometry [especially if alcohol remains on the tonometer tip]), intravitreal injections, intraocular surgery, eyelid surgery, inappropriate patching (e.g. in setting of CN VII palsy), and in unconscious patients. Corneal abrasions are the most common ocular complication of general anesthesia, as both Bell’s phenomenon and the blink reflex are inhibited by general anesthesia. Most centers use ocular protection during any surgery performed under general anesthetic.

References:

Wilson SA, Last A. Management of corneal abrasions. Am Fam Physician 2004;70(1):123-8.

Wong TY, Lincoln A, Tielsch JM, Baker SP. The epidemiology of ocular injury in a major US automobile corporation. Eye (Lond) 1998;12 (Pt 5):870-4.

Smith CH, Goldman RD. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions in children. Can Fam Physician;58(7):748-9.

Terry HR, Jr., Kearns TP, Love JG, Orwoll G. Untoward Ophthalmic and Neurologic Events of Anesthesia. Surg Clin North Am 1965;45:927-38.

White E, Crosse MM. The aetiology and prevention of peri-operative corneal abrasions. Anaesthesia 1998;53(2):157-61.

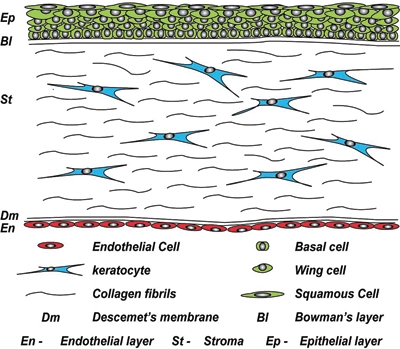
**Question 2**

Most corneal abrasions involve only the most superficial layer of the cornea, which is the:

1. endothelium
2. epithelium
3. Bowman’s
4. Stroma

Answer B: Epithelium

The cornea is a transparent structure made up of 5 layers; from anterior to posterior these include the epithelium, Bowman’s layer, stroma, Descemet’s membrane, and endothelium (see exhibit below). The corneal epithelium compromises roughly 10% of the corneal thickness, and is itself a complex structure made up of multiple cell layers.



Reference:

Sharma S. Ophthaproblem. Corneal abrasion. Can Fam Physician 1998;44:2385, 94.

**Question 3**

The thickness of the epithelium layer is approximately:

1. 10 um
2. 50 um
3. 100 um
4. 500 um

Answer B: 50 um

The epithelium is approximately 50 um thick and is made up of several layers of cells. The most superficial layer of the epithelium is made up of squamous cells with flattened nuclei. The next 2-3 layers are polyhedral cells known as wing cells. The deepest layer of the epithelium is made up of columnar cells known as basal cells.

Deep to the basal cells lies the basal lamina, a thin layer made up of extracellular secretory products of basal epithelial cells. Basal cells are anchored to the basal lamina by hemidesmosomes. The function of the basal lamina is to attach the corneal epithelium to the stroma, and once destroyed takes approximately 6 weeks to regenerate in full.

Reference:

Snell R, Lemp, MA. Clinical anatomy of the eye. Malden, Mass: Blackwell Science Inc, 1998; 143-5.

**Question 4**

The mitotically active cells of the epithelium are:

1. basal cells
2. wing cells
3. basal lamina
4. squamous cells

Answer A: Basal cells

Basal cells which comprise the deepest layer of the epithelium, are the only mitotically active cells in the epithelium. The lateral borders of columnar basal cells interdigitate and connect with one another via desmosomes and gap junctions. Superficial to the basal cells are 2-3 layers of polyhedral cells known as wing cells. The most superficial layer of the epithelium is made up of squamous cells with flattened nuclei. The mitotically active basal cells continually migrate anteriorly, changing shape into wing cells and subsequently superficial squamous cells. Squamous cells then disintegrate, lose their desmosome attachments, and are shed into the tear film.

**Question 5**

Bowman’s layer of the cornea is made up of:

1. cells
2. collagen
3. extracellular matrix
4. vascular tissue

Answer B: Collagen

Bowman’s layer is a thin membrane between the stroma and epithelium made up of irregularly arranged collagen fibers, that protect the deeper corneal layers from injury.

