CORNEAL PROCEDURES

AUTHOR

Luigi Bilotto: Brien Holden Vision Institute

PEER REVIEWER

Meng Meng Xu, The New England College of Optometry

PURPOSE

Various procedures are necessary when a patient presents with a corneal disruption secondary to foreign body (FB), recurrent corneal erosion or viral infection. The following will cover FB removal, rust ring removal, corneal debridement and pressure patching. The presentation is given in a SOAP format in order to apply a problem oriented approach.

S: Patient presents with a history of a FB entering the eye and/or Signs(Si)/symptoms (Sx) of discomfort. The level of discomfort varies from mild to severe and increases after 12 - 36 hours. The Si/Sx may include:

Symptoms	Signs
Irritation	Conjunctival injection
FB sensation	FB
Tearing	Rust ring
Photophobia	Anterior uveitis
Blurred vision	Lid edema/blepharospasm

Table 6.1*Signs and symptoms of a foreign body on cornea*

Within the case history the clinician must determine the following:

- What matter entered the eye?
- Was it organic or inorganic?
- When did the matter enter the eye?
- How much matter entered the eye?
- How did it happen? (hammering, working under a car, working with fiberglass, wind blown ,etc.)
- Where did the incident occur?
- Did the matter enter the eye at a high velocity or in a projectile nature?

O: The following diagnostic tests are essential:

- **Corneal anesthesia** may be necessary to perform any or all of the objective evaluation to alleviate the patient's discomfort & allow examination *(sometimes even before Case History!)*
- Visual acuity
- Pupils
- Extra-ocular muscles mouvement (EOM)
- Intra-ocular pressure (IOP)
- Slit lamp examination (SLE)
- Seidel's Test
- Comparative Tonometry - IOP will be drastically reduced with penetrating injury
- Dilated fundus examination (DFE) to rule out (R/O) intraocular FB from high velocity projectile entrance
- B-scan ultrasonography to R/O intraocular FB from high velocity/projectile entrance
- CT scan to R/O intraorbital FB from high velocity or projectile entrance.

On **SLE** the clinician must assess the following:

- The location & depth of the FB or abrasion
- Coat's White Ring: a white infiltrate that may surround the FB after 12 hours
- Rust rings: occurs after certain metallic FBs oxidize
- Epithelial cell growth over the FB: occurs after 6 hours
- Anterior chamber inflammation
- Under tarsal plate through single or double lid eversion
- Fornices for additional foreign material
- FB tracks & Seidel's sign with fluorescein

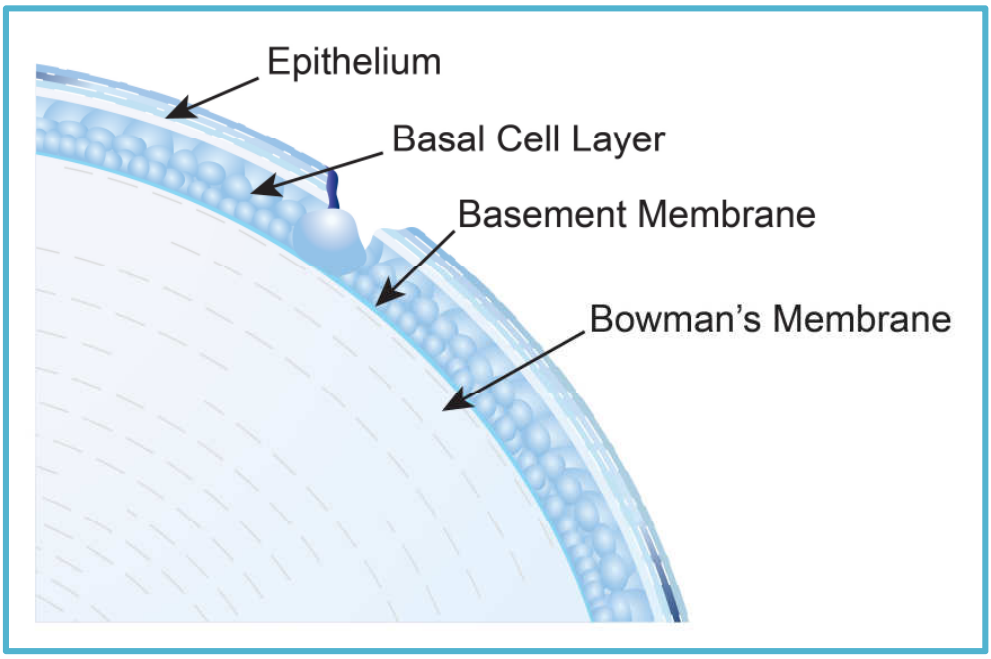

Figure 6.1 *Layers of the cornea with localized disruption*

Inspired Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

A: Corneal FB (include descriptors):

OD, OS, OU
location
superficial versus deeply embedded
organic versus inorganic
penetrating/perforating
associated uveitis
Intraocular penetration

