

# Small Animal Corneal Disease

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- Corneal Anatomy
  - Thickness
    - Dog: 0.62mm
    - Cat: 0.56mm
  - Epithelium: 5–11 cell layers
  - Stroma
    - 90% of thickness
    - regular arrangement of collagen fibrils allow transparency
  - Descemet's membrane
  - Endothelium: dehydrates stroma
    - Some regenerative capacity in young puppies
- Epithelial Wound Healing
  - Migration (starts within 3–6 hours)
    - Epithelial cells retract and thicken
    - Epithelial cells begin to slide across defect
  - Proliferation
    - Stem cells travel from limbus
    - Return epithelium to normal thickness
  - Adhesion
    - Reformation of normal adhesion of epithelium
    - 1–7 weeks (depends on whether previous anchoring structures remain intact following injury)
- Stromal Wound Healing
  - Keratocytes and fibroblasts invade wound (2–3 days after injury)
  - Fibroblasts transform into keratocytes over 15–30 days
  - Keratocytes begin forming collagen
    - Long process: 3 months+
  - Scarring – Disorganized collagen fibers
  - Rebuilding original strength a long process (50% tensile strength at 100 days)
- Classification of Corneal Ulcers
  - Simple
  - Viral: FHV-1
  - Complicated
    - Deep

- Melting
    - Infected
  - Indolent
- Simple Ulcers
  - Non-septic and superficial
  - Mild trauma
  - Should heal within 3–5 days
  - Management
    - Broad spectrum *topical* antibiotics TID/QID
      - Trimethoprim/polymyxin B
      - Neomycin/polymyxin B/bacitracin
      - Neomycin/polymyxin B/gramacidin
    - Topical atropine to effect
    - Recheck 3–5 days
- Indolent Ulcers
  - Middle-aged dogs (7–9 years)
  - Relatively common
  - Any breed, boxers overrepresented
  - History of ocular trauma not witnessed by owner
  - Waxing and waning course common
  - No underlying cause for the ulcer found (ectopic cilia, entropion, foreign body)
- Possible etiologies – indolent ulcers
  - Abnormality of epithelial adhesion complexes in number, formation, or function
  - Change in levels of neurotransmitters
  - Alteration of superficial stroma that prevents anchoring of epithelial adhesion complexes
- Treatment – Indolent Ulcers
  - Current Veterinary
    - Grid keratotomy, anterior stromal puncture
    - Superficial keratectomy
  - Human – Recurrent Corneal Erosions
    - Bandage contact and long-term artificial tears
    - Anterior Stromal Puncture/Nd:YAG laser
    - Excimer laser phototherapeutic keratectomy (PTK)
    - Diamond Burr Superficial Keratectomy
- Diamond Burr in Human RCES
  - Recent favorable results with diamond burr keratectomy (DBK)
    - 51/54 treated eyes had no recurrence (Sridhar MS, 2002)
    - No significant difference in corneal haze, recurrence, or vision when DBK used versus PTK (Soong HK, 2002)

- Double masked prospective trial comparing DBK with simple debridement (Wong VW, 2009)
      - Significantly fewer recurrences with DBK
      - Less need for repeated surgical intervention using DBK
      - Significantly lower mean magnitude of astigmatism after DBK
- What is a diamond burr?
  - Handheld battery driven instrument
  - Multiple sizes of diamond encrusted burrs available
    - 5mm diameter round burr
  - Some burrs can be resterilized
- Diamond Burr Superficial Keratectomy – MVS results
  - Faster healing times at 1–2 weeks and 2–3 weeks with DBSK than other treatment methods
  - Easy to use
  - Can be performed awake
- Superficial ulcers with suspected viral etiology: FHV-1
  - Dendritic ulcer pathognomonic for FHV-1
  - Suspect underlying FHV-1 based on history – recent stress, shelter animal, recurrent, etc
  - May take longer to heal
  - Treatment Options
    - Terramycin TID good initial choice
    - If poor response or more involved consider
      - 0.5% cidofovir BID topically (compounded)
      - Famcyclovir compounded as transdermal
    - Atropine or tropicamide to effect
    - L-lysine: 500mg PO BID – questionable efficacy
- Complicated Ulcers – Work Up
  - Cytology
    - Cocci: gram positive
    - Rods: gram negative
  - Bacterial Agents (Tolar, 2006)
    - 29% Staph intermedius
    - 17% B-hemolytic Strep
      - >80% resistant neomycin, polymyxin B, tobramycin
    - 21% Pseudomonas aeruginosa
  - Estimate depth of ulcer
    - Recommend referral if >25%
  - Assess for collagenolysis (melting)

