All Things Cornea

Elizabeth A. Steele, OD, FAAO
Associate Professor, University of Alabama at Birmingham School of Optometry
bsteele@uab.edu

Caroline B. Pate, OD, FAAO
Associate Professor, University of Alabama at Birmingham School of Optometry
cbeesley@uab.edu

Tammy P. Than, OD, MS, FAAO
Associate Professor, University of Alabama at Birmingham School of Optometry
tthan@uab.edu

Abstract
Proficiency in foreign body removal, corneal debridement, anterior stromal puncture, drip ocular irrigation and pressure patching is essential for optometrists. This hands-on workshop will provide information regarding indications and procedure for each, as well as instruction through video and the use of model eyes (animal/gel simulation).

Learning Objectives
I. To safely and effectively perform the procedures of foreign body removal, corneal debridement, anterior stromal puncture, drip ocular irrigation system and pressure patching.
II. To recognize the clinical indications and contraindications for each of the above procedures.
III. To become familiar with the instrumentation required for the above procedures, including proper disinfection of each when indicated.

Course Outline

I. Drip Ocular Irrigation System
   a. Indications
      i. Chemical burns
      ii. Treatment that requires saturation of the eye with topical agents
      iii. Stevens-Johnson Syndrome
   b. Contraindications
      i. Suspicion of penetrating injury
   c. Ideal Instrumentation
      i. Drip Ocular Irrigation System Components
         1. Molded Scleral lens with an aqueous lock that attached to an IV bag
         2. IV bag with lactated ringer’s solution or balanced saline solution
      ii. Litmus paper
      iii. Emesis basin or fluid management system
      iv. Topical anesthetic
      v. Biohazard bag for disposal
d. Procedure
   i. Instill topical anesthetic
   ii. Recline patient. Head should be tilted slightly toward the affect eye to avoid affect to opposite eye.
   iii. Position fluid management system temporally
   iv. Attach IV infusion tubing to the lens & start a minimal flow
   v. Have the patient look down and insert the Morgan lens under the upper lid. Position the lens horizontally as the patient looks straight ahead.
   vi. Adjust the flow to the desired rate
   vii. Irrigate the eye(s) for the recommended time
   viii. To remove the lens, have the patient look up, retract the lower lid and slide the lens out
   ix. Dispose of used lens in Biohazard bag.

e. Management of chemical burn
   i. Take a thorough history on the causative agent. Poison Control Center can be called if necessary. Severity is dependent on the chemical.
      1. Acid burns are usually self-limiting (e.g. battery acid, industrial cleaners)
      2. Alkali burns can penetrate ocular tissue (ex. Lye, cement, ammonia)
   ii. Initial treatment is copious irrigation with saline. **DO NOT CHECK VA FIRST!**
      1. Use a rapid/free flow: maximum rate (~1 L of solution per 30 minutes)
      2. Irrigate 30 minutes to 3 hours using this rate
      3. After 30 minutes of continuous irrigation, wait an additional 5 to 10 minutes, then test the pH of the eye using litmus paper. Lay litmus paper strip flat within inferior cul-de-sac until tip is saturated. Compare color of paper strip to color code provided with strips. Discontinue irrigation when pH is neutral (7).
   iii. Examine cornea and conjunctiva with sodium fluorescein for residual solid material. Evert eyelids to rule out a foreign body.
   iv. Check IOP with an instrument whose results are unaffected by central corneal compromise. Elevated IOP should be treated with a topical beta-blocker or acetazolamide 250 mg qid.
   v. Prophylaxis: Apply a broad spectrum antibiotic ointment to the lids qid and solution to the eye qid.
   vi. Inflammation and pain management:
      1. Anterior uveitis can be treated with a cycloplegic agent.
      2. Topical steroid can quiet the eye and promote collagen synthesis during the first week. Prescribe qid to q1hour depending on severity. Taper after 1 week to prevent collagen breakdown.
      3. Prescribe oral analgesic for pain. Also consider topical NSAID.
      4. Preservative-free artificial tears can help comfort and increase lubrication.
   vii. Other considerations
      1. Doxycycline prevents the matrix metalloproteinases (MMPs) and reduces ocular inflammation
      2. Oral vitamin C or Ascorbic acid may promote collagen synthesis and prevent ulceration.
      3. Citrate drops decrease proteolytic activity and appears to inhibit collegenases
      4. Platelet rich plasma eye drops are rich in growth factors and may increase speed of re-epithelialization for some types of burns.
      5. Phenylephrine should be avoided due to the vasoconstrictive properties.
6. Pressure patch can be applied if necessary. Therapeutic soft contact lens may also decrease scarring.

viii. Consider oculoplastic and/or corneal consult, especially when severe.