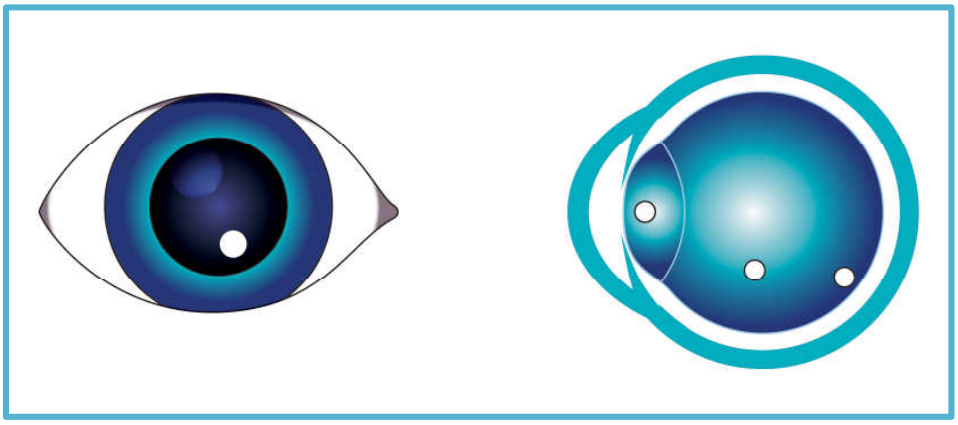

Figure 6.2 *Possible location for foreign bodies*

Inspired by Stein R. et al., Management of Ocular Emergencies, 2nd Edition

P: <u>Superficial FB (epithelial-anterior stroma):</u>

Remove
Antibiotic Ointment or drops
Cycloplegia (if indicated)
Hyperosmotic (if indicated)
Patch (if indicated)

<u>Deep FB (deep Stroma-Descemet)</u>

Should be considered a **penetrating/perforating** injury and **referred immediately** for a special consult including orbital X-rays. Intraocular metallic FBs become highly visible on X-ray.

FOREIGN BODY REMOVAL TECHNIQUES

INSTRUMENTATION

- Saline solution
- Golf club spuds
- Hypodermic needle
- Bailey nylon loop
- Jeweler's forceps
- Cotton swab

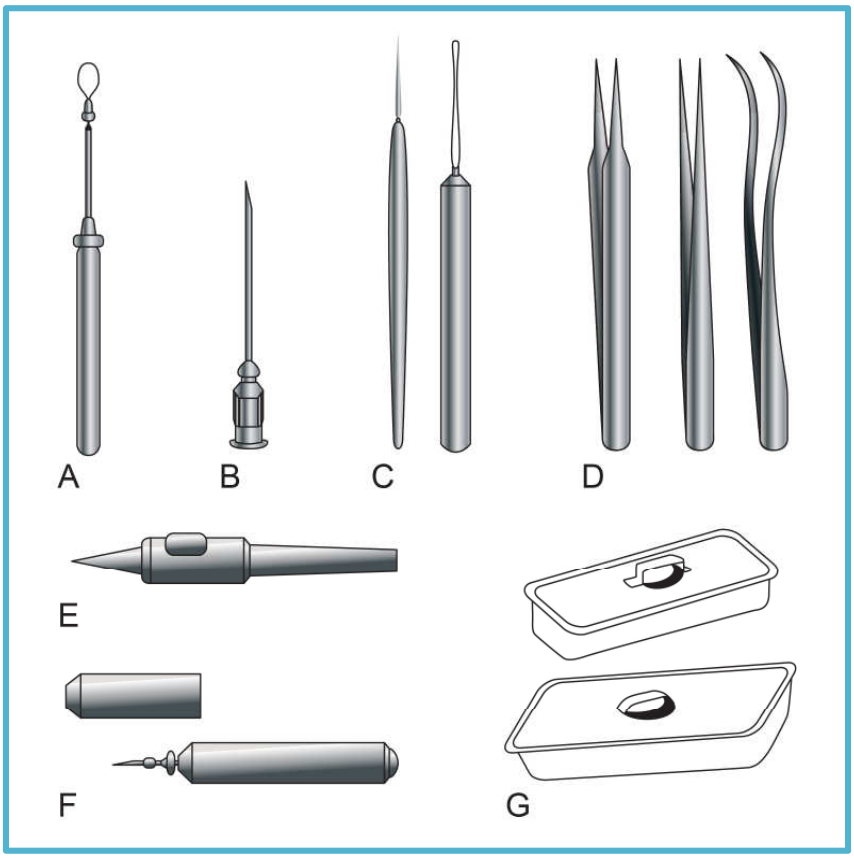

Figure 6.3: *A - Bailey loop, B – hypodermic needle, C – golf club spuds, D – jewellers forceps, E – battery powered drill, F – Alger brush, G – assorted instrument trays*

Drawn from Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

FLUSHING

Flushing the eye is indicated for superficial FBs especially those that contain multiple particles or fluids or those that can't easily be seen (e.g. glass). Balanced ophthalmic irrigating solution in **squirt** bottles or regular saline can be used for that purpose. It may be necessary to "squirt" the eye with some pressure to dislodge & remove all the particles.

Procedure

- Apply topical anaesthetic
- Have the patient hold towels or a basin against cheek to prevent soaking their clothes
- Send a forceful stream of saline tangentially at the FB until it is washed from cornea
- Treat the abrasion.

GOLF CLUB SPUD

The Golf Club Spud is indicated for superficial or deeply embedded FBs. The spud is used to loosen & lift the edges of the FB and scoop it from the cornea. The **blunt edges** of the spud protect against penetration into the deeper corneal layer during removal.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to FB
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the spud **tangential** to the cornea
- Slide golf club spud under FB and scoop or lift FB away
- Treat the abrasion.

