

The 25th Annual

# Waltham/OSU Symposium

## Small Animal Ophthalmology

October 27 – 28, 2001

### Medical Vs. Surgical Treatment Of Corneal Disease

---

Brian C. Gilger, DVM, MS

*Dipl. American College of Veterinary Ophthalmologists*

*Associate Professor, Ophthalmology*

*Department of Clinical Sciences*

*North Carolina State University*

*Raleigh, North Carolina*

---

#### Introduction

Corneal diseases are the most common ocular abnormality in small animal practice. We will review signs, classification and treatment. Simple corneal ulcers, nonhealing (indolent) ulcers, chemical burns, and superficial non-ulcerative conditions will be reviewed. Deep and/or progressive corneal lesions are the most frustrating of ocular disorders, and mistakes or failure to act aggressively in certain cases can lead to perforation and loss of the eye. Recognition of deep corneal lesions will be discussed. Medical vs. surgical treatments will be compared and contrasted.

#### Simple corneal ulcers

Simple corneal ulcers are the most common type of corneal disease in small animal practice. Simple corneal ulcers are most commonly superficial (involving only the epithelium), acute onset, usually painful (exposed nerve endings). These lesions are not associated with significant uveitis, are not infected, and are not caused by a retained foreign body or eyelid abnormality. Commonly, these ulcers are caused by trauma. Superficial corneal ulcers will heal rapidly on their own in 48 to 72 hours. The first step in management of these ulcers is to eliminate the cause (look for foreign bodies, distichiasis, KCS, etc). Treatment is aimed at prevention of infection. Topical broad spectrum antibiotics (i.e., Triple antibiotic) tid-qid +/- atropine (if pupil miotic - then atropine once a day) is the recommended treatment. Reevaluation should be scheduled in 72 hours. If the ulcer is still present then you have missed the cause of the ulcer, it has become infected with bacteria or fungus (complicated corneal ulcer), or the ulcer is an indolent ulcer.

#### Clinical features of simple corneal ulcers:

- Superficial
- Acute onset
- Usually painful
- No significant uveitis
- Not infected
- No associated foreign body or anatomic abnormality

#### *Surgical Management of Superficial Corneal and Scleral Lesions*

Many superficial corneal lesions are amenable to surgical correction, e.g., indolent corneal ulcers, dermoids, corneal neoplasms, sequestra, crystalline corneal degeneration, pigmentary keratitis, chronic superficial keratitis, among others. The most common treatment procedure of these superficial corneal lesions is superficial keratectomy. Superficial

keratectomy is also useful to obtain biopsy material for histologic diagnosis of corneal or scleral neoplasms, or inflammatory masses such as nodular granulomatous episclerokeratitis.

### ***Superficial Keratectomy***

Corneal lesions amenable to treatment by superficial keratectomy include indolent ulcers, corneal neoplasms, dermoids, sequestrums, foreign bodies, corneal abscesses, bacterial and fungal keratitis (usually in conjunction with a conjunctival flap) and crystalline corneal degeneration. Prior to performing a superficial keratectomy, determining the depth of the lesion by careful biomicroscopy will help plan the surgery. If the resulting corneal wound extends from 1/2 to 3/4 thickness of the cornea, use of a conjunctival pedicle flap is warranted to provide protection of the cornea, help prevent perforation, and promote healing. Because corneal stromal tissue may not completely regenerate, the number of superficial keratectomies that can be performed at the same site is limited to two or three, depending on the depth of tissue removed with each procedure.

Superficial keratectomy procedure involves removing the corneal epithelium and superficial stroma with a surgical blade. The use of magnification (e.g., an operating microscope) is essential to perform the surgery, and specialized surgical equipment, such as a micrometer diamond knife, corneal trephine, and a corneal dissector, greatly facilitates removal of corneal tissue and may improve the clinical outcome. The initial corneal incision should completely surround the lesion to be removed and can be made using the corneal trephine, diamond knife, or microsurgical blade. The initial incision can be round, square, or triangular. After the initial incision is made, the edge of the tissue to be removed is grasped by forceps, and a corneal dissector (e.g., Martinez corneal dissector, 64 Beaver microsurgical blade, iris spatula) is introduced and held parallel to the cornea. The dissector is used to separate the corneal lamella without penetrating deeper than the original incision. The cornea is separated until the opposite incision line, or limbus, is reached. Scissors may be needed to connect the dissection to the opposite incision or to remove the corneal tissue from the limbus.

