

## Managing Corneal Ulcers

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## Lecture Objectives

- Understand corneal anatomy and function
  - What anatomic factors contribute to corneal clarity?
  - How is the corneal stroma maintained in a relatively dehydrated state?
- Understand corneal wound healing
- Understand common corneal ulceration and treatment
  - Corneal ulceration
    - What are important criteria to evaluate when determining therapy for a corneal ulcer?
    - How is depth of a corneal ulcer determined?
    - What are potential causes of corneal ulceration?
    - What are appropriate medical treatments for a melting corneal ulcer?
    - When should surgery be considered for treatment of a corneal ulcer?
  - Calcific keratopathy/corneal degeneration
  - Corneal edema and ulceration
  - Corneal sequestrum

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### Corneal function

- Transmission of light
  - Optical transparency
  - Major refractive medium of eye
- Defense
  - Barrier between eye and outside environment



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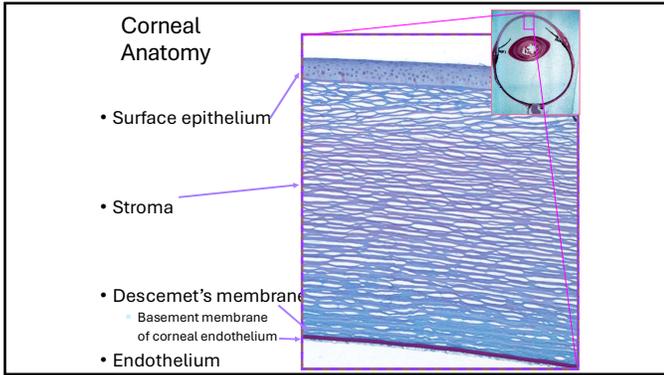
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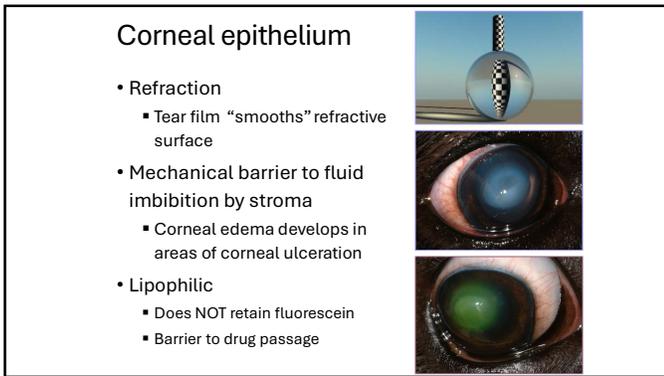
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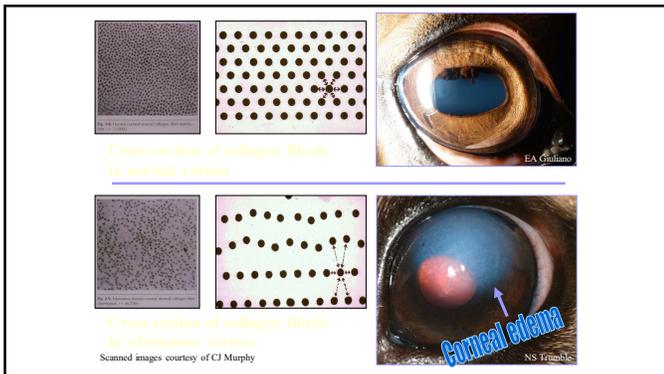
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### Corneal Deturgescence

• Corneal stroma is maintained in a relatively dehydrated state (despite being bathed in tears and aqueous humor)

• How????