II. Pressure Patching

The use of pressure patching is controversial and has been the subject of considerable debate recently.

a. Indications
   i. Corneal injuries
   ii. Following minor surgical procedures (i.e. chalazion incision and curettage)
   iii. Management of corneal epithelial compromise

b. Contraindications
   i. Herpetic infection
   ii. Trauma involving vegetative matter
   iii. Suspicion of penetrating injury
   iv. Contact lens wearer/abuser

c. Instrumentation
   i. Sterile gauze eyepads
   ii. 1-inch hypoallergenic, micropore tape
   iii. Alcohol prep pads
   iv. Topical anesthetic

d. Procedure
   i. Recline patient slightly
   ii. Instill topical anesthetic and other medications appropriate for condition (e.g. antibiotic ointment, long-acting cycloplegic agent)
   iii. Instruct patient to close eyes
   iv. Gently swab skin on ipsilateral forehead and cheeks with alcohol prep pad to remove excess skin oils, avoiding any lacerated areas. If patient has facial hair, alteration to recommended tape positions can be made.
   v. Tear 5 pieces of tape around 6 inches in length, and set them aside.
   vi. Fold one eyepad and place against closed eyelid. Additional eyepad(s) may be required for patients with a prominent frontal bone or deeply positioned globes.
   vii. Hold 2-3 additional eyepads flat against the folded ones with one finger, while placing one end of the 1st piece of tape at the midpoint of the forehead. Pull the tape diagonally across the eye, toward the top of the mandible. Pull the skin upward before placing taping to the skin.
   viii. Apply the 2nd piece of tape at the forehead, closer to the bridge of the nose. Pull it so that it overlaps the first piece, curves around, and covers both ends of the first piece of tape.
   ix. Apply the 3rd piece of tape at the forehead, but more temporally than the first piece. Position it similarly to the 2nd piece but on the temporal side, so that it overlaps both ends of the first piece.
   x. Apply a 4th piece of tape directly over the 1st piece, allowing it to cover all edges of tape on the cheek and forehead.
   xi. A slightly shorter, 5th piece of tape, is sometimes needed to cover any exposed area temporally/laterally.

e. Further Management
   i. Patient should avoid getting patch wet
   ii. RTC x 24 hours
   iii. Oral pain management, if applicable
   iv. If uveitis present, steroid therapy is often delayed until patching is no longer required, or until cornea is healed

f. Patch Removal
   i. Simultaneously pull down on the skin of the cheek and grasp the bottom end of the first strip of tape. Lift the tape from the bottom toward the forehead. The eyepads should come off easily with the tape.
ii. Wipe away any lid debris.
iii. Reassess visual acuity and other measurements after patient has readjusted to light and tear film has been reestablished.
iv. Consider re-patching if abrasion not completely healed.
g. Potential complications of patching
   i. SPK, ocular irritation: mechanical effects of patching and/or preservative within ointment
   ii. Corneal edema: self-limiting; 5% NaCl may help
   iii. Allergic reaction to tape: self-limiting; 0.5% hydrocortisone cream may be necessary

III. Corneal Foreign Body Removal
   a. Indication: Corneal foreign body which cannot be removed by simple irrigation
   b. Instrumentation
      i. Slit lamp
      ii. Golf spud or 25G needle (or other acceptable foreign body removal instrument)
      iii. Topical anesthetic
   c. Procedure
      i. Obtain a thorough history inquiring if the foreign body (FB) was projectile in nature (e.g. grinding, metal striking metal). If this is the case, one must rule out the presence of an intraocular FB.
      ii. Measure distance visual acuities, using a topical anesthetic if necessary to relieve significant patient discomfort.
      iii. Evaluate the number, location and depth of corneal foreign bod(ies) with the slit lamp.
         1. Initial irrigation of the eye is often appropriate in order to remove superficial foreign bodies/debris, particularly when multiple foreign bodies are suspected.
         2. Lid eversion should be performed to inspect eh fornices for additional matter.
         3. Embedded foreign bod(ies) must be removed using a spud or needle.
         4. Foreign bodies deeps than the epithelium may scar; the patient should be warned of this risk.
         5. Perform a Seidel’s test using NaFl if history or other signs suggests a penetrating injury.
      iv. Instill topical anesthetic if not already done at this point.
      v. Adjust and position patient comfortably behind slit lamp. Instruct patient to fixate with the opposite eye on a specific target.
      vi. Set the slit lamp to 6-10x, a wide parallelepiped beam, and at a rheostat setting that the patient can tolerate.
      vii. Brace hand which is holding instrument on the patient’s cheek or bridge of nose. Retract eyelid if necessary. Position instrument into light source of slit lamp before looking behind oculars.
      viii. Approach the cornea with the spud/needle held tangentially to cornea.
      ix. Position the tip of the instrument under the edge of the foreign body and gently attempt to release it. Apply a gentle flicking motion to remove it. Maintain a tangential position of the instrument with the cornea throughout the procedure.
      x. A flexible nylon loop is used in a similar manner and is useful for children and uncooperative patients.
      xi. Further irrigation and/or a “sweep” of the fornices with a moistened cotton-tipped applicator can be performed following the procedure, however this instrument is a poor choice for FB removal.
      xii. If a corneal rust ring is present, use an Algerbrush with a similar set up and approach toward the cornea
1. Turn the instrument on before looking behind the slit lamp oculars, and be sure to warn the patient regarding the noise that he/she will hear during the procedure
2. Algerbrush will not penetrate Bowman’s membrane