Following keratectomy, the cornea is treated with topical broad spectrum antibiotics to prevent infection, and topical atropine to decrease ciliary spasm and discomfort. A potentially devastating complication after keratectomy is corneal perforation, which is generally caused by infection of the surgical site. The potential for infection is exacerbated by deep, extensive keratectomies and is largely preventable by use of conjunctival flaps. Frequent reevaluations after surgery (with monitoring of healing by use of fluorescein dye application), use of topical antibiotics, and placement of conjunctival pedicle flaps in deep keratectomies should prevent most complications after surgery.

### ***Surgical Management of Ulcerative Keratitis***

Certain ulcerative corneal lesions are unresponsive to medical therapy and require surgical therapy. Thus, corneal ulcers deeper than one-half thickness of the cornea, ulcers that are progressing rapidly despite therapy, or ulcers that will not heal despite appropriate medical therapy require surgical intervention. Some examples of these types of ulcerative lesions include *indolent ulcers, bacterial or fungal-infected ulcers, collagenolytic (melting) corneal ulcers, and deep progressive corneal ulcers*

The first step in treating all corneal ulcers involves searching for and removing the inciting cause. The cause may be eyelid abnormalities (masses, lagophthalmos, distichiasis, ectopic cilia, etc), foreign bodies, repeated trauma, and keratoconjunctivitis sicca. Chronic, infected, or progressive corneal ulcers should have an aerobic bacterial and fungal culture and sensitivity done, and cytology of the cornea should be collected and examined. This culture procedure will help guide specific medical therapy after surgery.

### **Indolent Ulcer**

Indolent ulcers (recurrent erosions, Boxer ulcers) are superficial defects of the corneal epithelium that are characterized by nonadherent epithelium forming redundant epithelial ulcer borders. These ulcers do not invade the corneal stroma and are not typically associated with an infectious agent. The primary etiology may be a basal epithelial or superficial stromal defect that does not allow the normal adherence of the corneal epithelium to the stroma. Surgical therapy for indolent ulcers is the treatment of choice; however, a number of medical therapies, which are used with and without surgery, have been described recently with variable results (e.g., use of fibronectin, epidermal growth factors, and polysulfated glycosaminoglycans). **Multiple punctate keratotomy (MPK)** was initially described as a method to treat recurrent erosions in human beings. With this method, following application of a topical anesthetic, a 20-gauge hypodermic needle is used to create multiple superficial stromal punctures following complete debridement of loose epithelium with a dry cotton swab. Tranquilization or general anesthesia are rarely needed except in fractious or excitable dogs. Punctures are placed 0.5 to 1 mm apart throughout the affected areas and extended 1 to 2 mm into normal corneal epithelium. A disadvantage of the MPK procedure is that perforation of the cornea is possible. **Grid keratotomy**, also a modification of the SPK, may decrease complications (i.e., corneal perforations) and may be simpler to perform than the MPK. With a grid keratotomy, after application of a topical anesthetic, a 25-gauge needle is used to very lightly scratch the surface of the

debrided indolent ulcer. Horizontal and vertical scratches are made to form a grid pattern, with the scratches extending slightly into the normal epithelium. The scratches should be separated by approximately 1 mm. With both MPK and grid keratotomy, a topical antibiotic is prescribed after surgery and the animal is reevaluated within 5 to 7 days. Concurrent use of soft contact lenses may be beneficial in promoting healing.

A third surgical therapy for indolent ulcers is superficial. By removing the epithelium and abnormal superficial stroma of the indolent ulcer, the cornea generally heals rapidly<sup>1</sup> This can be used as either a primary therapy or if the MPK or grid keratotomy techniques fail. A disadvantage of superficial keratectomy is that general anesthesia is required.