- **Evaporation of tears**
  - Hypertonicity of tears draws fluid from corneal stroma
- **Epithelium**
  - Hydrophobic, mechanical barrier to fluid imbibition
- **Endothelium**
  - Na-K ATPase pump actively pumps fluid out of the cornea into the anterior chamber

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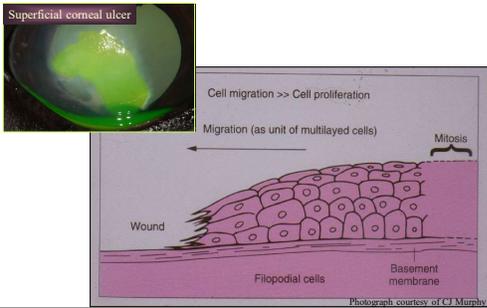
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### Corneal epithelial wound healing



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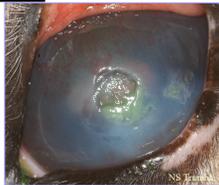
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### Corneal stromal wound healing

- Stromal invasion by neutrophils
- Keratocytes at wound margin transform into fibroblasts
- Fibroblasts invade fibrin plug of wound
- Collagen and GAG synthesis
- Reorganization of collagen
- Return of tensile strength



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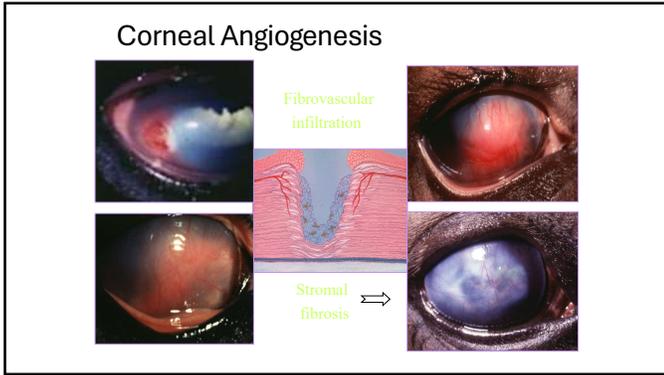
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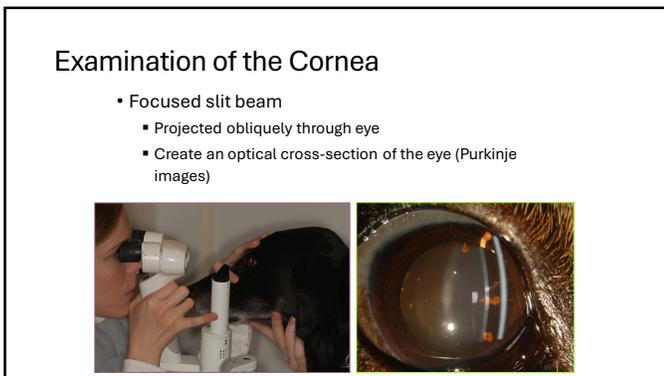
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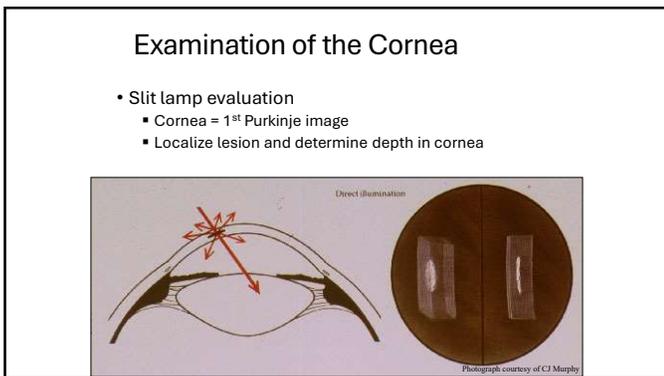
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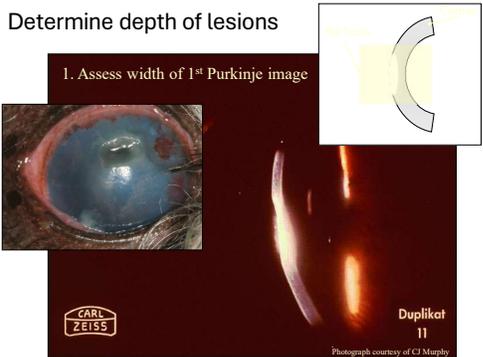
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Determine depth of lesions