xiii. Instill a cycloplegic agent.
xiv. If warranted, evaluate the fundus to rule out an intraocular FB. Imaging (B-scan, CT scan) may also be required.
xv. A broad-spectrum antibiotic should be instilled prophylactically. Pressure patching may be appropriate. Prescribe topical or oral pain medication as needed. Follow-up in 24 hours and then in 3-4 days as needed.
xvi. Disinfect spud properly using a high level disinfection system, or discard of the needle in a Sharps container. Burr tip of Algerbrush can be removed for proper disinfection as well.

IV. Corneal Debridement

a. Indications
   i. To smooth jagged or flap-like epithelial defects from:
      1. Traumatic corneal abrasions
      2. Recurrent corneal erosions (RCE)
   ii. To remove epithelium containing replicating virus in HSK
   iii. chemical corneal burns
   iv. thermal corneal burns

b. Instrumentation
   i. Slit lamp
   ii. Topical anesthetic
   iii. Forceps
   iv. Surgical microsponge sponge/cotton-tipped applicator
   v. Algerbrush

c. Procedure
   i. Instill topical anesthetic. Several drops of proparacaine are needed to soften the cornea. Lidocaine is better for extensive debridement.
   ii. Adjust and position patient comfortably behind slit lamp. Instruct patient to fixate with the opposite eye on a specific target.
   iii. Set the slit lamp to 6-10x, a wide parallelepiped beam, and at a rheostat setting that the patient can tolerate.
   iv. Brace hand which is holding instrument on the patient’s cheek or bridge of nose. Retract eyelid if necessary. Position instrument into light source of slit lamp before looking behind oculars.
   v. Approach the cornea with the instrument held tangentially to cornea.
   vi. Using Jeweler’s forceps, remove unhealthy epithelium. Gently pull the epithelium toward the center of the defect and then pick away the loose tissue.
   vii. Use the thin, pointed microsponge edge or cotton-tipped applicator to scrub the basement membrane. This removes cellular debris and promotes epithelial adherence to the new epithelium. Alternatively, the Alger brush may be used.
      1. Maintain tangential position of instrument with cornea
      2. Avoid removing areas of normal epithelium

d. Following debridement
   i. Irrigate the eye
   ii. Instill topical broad spectrum antibiotic drop/ointment and cycloplegic agent
   iii. Pressure patch if involvement of 50% or more (EXCEPT HSV). Patching duration depends on severity of defect.
   iv. Pain management
   v. RTC 24 hours, then RTC 3-4 days if improvement noted

e. Procedure for HSV keratitis:
i. Stain ocular tissues to identify replicating virus
ii. Remove replicating virus with debridement instrument

iii. Management
   1. Antiviral therapy
   2. Cycloplegic agent
   3. Optional: antibiotic ointment
   4. NO PATCHING or Bandage CL
   5. Pain management- as needed
   6. RTC 1 day, then every 1-7 days as needed

f. Disinfect your instruments properly using a high-level disinfection system.