### **Conjunctival flaps or grafts**

The surgical procedure most commonly used for chronic, infected, or progressive corneal ulcers is a conjunctival flap or graft. Conjunctival flaps provide corneal support, fibrovascular tissue to fill corneal defects, and bring blood supply (and blood-associated immune components, systemic antibiotics, natural anticollagenases – alpha 2 macroglobulin) to the lesion.<sup>2</sup> Because conjunctival flaps cover only a small area of the normal cornea, they allow visualization of much of the cornea and anterior chamber of the affected eye by the clinician, which allows continuous examination of these structures to monitor progression of the ulcer and possible anterior uveitis. Having only a small portion of the cornea covered may also allow the animal to continue to be visual.

All types of conjunctival flaps consist of thin conjunctival tissue transposed onto the cornea to cover the lesion. The bulbar conjunctival flap moves with the eye and thus no tension is applied to the flap itself. With all types of conjunctival flaps, it is important that the graft bed and ulcer be properly prepared. The recipient bed for the graft is prepared by debriding the lesion, thereby removing loose epithelium and devitalized corneal tissue.<sup>2</sup> Great care should be taken to prevent perforation of the cornea during this debridement.

The **hood** and **pedicle conjunctival grafts** are the most versatile and are recommended for most cases of severe corneal ulceration. The hood flap is indicated for peripheral corneal lesions. The conjunctiva adjacent to the lesion is cut from the limbs and undermined. The graft is advanced to cover the lesion and sutured in place, generally with 2 or 4 simple interrupted sutures.

The **pedicle (or rotational) flap** is probably the most useful and versatile conjunctival flap. The base of the pedicle flap should be directed toward the area of the limbs nearest to the lesion. Once the location of the base is determined, a site 1 to 1.5 cm temporal to the base is located, which will be site where the flap will be initiated. A small slit is cut in the conjunctiva perpendicular to the limbus. Through this small slit, the entire conjunctival flap site is undermined using blunt dissection. The underlying fibrous tissue (Tenon's capsule) should be freed from the overlying conjunctiva so that the conjunctiva appears transparent. Two parallel cuts are then made to create a strip of conjunctiva. This strip of conjunctiva is rotated to cover the corneal lesion. The flap is sutured to the cornea with simple interrupted sutures of 7-0 to 9-0 polyglactin 910 or nylon. The sutures are placed first at the distal end of the flap and then 1 to 1.5 mm apart. To prevent disruption of the blood supply, sutures are not placed within the pedicle portion of the graft or at the proximal portion of the lesion. The graft harvest site on the bulbar conjunctiva should be closed using a simple continuous suture of 7-0 to 9-0 polyglactin 910.

The conjunctival flaps will adhere to the corneal lesion and epithelialization surrounding the flap, but not generally underneath the flap, will occur. Three to 8 weeks after placement of the flaps, the blood supply should be interrupted by cutting the base of the flap at the limbus. This can usually be done with topical anesthesia and Stevens tenotomy scissors. Cutting off the blood supply will allow the conjunctival graft to recede and will lessen the resulting corneal scar.

The most common **complication** of any type of conjunctival grafting procedure is dehiscence of the graft from the corneal lesion. This may occur because the corneal lesion is progressing (i.e., worsening) and damaging the cornea at the points where sutures securing the graft are placed. Excessive tension on the graft or allowing a significant portion of the fibrous Tenon's capsule to remain attached to the graft may result in premature dehiscence of the graft. Proper suture placement in healthy cornea, using a thin conjunctival graft, and concurrent appropriate medical therapy will greatly decrease complications following conjunctival flap surgery.

### **Management of Desmetoceles and Full-thickness Corneal Perforations**

#### *Descemetocoele*

A descemetocoele is a deep corneal lesion in which the corneal epithelium and stroma are completely destroyed leaving a lesion lined only by Descemet's membrane and corneal endothelium. Descemet's membrane is a tough elastic membrane, but it is only 3–12 µm thick and easily ruptured. Once this final barrier is breached, a full-thickness lesion will occur, aqueous humor will be lost, and iris prolapse may occur. Contamination of the anterior chamber also occurs after rupture

of Descemet's membrane, which may lead to endophthalmitis and a much poorer prognosis for saving the eye and vision. Descemetocoeles and full-thickness corneal perforations can develop from a progression of deep corneal ulcers or from trauma.