**Question 6**

Which cranial nerve is responsible for sensation to the cornea?

1. CN II
2. CN III
3. CN V
4. CN VII

Answer C: CN V

The cornea is richly innervated, primarily through the ophthalmic division of cranial nerve V (the trigeminal nerve). Such rich innervation accounts for the often significant symptoms associated with even a slight abrasion. The reaction time of the eyelids to close in response to injury is approximately 425 ms, slower than many ocular insults, and helps explain why corneal abrasions are so common.

References:

Smith CH, Goldman RD. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions in children. Can Fam Physician;58(7):748-9.

Hua L, Doll T. A series of 3 cases of corneal abrasion with multiple etiologies. Optometry;81(2):83-5.

**Question 7**

Following an injury to the cornea, migrating basal cells usually cover a corneal abrasion within:

1. 1 hour
2. 24-48 hours
3. 7 days
4. 4-6 weeks

Answer B: 24-48 hours

A corneal abrasion is a defect in the superficial corneal layers, usually limited to the surface epithelium but occasionally also involving deeper layers such as the Bowman’s layer and superficial stroma.

Within one hour of injury, healing of an abrasion is initiated by the dynamic and mitotically active basal epithelial cells. These cells begin to slide and migrate in an amoeboid movement across the denuded epithelium (along Bowman’s layer). Simultaneously, surrounding basal cells undergo mitosis to supply additional cells to cover the defect. Corneal abrasions, even larger abrasions, are usually covered by migrating epithelial cells within 24-48 hours.

References:

Snell R, Lemp, MA. Clinical anatomy of the eye. Malden, Mass: Blackwell Science Inc, 1998; 143-5.

American Acadamy of Ophthalmology. Ophthalmic pathology and intraocular tumors. Singapore, 2011.

**Question 8**

Migration of basal cells in healing a corneal abrasion is stopped by:

1. contact inhibition
2. repetitive trauma
3. neurotrophia
4. enzymes in the tear film

Answer A: Contact inhibition

When the corneal is injured, mitotically active basal epithelial cells begin to slide and migrate in an across the denuded epithelium (along Bowman’s layer) until they touch other migrating cells. Contact inhibition subsequently arrests further migration.

Reference:

Snell R, Lemp, MA. Clinical anatomy of the eye. Malden, Mass: Blackwell Science Inc, 1998; 143-5.

**Question 9**

Complete structural restoration of the cornea after an abrasion takes:

1. 7 days
2. 14 days
3. 4-6 weeks
4. 1-2 years

Answer C: 4-6 weeks

Although large corneal abrasions are usually covered by migrating epithelial cells within 24-48 hours, complete restoration of all epithelial cell layers takes approximately 7 days, and the reformation of anchoring fibrils is not complete for 4-6 weeks.

Reference:

Snell R, Lemp, MA. Clinical anatomy of the eye. Malden, Mass: Blackwell Science Inc, 1998; 143-5

**Question 10**

Abrasions deep into the stroma generally result in:

1. facet formation
2. good wound healing
3. scar formation
4. neovascularization

Answer C: Scar formation

Abrasions involving the epithelial layers only usually heal rapidly and do not form a scar. If an abrasion extends deeper into the corneal stroma, the defect will usually be repaired by a scar formation, characterized by an abnormal collagen arrangement seen clinically as a densely opaque and clinically obvious lesion.

**Question 11**

Patching provides benefit for treating corneal abrasions by:

1. preventing infection
2. decreasing pain
3. promoting more rapid wound healing
4. none of the above

Answer D: None of the above

Classically, eye patching with antibiotic ointment with or without cycloplegia was standard of care for patients with corneal abrasions. It was proposed that patching improved symptoms of ocular pain and photophobia, and also provided a favorable environment for epithelial healing.

However, subsequent research has called into question the benefit of ocular patching. A randomized clinical trial by the Corneal Abrasion Patching Study Group in 1995 randomized 223 patients with non-infected, non-contact lens related traumatic or foreign body removal-related corneal abrasions to cycloplegia and topical antibiotics with either pressure patching or no patching. Surprisingly, patients randomized to the no-patch group had faster resolution and less pain than the patch group.