1. Assess width of 1<sup>st</sup> Purkinje image



CARL ZEISS  
Duplikat II  
Photograph courtesy of CJ Murphy

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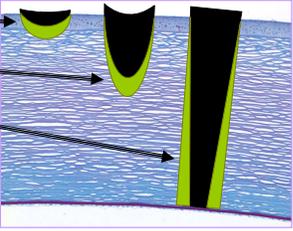
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Corneal Ulceration

- Superficial ulcer
- Stromal ulcer
- Descemetocoele
- Indolent ulcer/ SCCED
- Corneal facet



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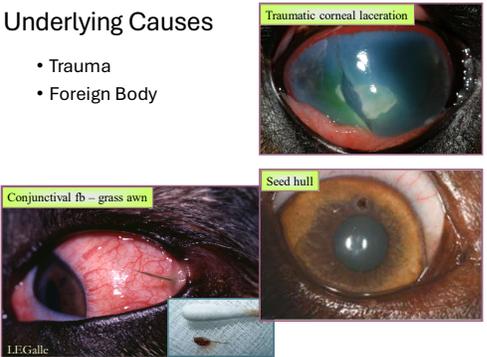
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Underlying Causes

- Trauma
- Foreign Body



Traumatic corneal laceration  
Conjunctival fb - grass awn  
Seed hull  
LEGalle

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### Underlying Causes

- Eyelid abnormalities
  - Entropion
- Lash abnormalities
  - Trichiasis
  - Distichiasis
  - Ectopic cilia
- Eyelid tumors






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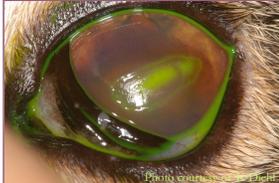
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### Underlying Causes

- Conformational disorders
  - Lagophthalmos
    - Exophthalmos
    - Buphthalmos




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### Underlying Causes

- Infectious
  - Feline
    - Feline Herpesvirus-1 - primary corneal pathogen
  - Canine
    - Primary infectious keratitis rare (Canine Herpesvirus)
    - Secondary bacterial or fungal infections may result from corneal ulceration




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### Underlying Causes

- Neurologic defects
  - CN V - sensory
  - CV VII - lagophthalmos
- Keratoconjunctivitis sicca



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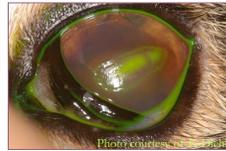
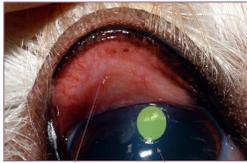
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### Important considerations:

1. The ulcer tells you where the problem is.



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### Important considerations:

2. Any uncomplicated ulcer should heal in a week.
3. What if an ulcer hasn't healed within a week?
  - a. The inciting cause is still present
  - b. The ulcer is infected
  - c. The ulcer is indolent (aka SCCED)



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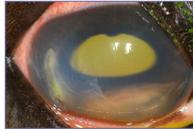
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### Important considerations:

- Corneal ulcers cause reflex anterior uveitis
  - Neuronal reflex from corneal nerves to anterior uveal tract
  - Anterior uveitis = Inflammation of anterior uvea (iris, ciliary b.)
    - Blepharospasm
    - Episcleral injection (redness)
    - Miosis (small pupil)
    - Aqueous Humor flare (protein in AH) or hypopyon (pus in AH/AC) due to breakdown of the blood-aqueous barrier (BAB)
- Severity of uveitis usually correlates to severity of ulceration
- \*\*brachycephalic\*\*



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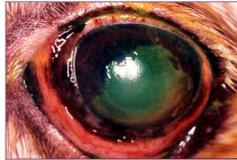
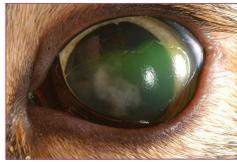
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### Superficial Corneal Ulcer

- Acute
- Clinical appearance
  - Very painful, blepharospasm
  - Distinct border of epithelial loss
  - Corneal edema mild
  - Absence of cellular infiltrate or malacia of the stroma
  - Reflex anterior uveitis
    - Often mild
    - Miosis, aqueous flare, episcleral injection