### *Presurgical assessment*

Because of the fragile nature of descemetocoeles and the potential for infection and intraocular inflammatory damage with perforations, repair of the lesions should be considered a surgical emergency. Prior to surgery, an assessment of the posterior segment of the affected eye should be attempted to help determine prognosis for vision. Posterior segment examination may be possible in descemetocoeles, but it is usually difficult with perforations. In those instances where ophthalmoscopy is not possible, evaluation of consensual pupillary light response and dazzle reflexes may provide some information regarding the integrity of the posterior segment of the eye. Presence of a consensual pupillary light response and a dazzle response is a positive clinical sign, but it does not ensure a normal posterior segment (e.g., eyes with retinal detachments may have both a consensual pupillary light response and a dazzle response early in the disease process). However, absence of consensual pupillary light responses and the dazzle reflex indicates a poor prognosis, and alternatives to surgical repair should be considered (i.e., enucleation). Ocular ultrasound can also be used to assess posterior segment damage with corneal perforations; however, it is important that the ultrasound coupling gel does not get into the wound or anterior chamber of the eye. If ultrasound of the injured eye is attempted, the animal should be sedated or anesthetized so that movement of the animal does not further damage the eye, and a standoff pad (e.g., solid gel standoff pad or a water-filled balloon) should be used to separate the globe, gel, and eye. Seven and one-half or 10 megahertz ultrasound transducers should give excellent views of the eye. Preoperative bacterial and fungal culture and sensitivity should always be performed along with evaluation of conjunctival cytology prior to surgery to help direct medical therapy after surgery.

### *Surgical planning*

Most descemetocoeles can be repaired successfully using conjunctival flaps. However, if a conjunctival flap is used, the corneal lesion will remain fragile and, in many instances, a large stromal scar will develop. However, conjunctival tissue may not have the structural integrity, in many instances, to maintain a watertight seal and a formed anterior chamber after surgery. This results in a continuing leakage of aqueous humor, which results in increased inflammation and anterior synechia formation. Use of corneal tissue or another tissue with more structural integrity than conjunctival tissue may help overcome some of these problems. The difficulty is finding a source of these tissues. The tissues may be harvested from an adjacent normal cornea (e.g., as in autogenous corneal grafting or corneal-scleral transposition, from donor animals with the tissues used fresh or frozen,<sup>3</sup> or from other strong fibrous tissue such as periosteum or cartilage.<sup>4-6</sup> Direct suturing of the lesion is rarely possible, but may be attempted in small lesions (less than 1 mm) that have firm, healthy corneal margins. Direct suturing of larger lesions may cause significant corneal astigmatism and poor visual outcome after surgery. Tissue adhesives are not recommended for use in descemetocoeles because during the polymerization of the glue after application, heat is generated which may cause perforation of Descemet's membrane. Because of aqueous humor leakage, it is nearly impossible to sufficiently dry the corneal lesion in corneal perforations to allow the glue to adhere to the lesion. Furthermore, intraocular leakage of the glue may cause severe damage.<sup>7</sup>

Corneal-scleral<sup>8</sup> or corneo-conjunctival transposition: This procedure is a type of autogenous corneo-scleral graft that uses a sliding pedicle of cornea and attached sclera to repair corneal defects. It is indicated in central, deep, or perforated corneal lesions where there is sufficient peripheral healthy cornea present that can be used for the grafting procedure. In general, the distance from the peripheral edge of the lesion to the corneal limbus needs to be at least 1 mm longer than the diameter of the corneal lesion itself to be able to perform the corneal-scleral transposition. Because "self" tissues are used, the corneal-scleral transposition eliminates the need for corneal tissue donors and decreases immune-mediated inflammation. This may decrease the corneal scarring and allow a clearer postoperative cornea than that seen after conjunctival grafts and some other corneal grafts. A disadvantage, however, is that the corneal-scleral transposition damages normal, healthy corneal tissue.

Postoperative management of corneal-scleral transposition is similar to that of conjunctival flaps. Appropriate topical antibiotics (based on culture and sensitivity, and cytologic results) and medications to control postoperative uveitis and pain (topical atropine+/- systemic nonsteroidal anti-inflammatory medications) should be used. Usually, the conjunctival and scleral sliding graft is well adhered to the cornea and cannot be trimmed as is typically done with conjunctival flaps. However, in some animals, after the cornea has completely healed (usually in 4 to 6 weeks), the conjunctiva can be cut, undermined, and excised. This usually requires general anesthesia and in most cases is not required because the conjunctiva is on the peripheral cornea and not significantly obstructing vision.