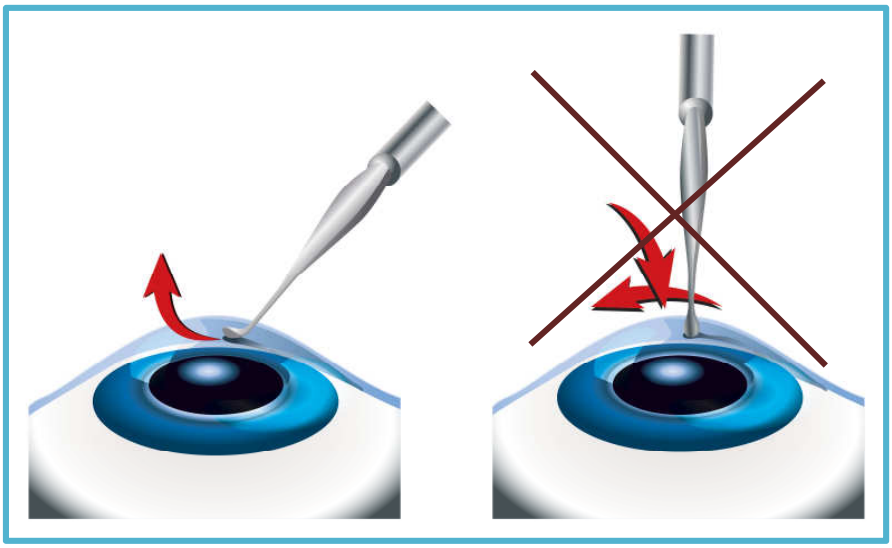

Figure 6.4 *Using the golf club spud for removal of a FB*

Drawn from Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

STERILE SYRINGE NEEDLE

The sterile syringe needle is indicated for partially or completely embedded FBs. An advantage to the syringe is that it comes sterile & can be discarded after procedure. Since the tip is smaller than the golf spud, it is ideal for smaller size foreign bodies. A 5 cm hypodermic needle (18, 20, 22 or 25 gauge) is most commonly used with or without a syringe.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to FB
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the needle **tangential** to the cornea
- Use the beveled tip to loosen overlying cells and rust rings (if present)
- Lift the entire FB from the cornea
- Treat the abrasion.

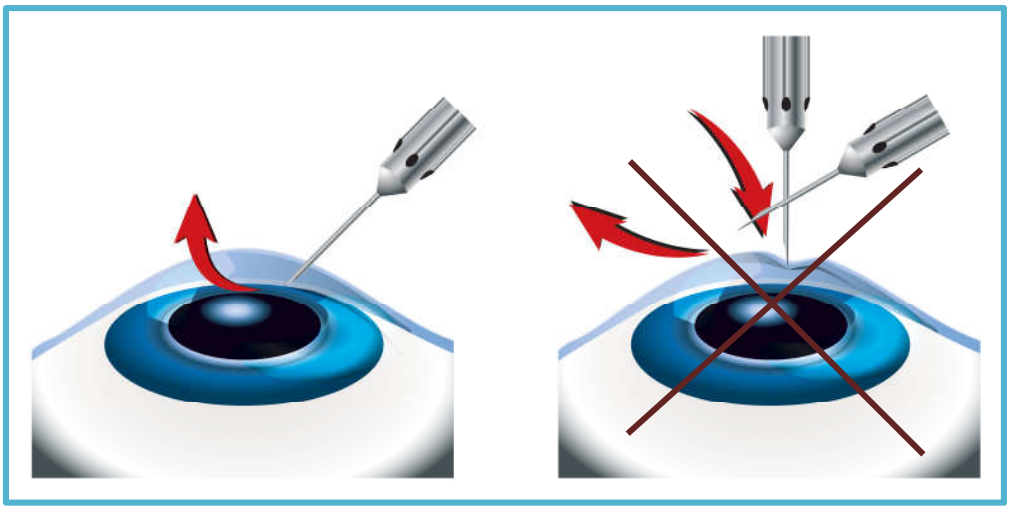

Figure 6.5 *Using a sterile syringe needle to remove a FB*

Drawn from Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

Note:

- Avoid "snagging" Bowman's membrane which feels like tugging on canvas. If it occurs transient striae lines will become visible & possibly cause scarring
- **Cockburn curve technique** - the needle can be modified to provide a safer method to remove the FB. When removing needle from its plastic container, drag the back side along the wall of the jacket. This will bend the needle in a curve and reduce the risk of tearing Bowman's layer. Some bent needles are available commercially.

BAILEY NYLON LOOP

The Bailey Nylon Loop is smooth & flexible & therefore safer. It is indicated in non-cooperative patients (e.g. children) or patients that are nervous and constantly moving. It can only be used if the FB is **partially** embedded.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to FB
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the loop tangential to the cornea
- Aggressively "tease" the edges of the FB
- Place the loop under the FB
- Lift the loop up in a flicking motion to remove FB
- Treat the abrasion.