- Recommend referral if present
  - Avoid
    - 3<sup>rd</sup> eyelid flaps
    - Topical steroids and anesthetics
    - Tonometry
- Complicated Ulcers –Medical Management
  - Topical antibiotic (Tolar, 2006)
    - Fluoroquinolone (ciprofloxacin, ofloxacin)
    - first-generation cephalosporin and tobramycin until culture results
  - Atropine to effect (SID to BID)
    - Mydriasis
    - Stabilizes blood–aqueous barrier
    - cycloplegic
  - Long-lasting artificial tear QID up to q2hr
  - Consider systemic antibiotic and NSAID if rupture is imminent
  - Consider anti-collagenase such as serum for melting ulcers q2hr
  - *Recheck daily*
- Complicated Ulcers – Surgical Management
  - Goals
    - Reduce pain
    - Save the globe
    - Restore/maintain vision
  - Ideal treatment
    - Protection
    - Support
    - Antimicrobial
    - Anti-protease activity
    - Nutrition
    - Analgesia
    - Maintains visual axis
  - Consider when defect  $\geq 50\%$  depth
  - Conjunctival Pedicle Graft meets many of these ideals
- Corneal Sequestration
  - Chronic trauma/exposure (brachycephalics)
  - Associated with FHV-1 infection
  - Can be caused by grid keratotomy of feline cornea
  - Variably painful
  - Can slough and cause perforation

- Surgery recommended
  - Keratectomy
  - Corneal–conjunctival transposition
  - Adjunctive conjunctival pedicle graft
- Life–long artificial tears in brachycephalics BID – TID

## Non–ulcerative Corneal Disease

- Calcific Degeneration
  - Predispositions
    - chronic corneal inflammation
    - hypercalcemic states
    - old corneal scars
  - Unknown mechanism
    - Tissue pH changes caused by inflammation/tear evaporation?
    - Phosphates in topical meds?
  - Treatment
    - 1% EDTA (unknown efficacy)
    - Keratectomy if non–healing ulcer
- Lipid Deposition
  - Dystrophy = bilateral, presumed inherited
  - Keratopathy = systemic lipid abnormalities
    - Rottweiler
    - Miniature Schnauzer
  - Degeneration = secondary to pathologic changes within cornea
  - Airedale, collie, sheltie, husky, beagle, dachshund, afghan, CKC, GSD predisposed to dystrophy
  - Topical steroids may exacerbate condition
  - Usually no treatment necessary (restriction of fat may prevent progression)
  - Keratectomy if severe vision impairment, but usually reoccurs
- Superficial Punctate Keratitis
  - Shetland Sheepdogs predisposed
  - Multifocal greyish white round or irregular rings in cornea
  - Observed dogs as young as 4 months – corneal dystrophy, immune–mediated?
  - Initially non–painful
  - May develop corneal erosions and have reduced TFBUT
  - Unknown etiology
    - Low thyroid hormone has been observed
    - Viral cause has been postulated
    - Immune–mediated?

- Treatment
  - Cyclosporine 1% BID
  - Artificial tear – Genteal Gel – Severe BID – TID
- Usually good response with improved comfort
- Superficial Keratitis  
(fibrosis, neovascularization, pigmentation, cellular infiltrate)
  - KCS
  - Mechanical trauma from hairs
  - Exposure
  - Immune-mediated
    - Chronic Superficial Keratitis (pannus)
    - Eosinophilic keratitis (cats)
    - Proliferative keratitis (cats)
  - Neurogenic
    - Lack of sensory innervation
    - Lack of motor innervation to eyelids
  - Pigmentary keratitis may result from any of the above
- Chronic Superficial Keratitis (Pannus)
  - German Shepherd Dog and Greyhound predisposed
  - Severity increases with higher altitudes
  - Young GSD more severe disease
  - Cause: immune-mediated – possibly modulation of corneal antigens by UV-light
  - Treatment:
    - Topical corticosteroids/cyclosporine
    - Avoid prolonged exposure to UV-light
    - Consider Doggles if living at higher altitude
- Eosinophilic keratitis
  - White/yellow plaques (may take up fluorescein) and neovascularization
  - Conjunctiva alone may be involved
  - Association with FHV-1 suggested
  - Cytology:
    - Neutrophils, plasma cells, lymphocytes, eosinophils
    - Eosinophils are not normal corneal/conjunctival inhabitants, so finding one is diagnostic
  - Treatment
    - 88% cases responded to 1.5% cyclosporine BID-TID topically (Sapienza, 2009)
    - Good response to topical corticosteroids – caution with FHV-1

- Megestrol Acetate: 5mg daily x 5d, then qod x 5d, then weekly – not recommended unless topical treatment impossible
- Stromal Keratitis
  - Deep, straight vessels in the cornea
  - Corneal edema may be present because endothelium can be affected
  - Anterior uveitis can be present
  - Herpesvirus, vaccine reactions (CAV), idiopathic
  - Treatment
    - Topical corticosteroids BID – QID – taper slowly to effect
    - Topical cyclosporine 1% BID
- Corneal endothelial dystrophy/degeneration
  - Removing endothelium causes 500% increase in thickness, removal of epithelium causes 200% increase
  - Focal area of edema starts in one eye (usually temporally) and moves across cornea
  - Eventually both eyes are involved
  - Bullae may form and rupture
  - Rule out other causes of corneal edema (uveitis, glaucoma, etc)
  - Treatment
    - Hypertonic saline
    - Antibiotics if ulcerated
    - Thermokeratoplasty if non-healing ulcer