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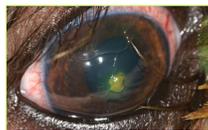
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### Superficial Corneal Ulcer

- Treatment
  - Identify underlying cause
  - Prevent 2<sup>o</sup> bacterial infection
    - Broad spectrum topical antibiotic
  - Address any reflex anterior uveitis
    - +/-Atropine - dilates pupil, alleviates ciliary muscle spasm (which causes miosis and pain), stabilizes BAB-one dose may be sufficient
    - Oral NSAID - stabilizes BAB (no topical NSAIDs)
  - Recheck in 1 week (sooner if brachycephalic)
  - Provide with Elizabethan collar



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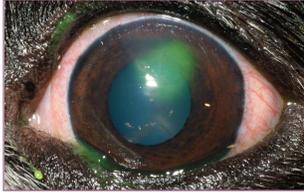
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### Indolent ulcer

- aka. Spontaneous chronic corneal epithelial defect (SCCED), Boxer ulcer, non-healing corneal ulcer/erosion



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### SCCED/Indolent ulcer

- Superficial, chronic, nonhealing corneal ulcer
- Diagnosis based on appearance:
  - Non-adherent lip of epithelium at edge of ulcer
  - Peripheral rim of hazy fluorescein stain uptake
  - Always superficial with no cellular infiltrate
  - Middle age to older dogs (average 9 years)



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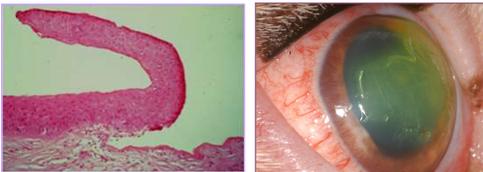
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### SCCED/Indolent ulcer

- Etiology:
  - Abnormal anterior stroma prevents adherence of migrating epithelium
  - Common in Boxers and Corgis



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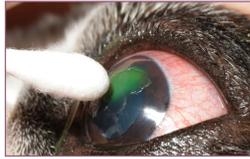
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### Treatment

- Q-tip debridement
  - To remove epithelial tip
  - Topical anesthesia
- Diamond burr keratotomy
  - To penetrate abnormal anterior stroma
  - Topical anesthesia
  - Good restraint
  - +/- Sedation




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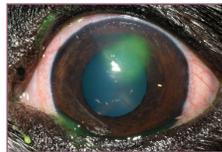
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### Treatment

- Medications:
  - Oxytetracycline Terramycin ¼"strip TID
  - Oral Doxycycline 5mg/kg BID
- \*May improve healing times over neo-poly-bac Vet Ophth 7(6)2004
- +/- Atropine (one dose)
- +/- NaCl 5% ointment TID for corneal edema
- Oral NSAID and analgesic (Gabapentin)
- ~85% will heal within 2 weeks
  - 2<sup>nd</sup> keratotomy or surgical keratectomy may be necessary (Corgis, corneal edema)




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### Placement of Bandage Soft Contact Lens

- Alleviates discomfort by covering exposed corneal nerves
- Medications will diffuse through lens
- Promotes healing
- Remove at 10-14 day follow up if still in place




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### Deep stromal ulcers

- Appearance
  - Severe corneal edema
  - Variable depth of stromal loss
  - Soft, **melting** corneal stroma
  - Yellow-cream stromal infiltrates
  - Corneal neovascularization
  - Anterior uveitis usu. severe
    - Hypotony
    - Miosis
    - Aqueous flare
    - Hypopyon or fibrin in AC



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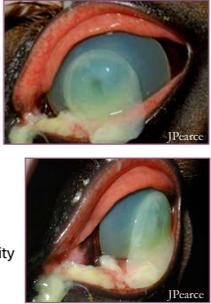
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### Melting Corneal Ulcers - Causes

- Endogenous proteinases
  - Leukocytes
  - Corneal epithelial cells
  - Stromal fibroblasts
- Secondary bacterial infection
  - Collagenase production
    - *Pseudomonas*
    - *B-hemolytic Streptococcus* sp.
- Topical corticosteroids
  - Local immune suppression
  - Potentiation of collagenase activity