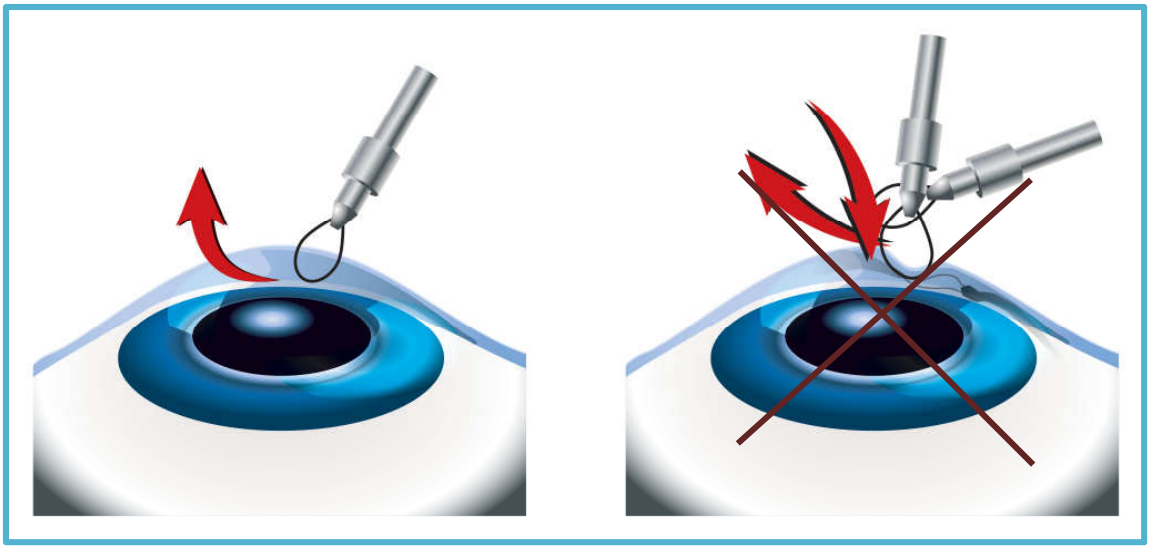

Figure 6.6 *Using the Bailey nylon loop to remove a FB*

Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

JEWELLER'S FORCEPS

The Jewelers forceps are indicated for superficially embedded large FBs. The method is similar to using a needle because you close the forceps initially to lift the edges of the FB.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably and securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to FB
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the forceps **tangential** to the cornea
- With forceps closed lift the edges of the FB, loosen and lift FB away from cornea
- Open forceps to grasp & lift the FB above the epithelium
- Treat the abrasion.

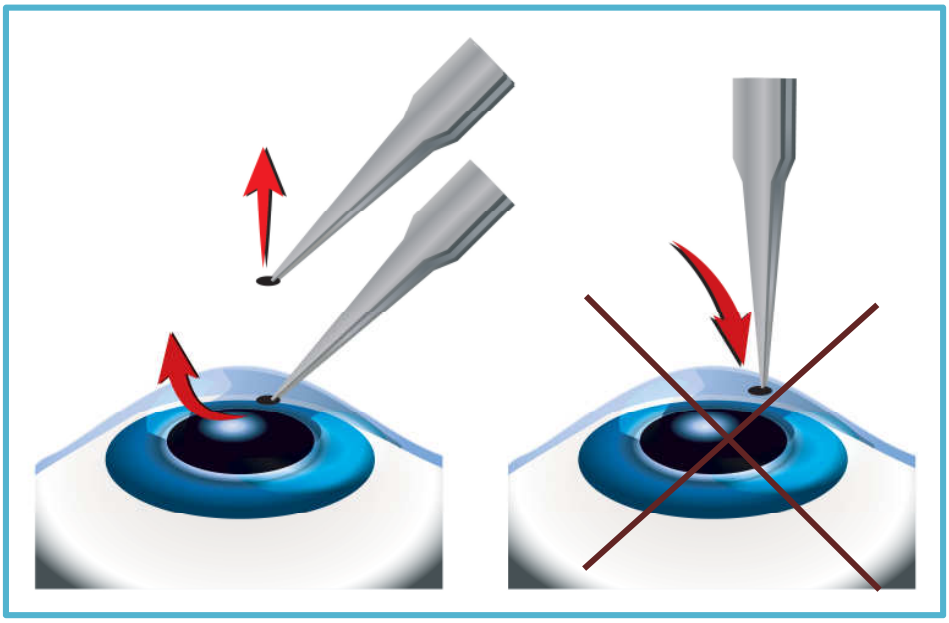

Figure 6.7 *Using the jeweller's forceps to remove a FB*

Catania Louis J., Primary Care of the Anterior Segment, Norwalk, CT: Appleton & Lange; 1994.

COTTON SWAB

The cotton swab (sterile Q-tip) is indicated for superficial FB. The swab is recommended only when nothing else is available because it removes far more epithelium than necessary & it can fragment the FB. The cotton swab is more useful for removing conjunctival FBs that are not deeply embedded.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to FB
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Wet the cotton swab with sterile saline or irrigating solution
- Lift the FB from the surface of cornea
- Treat the abrasion.

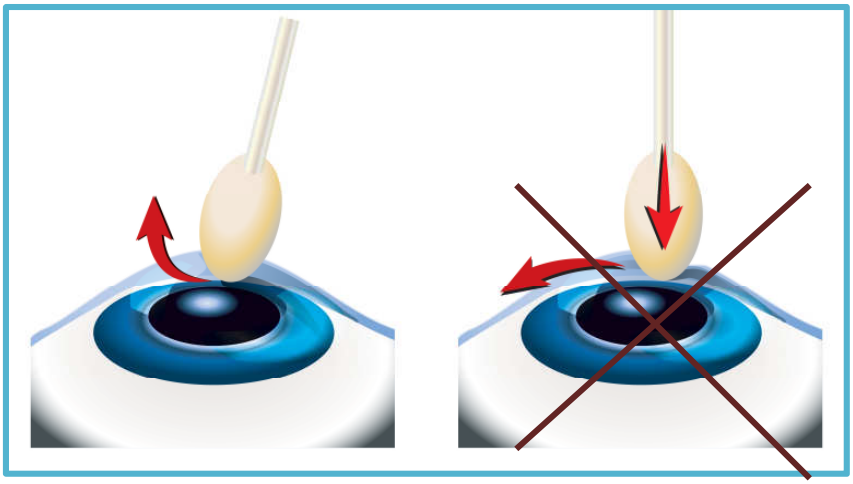

Figure 6.8 *Using a cotton swat to remove a FB*

CORNEAL RUST RING REMOVAL TECHNIQUES

Corneal Rust Ring Removal is indicated for removal of stained cells & oxidizing particles after a metallic FB has been removed. Metallic FBs may produce a surrounding rust or hemosiderin ring after 12-24 hours. Rust rings appear orange to brown and may stain the epithelium and/or Bowman's membrane. Rust ring removal is most commonly performed immediately following FB removal.