Recently, a Cochrane review reported on a meta-analysis of all available trials studying patching in the setting of corneal abrasions. It likewise concluded that patching did not significantly improve healing time or improve pain scores.

It is also suggested that patching may create a warm, moist environment to support bacterial proliferation. Other potential adverse effects of patching include decreased oxygenation of the cornea, reduced epithelial turnover, and decreased elimination of cellular metabolism waste products which may interfere with washout of bacteria.

References:

Turner A, Rabiu M. Patching for corneal abrasion. Cochrane Database Syst Rev 2006(2):CD004764.

Kaiser PK. A comparison of pressure patching versus no patching for corneal abrasions due to trauma or foreign body removal. Corneal Abrasion Patching Study Group. Ophthalmology 1995;102(12):1936-42.

**Question 12**

The most important functional impact of applying a patch to patients is:

1. sudden change to monocular vision
2. diplopia
3. decreased visual acuity in the fellow eye
4. discomfort

Answer A: Sudden change to monocular vision

The sudden change from binocular to monocular vision with patching creates consequences for depth perception (e.g. driving implications). Along with concerns about creating an environment that encourages bacterial growth and other adverse effects to the cornea, patching is no longer recommend for routine use in the setting of corneal abrasions, and is in fact generally contraindicated.

It should be noted that some experts consider patching to be useful in the setting of large abrasions and deeper abrasions involving the corneal stroma. Patching is best avoided in patients at risk of infection such as in the setting of contact lens wear or vegetative matter trauma.

Reference:

Kaiser PK. A comparison of pressure patching versus no patching for corneal abrasions due to trauma or foreign body removal. Corneal Abrasion Patching Study Group. Ophthalmology 1995;102(12):1936-42.

**Question 13**

Topical antibiotics should be routinely used in the treatment of:

1. large corneal abrasions
2. corneal abrasions due to vegetative matter
3. abrasions in contact lens wearers
4. all of the above

Answer D: All of the above

Topical antibiotics are frequently prescribed in the setting of corneal abrasion to reduce the risk of secondary infection. It is suggested that an injured cornea is vulnerable to infection by either the normal ocular surface flora, or a contaminated foreign body.

However, it should be noted that there is limited evidence to support the routine use of antibiotics, with limited data from large well-designed studies. Many antibiotics may also delay corneal epithelial healing. While traditionally topical antibiotics were prescribed to all patients with corneal abrasion, most experts only recommend their use in the setting of higher risk of infection such as with large abrasions, abrasions caused by contaminated foreign bodies, and abrasions in the setting of contact lens wear.

If topical antibiotics are to be used for prevention of infection, a broad-spectrum agent should be chosen. Drops or ointment may be used – while drops interfere less with vision, they require more frequent application. Ointment is best used in children as it requires less frequent application and is less likely to be washed out of the eye by crying.

Options for antibiotic use include chloramphenicol, fucithalmic, polymyxin-trimethoprim (Polytrim, which is generally commercially available), and fluoroquinolones. In the United States and Canada, fluoroquinolones are frequently used for prophylaxis because of their broad-spectrum coverage, proven efficacy in the setting of infectious keratitis, low toxicity, and low potential for antibiotic resistance.

Reference:

Upadhyay MP, Karmacharya PC, Koirala S, et al. The Bhaktapur eye study: ocular trauma and antibiotic prophylaxis for the prevention of corneal ulceration in Nepal. Br J Ophthalmol 2001;85(4):388-92.

**Question 14**

Antibiotic coverage for Pseudomonas is especially important for corneal abrasions in the setting of:

1. metallic corneal foreign bodies
2. central corneal abrasions
3. contact lens wear
4. children

Answer C: Contact lens wear

In cases of corneal abrasions in patients who wear contact lenses, strong consideration should be given to an agent with activity against *Pseudomonas* species such as gentamicin, tobramycin, ciprofloxacin, or gatifloxacin.