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### Descemetocoele



Photograph courtesy of EA Giuliano

Photograph courtesy of M Ford

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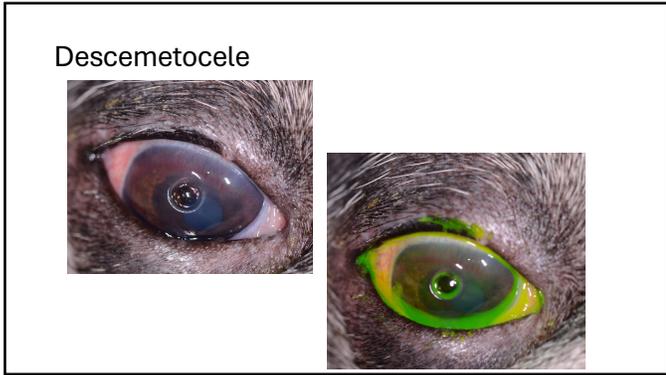
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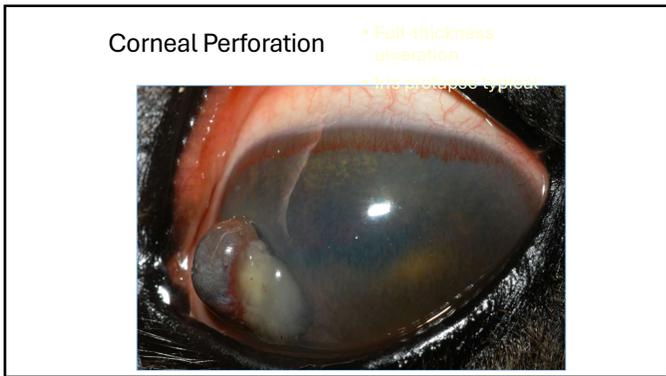
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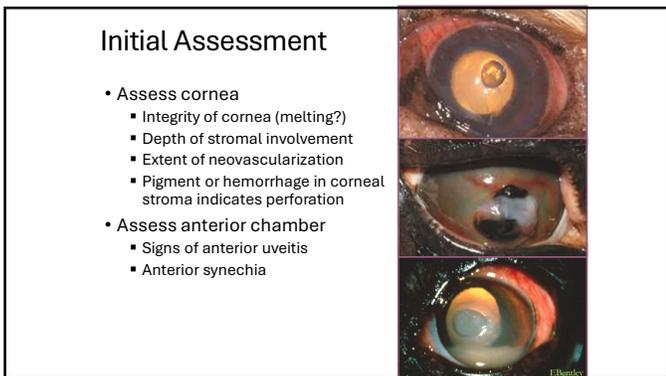
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### Medical Tx :

- Topical Antibiotics
  - Select based on severity & cytology
  - Frequency – Up to hourly (for 24-48 hours)
  - Pend culture results






- Gram + Cocci
  - Fortified cefazolin 50mg/ml
- Gram – Rods
  - Ofloxacin 0.3%

**IMPORTANT; do NOT use any ointments in an eye that has a present or impending perforation**

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### Proteinase Inhibitors

- Inhibit endogenous and bacterial collagenases, prevent continued stromal melting
  - Systemic Doxycycline
  - Vetrix EyeQ Amniotic Eye Drops
  - Serum
    - Contains  $\alpha$ -1 antitrypsin,  $\alpha$ -2 macroglobulin, and TIMP

**Recipe:**  
 10-20 cc of blood from patient, or healthy donor.  
 Allow to clot, spin for 15 min..  
 Aseptically place in sterile eye dropper or 3 cc red top tube.  
 Refrigerate. Discard after 7 days.