Delaying rust ring removal for several days may result in permanent staining of Bowman's membrane. Permanent staining may prevent proper corneal regeneration and lead to recurrent corneal erosion. Immediate removal will therefore minimize the patient's length of discomfort, extent of hemosiderosis and risk of recurrent corneal erosion. Some practitioners prefer waiting a day or two after FB removal to remove the rust ring to allow the "rust" to soften and possibly grow out towards the surface. This makes removal of the rust ring easier. Delayed rust ring removal is preferred when the FB is deeply embedded.

INSTRUMENTATION

- Alger brush
- Battery-powered drill
- Hand-held burr
- Golf club spud
- Hypodermic needle

ALGER BRUSH, BATTERY-POWERED DRILL, HAND-HELD BURR

The Alger brush and battery-powered drills produce a **sound** that may cause apprehension and occasional resistance by the patient to the procedure. Therefore make the patient aware of the sound before starting and assure them that the procedure is performed superficially, **not deep in the cornea.** The Alger Brush works by a weak battery powered motor that spins a small metal drill-burr that will stop if too much pressure is applied. This minimizes the risk of penetrating Bowman's membrane. The regular battery powered drill does not have this safety mechanism. Therefore the Alger brush is preferred and used more commonly. The hand-held burr is rolled manually tangential to the cornea and it acts like an Alger Brush to remove the rust ring.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to rust ring
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the instrument tangential to the cornea
- Let the instrument **lightly** touch the epithelium
- Use a circular sweeping motion to remove stained cells & oxidizing particles
- With the hand-held burr, roll or twirl the burr between the thumb & index fingers
- The spinning tip of the drill-burr should gradually wipe away the rust & damaged epithelium
- Lavage the eye to remove loose debris
- Treat the abrasion.

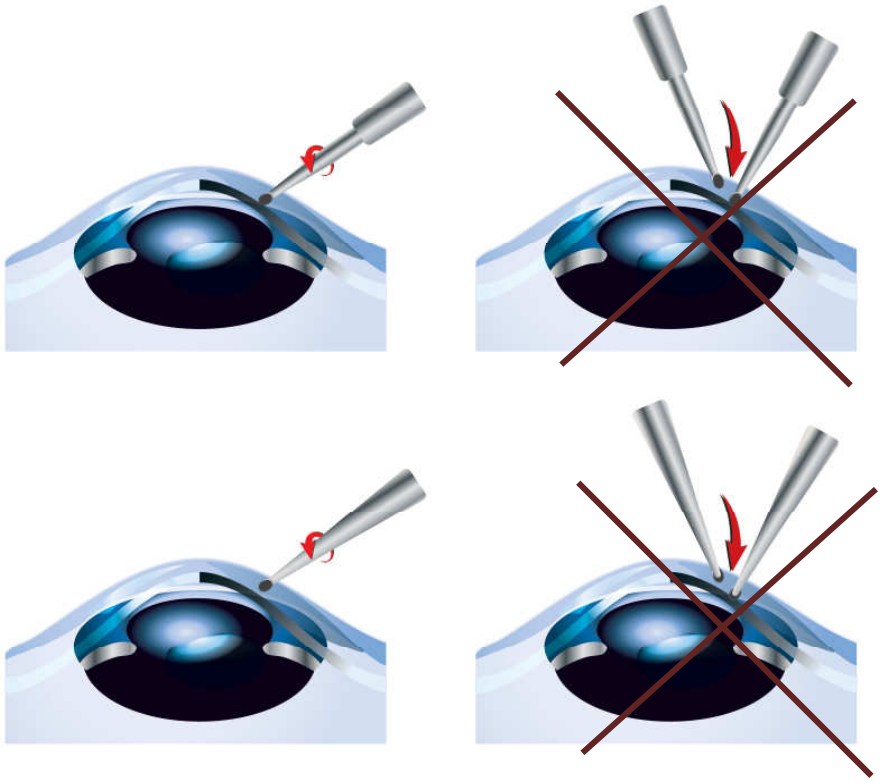

Figure 6.9 *Using the Alger brush, the battery powered drill or hand-held burr to remove rust rings.*

GOLF SPUD/NEEDLE

The golf spud or a needle may be used when other instruments are not available.

Procedure

- Apply topical anaesthetic
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to rust ring
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the instrument tangential to the cornea
- Let the instrument **lightly** touch the epithelium
- Make small sweeping motions over the corneal surface
- This lightly scrapes the epithelial surface and removes the hemosiderosis
- Lavage eye to remove loose debris
- Treat the abrasion.

CORNEAL DEBRIDEMENT

Corneal debridement may be useful in the treatment of traumatic corneal abrasions, recurrent corneal erosions, herpes simplex keratitis & corneal burns. In these conditions, the procedure is used to remove loose, jagged, flap-like or sick corneal epithelium to smoothen the edges of the corneal defect & facilitate the growth & adherence of a new healthy layer. In the case of herpes simplex keratitis, it is used to remove epithelium at the edge of a dendritic ulcer that contains the replicating virus.

INSTRUMENTS

- Cotton-tipped applicator
- Alger brush
- Battery-powered drill
- Hand-held burr
- Golf Spud
- Jeweller's forceps.

COTTON-TIP APPLICATOR

Procedure

- Instill anaesthetic until cornea softens (Lidocaine 4.0% is best for an extensive debridement).
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to the area of interest
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the instrument tangential to the cornea
- Gently pull epithelium toward the center of the epithelial defect
- Rub away the loose tissue
- Scrub the basement membrane to remove debris
- Lavage the eye to remove excess loose debris
- Treat the abrasion.

Note:

- Following debridement for traumatic corneal abrasions, recurrent corneal erosion & chemical burns the resultant "abrasion" is treated in the usual manner
- **For HSV antiviral & "abrasion" therapy is given but patching is contra-indicated.**

ALGER BRUSH, BATTERY-POWERED DRILL AND HAND-HELD BURR

Procedure

- Instill anaesthetic until cornea softens. (Lidocaine 4.0% is best for an extensive debridement)
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to the area of interest
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align instrument tangential to the cornea
- Skim instrument across the epithelial surface
- Stop when all damaged cells are sloughed off
- Lavage the eye to remove excess loose debris
- Treat the abrasion.