Reference:

Aslam SA, Sheth HG, Vaughan AJ. Emergency management of corneal injuries. Injury 2007;38(5):594-7.

**Question 15**

If topical NSAIDs are used for pain management in the treatment of corneal abrasions, they are generally dosed:

1. once daily
2. twice a day
3. three times a day
4. four times a day

Answer D: Four times a day

Topical NSAIDs are used for a range of painful eye conditions including post-ocular surgery and in treating ocular inflammation. Examples include ketorolac 0.5% (Acular) or diclofenac 0.1% (Voltaren). Pain with corneal abrasions is variable and may be severe due to the densely innervated anatomy of the cornea. Proper pain management is especially critical with children, as associated pain may have significant implications with respect to sleep, school performance, and other activities.

Topical NSAIDs are often used in treating pain associated with corneal abrasions, and are generally dosed QID. While some experts recommend their routine use, they are expensive and have shown only a modest benefit in reducing pain scores compared to placebo. Routine use of topical NSAIDs is likely not indicated. However, they are reasonable if a quick return to work is desired and the patient is able to afford them or has drug coverage.

References:

Calder L, Balasubramanian S, Stiell I. Lack of consensus on corneal abrasion management: results of a national survey. Cjem 2004;6(6):402-7.

Calder LA, Balasubramanian S, Fergusson D. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions: meta-analysis of randomized trials. Acad Emerg Med 2005;12(5):467-73.

Goyal R, Shankar J, Fone DL, Hughes DS. Randomised controlled trial of ketorolac in the management of corneal abrasions. Acta Ophthalmol Scand 2001;79(2):177-9.

Szucs PA, Nashed AH, Allegra JR, Eskin B. Safety and efficacy of diclofenac ophthalmic solution in the treatment of corneal abrasions. Ann Emerg Med 2000;35(2):131-7.

**Question 16**

The most serious complication of topical NSAID use is:

1. conjunctival injection
2. corneal melting
3. acute glaucoma
4. anticholinergic side effects

Answer B: Corneal melting

Potential side effects of topical NSAIDs include:

*Common*

* Burning or stinging
* Conjunctival hyperemia
* Contact dermatitis

*Less common*

* Corneal melting: Corneal melting, while rare, is an important potential side effect of topical NSAIDs. Topical NSAIDs may lead to progressive corneal ulceration and destruction of corneal stroma, and even corneal perforation with subsequent vision loss. Corneal melting is especially common in the setting of prolonged use (e.g. after cataract surgery) and when prescribed concurrently with topical steroids.

References:

Smith CH, Goldman RD. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions in children. Can Fam Physician;58(7):748-9.

Calder LA, Balasubramanian S, Fergusson D. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions: meta-analysis of randomized trials. Acad Emerg Med 2005;12(5):467-73.

Gaynes BI, Fiscella R. Topical nonsteroidal anti-inflammatory drugs for ophthalmic use: a safety review. Drug Saf 2002;25(4):233-50.

**Question 17**

Patients with fingernail injuries should be warned about the possibility of:

1. recurrent corneal erosion
2. vision loss
3. corneal melting
4. loss of corneal sensation

Answer A: Recurrent corneal erosion

Patients with abrasions due to fingernail injuries or vegetative material should be warned about the possibility of recurrent corneal erosion syndrome (RCES). Days to years after even seemingly benign abrasions, patients may be bothered by RCE. RCE is characterized by repeated episodes of foreign body sensation, pain, and photophobia due to failure of proper attachment between the epithelial cells and underlying Bowman’s membrane. Symptoms are especially common in the morning as the patient awakes, and signs on exam may be minimal due to rapid healing within hours of each episode. Treatment of RCES involves use of topical hypertonic agents, bandage contact lenses, surface debridement, and surgery.

Other potential complications of corneal abrasions include scarring and secondary infection. Scarring may cause visual symptoms such as decreased vision, glare, or monocular diplopia if on the visual axis.

Secondary infections are more common with abrasions in setting of contact lens wear or vegetative matter.

Reference:

Aslam SA, Sheth HG, Vaughan AJ. Emergency management of corneal injuries. Injury 2007;38(5):594-7.