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### Topical therapy

- Atropine
  - Pupillary dilation




- Cycloplegia for ciliary muscle spasm associated with reflex uveitis
- Stabilize blood-eye barrier/decrease vascular permeability
- Use to effect, caution with KCS and glaucoma

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### Systemic Therapy

- Broad spectrum antibiotics
  - In case of corneal perforation
  - Cephalexin or Clavamox orally
- Systemic anti-inflammatory
  - NSAID for anterior uveitis and pain relief
  - NO TOPICAL NSAIDS OR CORTICOSTEROIDS
- Systemic pain medications
  - Gabapentin
  - Buprenorphine
- E-collar
- Sedatives if needed
  - Trazadone



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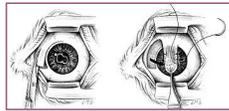
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### Conjunctival Graft



- Brings immediate tectonic support and vascular supply
- Frequency of topical antibiotics can be decreased, serum can be discontinued



Photos courtesy of JRCentral

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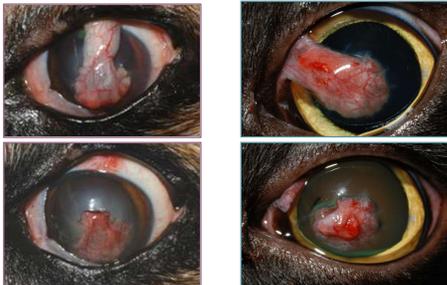
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### Conjunctival Graft

- Remains in place for 6-8 weeks, then trimmed at limbus



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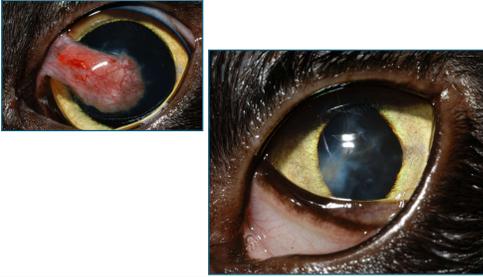
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### Conjunctival Graft

▪ Permanent corneal scar will remain



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### Calcific Keratopathy/Calcareous Corneal Degeneration

- Geriatric dogs (>13 years)
- Mineral deposition on corneal surface
- Cushing's disease
- Renal disease
- Diabetes mellitus
- Idiopathic
- Spontaneous corneal ulceration that will not heal
- Can result in descemetocoele/perforation
- Diamond burr keratotomy (superficial)
- Keratectomy with conjunctival graft (deep)
- EDTA ophthalmic ointment (variable results)



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### Corneal Edema and Ulceration

- Primary corneal endothelial dystrophy/degeneration results in diffuse corneal edema
- Predisposition in Boston Terriers, Chihuahua, Dachshund
- Results in corneal bullae and spontaneous corneal ulceration
- Ulceration can be difficult to heal and often will reoccur



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### Corneal Edema Treatment

- Medical with NaCl 5% ointment and antibiotic therapy as needed for ulceration
- Gunderson Flap (keratoleptysis)-ideal for preserving vision and preventing progression of edema and reoccurring ulceration
- Thermal Keratoplasty



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### Corneal Sequestrum

- Area of corneal degeneration/necrosis with amber to brown/black discoloration
- Caused by chronic corneal irritation
  - Entropion and trichiasis
  - Exposure keratitis
  - Chronic FHV-1
  - Chronic ulceration
- Persian and Himalayan breeds predisposed
- Treat with lamellar keratectomy +/- conjunctival graft or corneal-conjunctival transposition to prevent recurrence



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### Ulcerative keratitis: Summary

- Superficial erosion / ulceration
  - Loss of epithelium
  - Treatment: broad spectrum abx, +/- atropine, +/- oral NSAID
- Indolent ulcer/SCCED
  - Loss of epithelium, with non-adherent epithelial lip
  - Treatment: debride, grid keratotomy, broad spectrum abx, +/- atropine, +/- oral NSAID
- Stromal / deep ulceration
  - Variable loss of corneal thickness
  - Culture/sensitivity and cytology indicated
  - Treatment: Aggressive abx, anti-collagenases, atropine, oral NSAID, possible sx
- Descemetocoele
  - Stromal loss down to Descemet's membrane
  - Surgical emergency
- Perforation
  - Often seals with fibrin or iris tissue
  - Surgical emergency

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