Note:

- Following debridement for traumatic corneal abrasions, recurrent corneal erosion & chemical burns the resultant "abrasion" is treated in the usual manner
- **For HSV antiviral & "abrasion" therapy is given but patching is contra-indicated.**

GULF SPUD / JEWELLER'S FORCEPS

Although not commonly used, it may be possible to debride loose epithelium using the golf spud &/or jeweller's forceps.

Procedure

- Instill anaesthetic until cornea softens (Lidocaine 4.0% is best for an extensive debridement)
- Seat patient comfortably & securely at the slit lamp
- Use a parallelepiped with moderate magnification
- Direct patient's fixation to allow for easy access to the area of interest
- If necessary hold upper eyelid to prevent blepharospasm
- Stabilize your arm by placing your elbow down on the SL table
- Stabilize your instrument by placing the back of your hand on the patient's face
- Align the instrument tangential to the cornea
- Gently scrub or pull epithelium toward the center of the epithelial defect
- Rub away the loose tissue
- Scrub the basement membrane with the blunt ends of the instruments to remove debris & promote better adherence of new epithelium
- Lavage the eye to remove excess loose debris
- Treat the abrasion.

SLIT LAMP CONSIDERATIONS

- Use right hand for left eye and left hand for right **only if you are capable**
- Otherwise use your dominant hand & crossover the patients face when necessary
- Have patient turn head as much as slit lamp headrest will allow to minimize nose interference
- Slit lamp hand rest posts are available to stabilize your hand during the procedure
- Alternatively rest your elbow on the table or place your elbow on a "cushion"
- Stabilize your hand by resting the 4th and 5th fingers against patients face
- Approach the FB removal instrument from an angle that the patient cannot see so as to diminish patient apprehension.

Figure 6.10 *Foreign body removal at the slit lamp*

INSTRUMENT MAINTENANCE & CLEANING

- Needles are already sterile if sealed in plastic
- Keep tools in a stainless steel tray of ZephiranHCl 1:750 with antirust tablets for prolonged storage
- Rinse the Zephiran or alcohol off with preserved saline irrigating solution
- With the instruments kept in sterile wrapping, autoclave sterilization is the best method to use
- Flame platinum coated instruments prior to use
- Hydrogen peroxide, bleach, alcohol or Cetylite chemical germicide are alternative to Zephiran HCl.

RECORDING

Draw and/or record the following:

- Location of the FB
- Size of epithelial defect
- Depth of penetration
- Edge quality (e.g. loose squamous epithelial edges, flaps or tags)
- Presence of edema with diameter, intensity & depth
- Instrument used
- Therapy initiated

PRESSURE PATCHING

Pressure patching (PP) is performed following corneal FB removal, corneal rust ring removal and/or corneal debridement. Therefore all pertinent testing has been performed prior to PP. The purpose of the PP is to **promote the healing process** of the corneal epithelium by pressing the new cells down to the basement membrane. It also provides **symptomatic** relief to the patient because constant blinking will cause irritation to the cornea and pain. At this point, the issue of **PP is controversial** and its value is being questioned. PP may actually slows down the healing process and provides little additional comfort to the patient. Therefore some practitioners will prefer not to PP, especially in the case of small superficial abrasions.

The indications for pressure patching include:

- Abrasions with moderate to severe depth (up to basal cell layer or basal membrane)
- Loose epithelial edges
- Extremely large abraded area (> 4 to 6mm)

There are several ways to pressure patch but the intent is to **tightly close the eyelids to prevent blinking.** Besides prolonging the FB sensation and discomfort to the patient, blinking tends to shear off new corneal cells and impairs the healing process. If performed in an appropriate manner, the patch will press the basal layer of the epithelial cells onto the basement membrane, increase cellular adherence & decrease corneal edema.

MATERIALS

- Pre-shaped sterile gauze eye pads
- Hypoallergenic paper, plastic or cloth adhesive tape
- Broad-spectrum topical ophthalmic antibiotic ointment
- Cycloplegic solution
- Hyperosmotic ointment (NaCl 5%).

PROCEDURE

- **Lavage** eye thoroughly with ophthalmic irrigating solution to reduce risk of secondary infection
- **Instill cycloplegic** the eye to reduce the pain & the risk of developing a secondary uveitis
- Instill broad-spectrum antibiotic **ointment** (~1cm ribbon) into the inferior cul-de-sac
- Place the patient's head rests against headrest with eyes closed
- Wipe with alcohol swabs the forehead and cheek skin to remove skin oil
- This ensures proper tape adherence
- Push back hair from forehead and face (beard!?)
- Assess depth of orbit and prepare two to four pads in a stack
- Fold one in half and place it over closed lid
- Place two to four pads over folded pad at slight angle
- Using 15 to 18 cm strips of tape:
    - Start at mid-forehead at an angle aiming directly over the middle of the pads
    - Pull the skin of the cheek upward and pull the end of the tape tightly over it
    - Start again at the mid-forehead a little closer to the nose bridge
    - Curve this strip over the superior edge of the pads such that all are covered by the strip

- Tape the end of strip tightly and firmly onto skin of cheek
- Start again at the mid-forehead but on the lateral side to cover the lower edges of the pads.
- Next place another strip over the first strip to cover the inner edge of the other strips & apply it tightly to the cheek over the ends of all other strips.

- Advise the patient to take **aspirin or ibuprofen** if the pain persists
- Instruct the patient to leave patch in place until reexamination
- Reschedule the patient **within 24-hour** for follow-up.