V. Anterior Stromal Puncture
   a. Indication: To promote firm adherence of the epithelial tissue in patients with recalcitrant recurrent corneal erosions (RCE).
      i. Patients with RCE have an abnormal or compromised basement membrane
      ii. Anterior stromal puncture (ASP) breaches Bowman's membrane. Thus new epithelial growth can bypass this faulty tissue adhering directly and more firmly to the grooved made in the anterior stroma.

   b. Instrumentation
      i. Slit lamp
      ii. Topical anesthetic
      iii. 25G ASP needle; ASP needle design helps avoid a full-thickness puncture
      iv. Fabrication of an ASP needle by bending the tip of a 25 gauge needle is an option. It approximates the ASP needle design and helps to avoid a full thickness puncture should the patient squirm or lean forward unexpectedly.
         1. Remove a 25G needle from its package and properly uncap the needle
         2. Using jewelers forceps, create a 45-degree bend in the shaft of the needle, then a second smaller 90-degree bend at its bevel

   c. Procedure
      i. Instill topical NSAID and antibiotic q15minutes for 1 hour before the procedure.
      ii. Instill topical anesthetic.
      iii. Instill NaFl dye to evaluate the epithelial integrity and to increase visibility of puncture marks during the procedure.
      iv. Adjust and position patient comfortably behind slit lamp. Instruct patient to fixate with the opposite eye on a specific target.
      v. Set the slit lamp to 10-16x, a wide parallelepiped beam, and at a rheostat setting that the patient can tolerate.
      vi. Debride cornea as previously discussed only if needed (i.e. if a flap of tissue which is moving with each blink is present).
      vii. Brace hand which is holding instrument on the patient’s cheek or bridge of nose. Retract eyelid if necessary. Position instrument into light source of slit lamp before looking behind oculars.
      viii. Approach the cornea with the shaft of the needle tangential to the cornea. The tip of the ASP needle should be perpendicular to the cornea
      ix. Make multiple punctures just into the anterior stroma, which are closely spaced
         1. Start at the edge of the defect and work toward the center
         2. 20 – 50 punctures are used depending on the size of the lesion
         3. Apply a concentric pattern of punctures 1-2 mm wide in the epithelium surrounding the defect, protecting against future erosions.
      x. Dispose of needle in Sharps container.

d. Following Procedure:
i. Instill cycloplegic
ii. Instill broad spectrum antibiotic ointment
iii. Pressure patch
iv. RTC x 24h and 1-2 days thereafter PRN until the epithelium heals.

v. Long-term follow up: q1-6m based on severity and frequency of the RCE.

vi. 0.5% NaCl drops qid and ointment qhs for several months following the procedure will reduce corneal swelling, lubricate the corneal surface and promote epithelial adherence

VI. Disinfection of Instruments

a. High level disinfection with 2% or 2.6% glutaraldehyde
   i. WARNING: Wear gloves, face mask, a fluid resistant gown (unless skin is covered by clothing or clinic coat) and protective eye wear while handling glutaraldehyde solution. Avoid direct contact with solution. Avoid prolonged exposure to fumes. Extreme caution should be used if pregnant.
   ii. HEALTH HAZARD DATA and EMERGENCY/FIRST AID PROCEDURES (from OSHA Material Safety Data Sheet):
       Skin: Can cause moderate irritation. Wash skin with soap and water.
       Eyes: Flush with water for 15 minutes. If irritation persists, seek medical attention.
       Inhalation: Low to mild irritation with prolonged exposure. Remove to fresh air. If irritation persists, seek medical attention.
       Ingestion: Toxic to ingest. If ingested do not induce vomiting. Give large amounts of water. Seek medical attention.
   iii. NOTE: If instrument came in contact with blood or ulcerated cornea, instrument requires sterilization before next procedure.

iv. Procedure:
   1. Before soaking, clean instrument with mild soap (or non-abrasive RGP cleaning solution) and water. Dry instrument thoroughly but carefully with a soft, lint-free cloth or non-linting instrument wipe. Place clean, dry instrument into soaking tray. Lenses should be laid on their side to ensure full coverage of lens surface by solution.
   2. Close tray and allow instrument to soak for 20 minutes. To avoid damage to instrument, do not exceed recommended exposure time.
   3. Remove instrument from soaking tray and rinse thoroughly to remove disinfection solution. Three cycles of a one-minute rinse with cool or tepid tap is recommended. A final, brief rinse with distilled water or sterile saline is recommended.
   4. Dry instrument thoroughly but carefully with a soft, lint-free cloth or non-linting instrument wipe.
   5. The solution in the soaking tray must be changed every 14 days

b. Sterilization with autoclave
   i. Before autoclaving, clean instrument with mild soap (or non-abrasive RGP cleaning solution) and distilled water. Dry instrument thoroughly but carefully with a soft, lint-free cloth or non-linting instrument wipe. Place clean, dry instrument into autoclave packaging.
   ii. Autoclave for recommended time.