**Question 18**

Patients with excruciating pain from a corneal abrasion may require:

1. narcotics
2. acetaminophen
3. patching
4. bandage CL

Answer A: Narcotics

In patients with excruciating pain, short-term narcotics may be necessary for analgesia. However, as soon as possible patients should be switched to over the counter analgesics such as acetaminophen and/or ibuprofen.

Bandage contact lenses may be beneficial in select cases of corneal abrasion. They are used to relieve the pain of constant blinking over the abrasion, and encourage epithelial healing. They also carry the advantage of allowing examination through the contact lens. Bandage contact lenses should not be used in cases of vegetative matter injury.

Frequent use of artificial tears can be a useful adjunct in managing foreign body sensation associated with corneal abrasions, and cool compresses will help in cases associated with significant eyelid swelling.

Reference:

Turner A, Rabiu M. Patching for corneal abrasion. Cochrane Database Syst Rev 2006(2):CD004764.

**Question 19**

Cyclopegics are useful in the treatment of corneal abrasions to:

1. manage ocular pain due to ciliary muscle spasm
2. manage patients with marked photophobia
3. prevent coexisting traumatic iritis
4. all of the above

Answer D: All of the above

Many corneal abrasions are associated with ciliary muscle spasm which may contribute to ocular pain, headache, and photophobia. Although there is limited evidence that cycloplegics are of benefit in routine cases of abrasion, many experts recommend their use not only for managing pain and photophobia but also for managing and preventing coexisting traumatic iritis. They are most useful for patients with marked photophobia and blepharospasm.

Reference:

Meek R, Sullivan A, Favilla M, et al. Is homatropine 5% effective in reducing pain associated with corneal abrasion when compared with placebo? A randomized controlled trial. Emerg Med Australas;22(6):507-13.

**Question 20**

Research studies into the safety and efficacy of topical anesthetics for corneal abrasion management have determined that the use of tetracaine compared to a placebo:

1. significantly reduced the pain reported by patients with corneal abrasions
2. significantly increased the time required for complete healing of corneal abrasions
3. reduced reports of pain initially, but symptoms persisted for a longer period of time
4. showed no significant difference in pain, persistence of symptoms, or corneal healing

Answer D: Showed no significant difference in pain, persistence of symptoms, or corneal healing

A recent meta-analysis of literature analyzing studies designed to determine the safety and efficacy of topical anesthetics for corneal abrasion management revealed no significant difference between tetracaine and placebo in terms of pain, persistent symptoms, and corneal healing. However, the study conclusions have low confidence due to the limited available evidence (only 2 studies with 140 total subjects were included), and highlights the need for deeper study.

Reference:

Puls HA, Cabrera D, Murad MH, Erwin PJ, Bellolio MF. Safety and effectiveness of topical anesthetics in corneal abrasions: a systematic review and meta-analysis. J Emerg Med 2015;49:816-824.

**Question 21**

Patients with non-healing corneal abrasions should be:

1. followed more frequently
2. taken off all drops
3. investigated for causes of poor wound healing
4. patched

Answer C: Investigated for causes of poor wound healing

All corneal abrasions should be seen in follow-up to ensure proper healing and to monitor for potential complications such as infectious keratitis (it should be noted that all corneal ulcers start out as an abrasion). Careful follow-up is especially important when topical NSAIDs are used, and in patients with contact lens-related corneal abrasions.3 An initial follow-up 24-48 hours after first presentation is appropriate in most cases. Patients should also be warned for signs and symptoms of infection such as increasing pain, redness, decreased vision, and purulent discharge.

Corneal abrasions should be followed until the epithelial defect is healed and fluorescein staining is negative. If healing is slower than expected, other causes for impaired healing should be considered such as infection (especially herpes simplex), neurotrophic keratopathy, topical anesthetic abuse, and others. Topical anesthetic abuse is especially common in healthcare workers and may lead to potentially disastrous corneal melting.

Reference:

Smith CH, Goldman RD. Topical nonsteroidal anti-inflammatory drugs for corneal abrasions in children. Can Fam Physician;58(7):748-9.