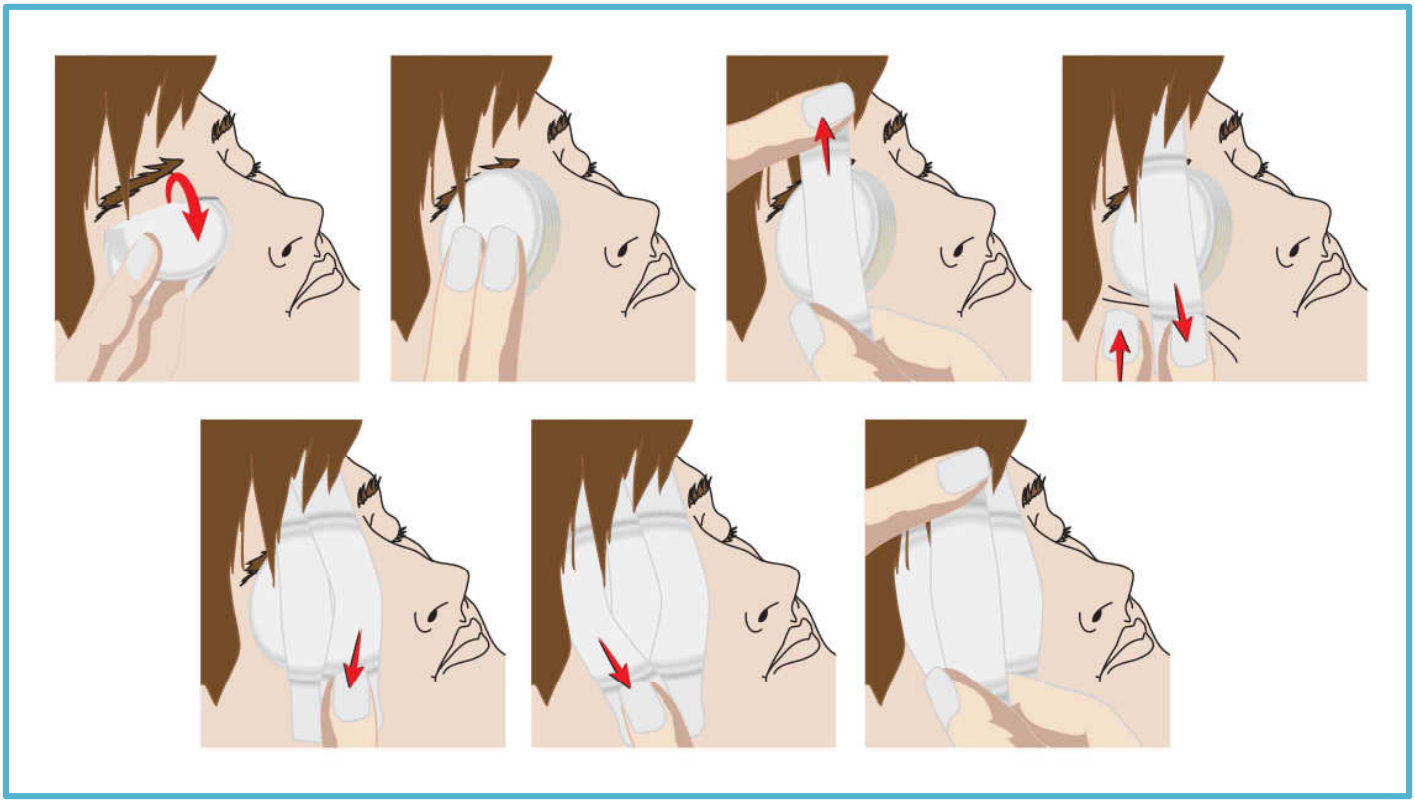

Figure 6.11 *How to apply and secure a pressure patch*

Akorn Presspatch

In the case where the patient has a beard, the hypoallergenic tape does not adhere well, a patch can be held in place with a specially designed plastic eye shield, held in place by an elastic and Velcro fastener.

Figure 6.12 *Akorn presspatch*

Donaldson Natural Eye Patch

In a circumstance where a “light” or shorter duration patch is indicated or when medication must be applied constantly applied to the eye, the conventional pressure patch is not the optimal method. For cases such as these, the Donaldson Natural Eye Patch is available. The patch is T-shaped and it fastens to the cheek by a circular piece of velcro and surgical tape. This design permits the patch to be lifted for instillation of medicine and re-fastened.

The Donaldson Natural Eye Patch is useful in cases of mild abrasions (e.g. lagophtalmos that present with compromised abraded cornea) and cases of recurrent corneal erosions.

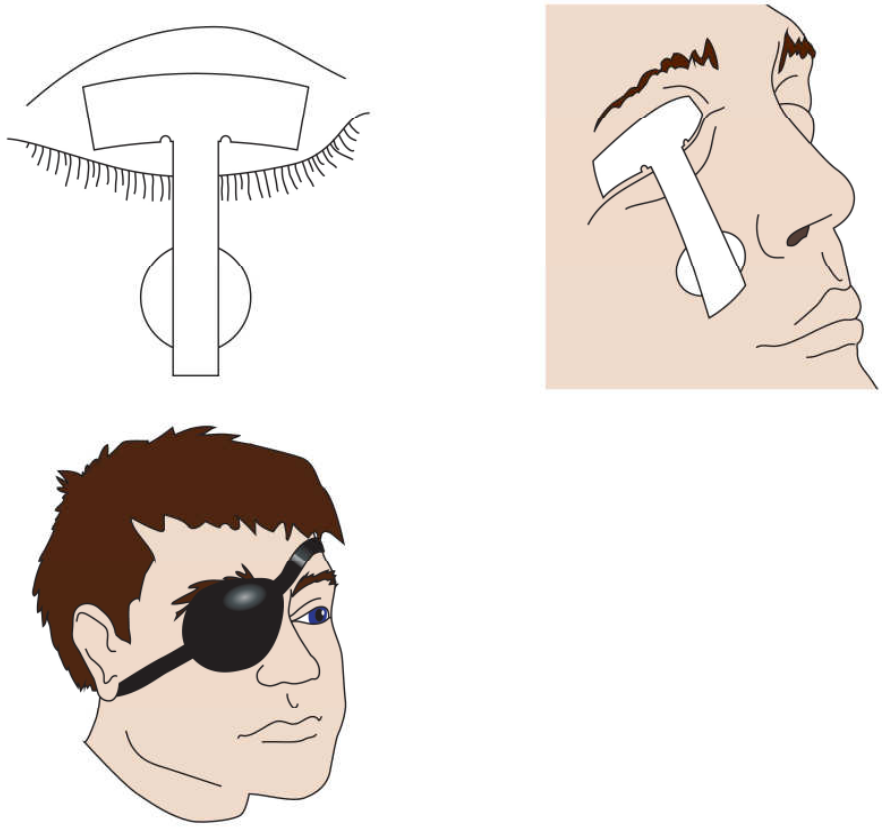

Figure 6.13 *Donaldson natural eye patch*

Inspired by Eskridge JB, Amos JF, Bartlett JD, Clinical Procedures in Optometry, Philadelphia, PA: J.B.Lippincott Company, 1991.

Contra-Indications

- **Never** apply a PP when a penetrating/perforating injury is suspected!
- **Never** apply a PP when mucopurulent, a sign of ocular infection, is present!
- **Never** apply a PP when the FB is organic in nature; the risk of fungal infection is present & would rapidly deteriorate the cornea if patched!
- **Never** apply a PP on an abrasion that occurs in a CL wearer; the risk of *Pseudomonas* infection is present which would rapidly ulcerate & perforate the cornea!

PP removal

- Gently remove the tape by pulling down on the skin of cheek & at the same time grasping with the other hand the end of the first strip; lift it up from cheek to forehead
- Avoid adding skin irritation
- If an allergic reaction in the form of mild red erythematous patches under and around the taped areas appears, treat with cold compresses or 1% hydrocortisone cream or **nothing!** It is usually self-limiting in a few days
- Assess the VA, the corneal abrasion and the associated ocular signs
- Mild to moderate striate keratitis (e.g. in Descemet's membrane) may appear secondary to the mechanical folding of the cornea; self-limiting within 2 to 3 days
- Mild to moderate abrasions usually heal in 24 -36 hrs
- Severe abrasions usually heal in 48 to 72 hours
- **Re-patch** if necessary & re-evaluate within 24 hrs.

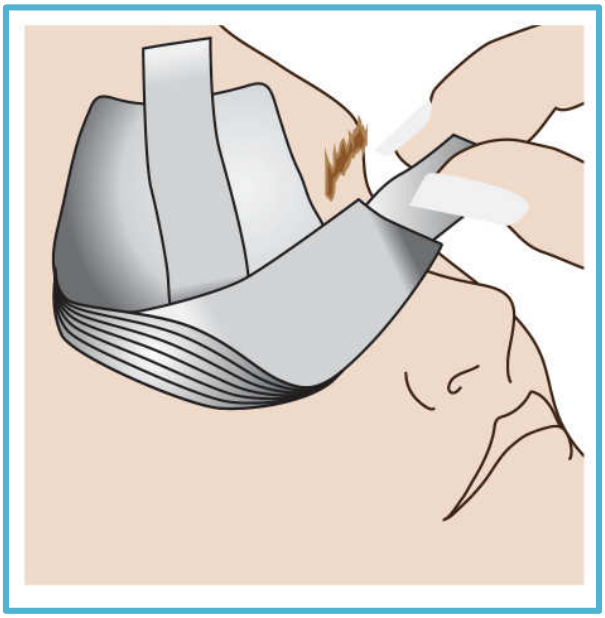

Figure 6.14 *Removing a presspatch*

Inspired by Fingeret M, Casser L, Woodcome HT. Atlas of Primary Eyecare Procedures. Norwalk, Ct: Appleton & Lange; 1990.

BANDAGE SOFT CONTACT LENSES (BSCL)

With the advancement of mid-high water and disposable SCL, an alternative to PP presents itself. Clinicians are using mid-high water SCL with large diameters to cover the corneal abrasion. A low power or plano SCL with a base curve on “K” or steeper is optimal. If the abrasion is too extensive to allow the reading of the corneal curvature of the affected eye the curvature of the fellow eye can be used as reference. Medications must be instilled continuously with this method. With the advent of disposable SCL and the controversy surrounding PP, bandage SCL may become the optimal method for the treatment of abrasions. A comparison of advantages versus disadvantages follows:

Advantages	Disadvantages
• Reduced corneal edema • Reduced risk of infection (not a warm, moist environ) • Cosmesis • Reduced risk of allergies to tape • Cost to practitioner • *Visual considerations* (patient remains binocular)	• Risk of pulling off epithelium (incomplete healing) • Requires constant instillation of meds by patient • Significantly less pressure is applied to the eye • Photophobia may present a problem • Cost to patient (may needs additional Antibiotics) • *Visual considerations* (monocular dilation!)

Table 6.2 *Comparison of advantages and disadvantages of bandage soft contact lenses*

COLLAGEN SHIELDS

Collagen shields are recommended for use in cases of corneal abrasions or recurrent corneal erosions (RCE). They are dissolvable contact-lens type patches. Collagen shields are very expensive when compared to the BSCL and they are not as easy to handle.