Autogenous lamellar corneal grafts: This procedure is indicated for use in corneas with descemetocelles, stromal abscesses, and perforated ulcers. These grafts use adjacent corneal tissue which is slid to cover the corneal defect. Advantages of this procedure are that the autografts are used and therefore graft rejection should be minimal, tissue is usually readily available, and a clear cornea may result after surgery. The main disadvantage of this procedure is that an area of normal cornea is weakened. In 7 dogs with corneal disease, Brightman et al found that 6 of 7 grafts remained translucent and only one had pigmentation. The surgical procedure is initially similar to the corneal-scleral transposition. Two parallel incisions are made which extend past the lesion toward the limbus. The distance between the incisions is 2 to 3 mm wider than the diameter of the lesion. The incisions are joined by making a perpendicular incision and a 1/2 thickness keratectomy is performed. The graft should be 0.5 to 1 mm wider and deeper than the lesion. The graft is positioned in the graft bed of the lesion and sutured into place with a continuous or interrupted suture pattern. A conjunctival pedicle flap can be placed over both the graft and lesion to help promote healing, bring in blood supply, and give added strength to the corneal lesions and graft site. Use of the conjunctival flap may be especially important in infected ulcers or rapidly progressing ulcers; however, increased scarring may subsequently occur.

Tectonic corneal grafting using frozen corneal tissue has also been described for treatment of corneal descemetocelles and perforations.<sup>3</sup> Fresh corneal tissue was collected at the time of euthanasia of donor animals and placed in a bottle of triple antibiotic ophthalmic solution. The tissue was then placed in a standard -20° C freezer and kept suitable for up to 10 months. Others have found tissue suitable for surgery when frozen for over 24 months.<sup>9</sup> When the tissue is needed for surgery, it is thawed in warm water or at room temperature.<sup>3</sup> The grafts were cut and placed over descemetocelles or perforations and sutured into place with 8-0 polyglycolic acid suture. No attempt was made to limit vascularization until the graft was completely vascularized and the cornea fluorescein negative. In Hacker's series of 19 cases, 84% were successful and had vision, despite vascularization and scarring of the graft.<sup>3</sup>

## **Management of Full-Thickness Corneal Lacerations**

### *Preoperative assessment*

Surgical repair of most corneal lacerations is usually not overly challenging provided proper instrumentation, magnification, and suture materials are used. However, a successful visual outcome after traumatic corneal laceration requires careful, thorough preoperative evaluation and selection of the appropriate surgical procedure(s). The extent of the ocular trauma must be determined prior to repairing the cornea and in many cases this can be difficult. Deflation of the anterior chamber, iris prolapse, hyphema, hypopyon, and/or significant corneal edema may prevent a complete ophthalmic examination. Presence of a consensual pupillary light response and dazzle response are positive clinical signs, but they do not ensure a normal posterior segment. Ocular ultrasound, using a 7.5 or 10 MHz probe, can also be used to assess posterior segment damage with corneal lacerations; however, it is important that the ultrasound coupling gel does not get into the wound or anterior chamber of the eye. If ultrasound of the injured eye is attempted, the animal should be sedated or anesthetized so that movement of the animal does not further damage the eye, and a standoff pad (e.g., solid gel standoff pad or a water-filled balloon) should be used to separate the globe, gel, and eye. If possible, integrity of the anterior lens capsule should be examined. If careful examination was not possible prior to surgery, it should be done during the surgical procedure. If the lens capsule is ruptured, significant lens-induced uveitis and cataractogenesis will occur. Phacoemulsification of the lens and implantation of a synthetic intraocular lens occurring simultaneously with the corneal repair will decrease the postoperative inflammatory response and help maintain vision.<sup>10</sup>

Full-thickness corneal lacerations may or may not have incarcerated uveal tissue. Incarcerated yet viable iris tissue should be repositioned in the anterior chamber when possible. Iris tissue that has been prolapsed for longer than 6 to 8 hours should be amputated with electrocautery. When removing a prolapsed iris, gentle traction is placed on the prolapsed portion and the fresh uveal tissue is cauterized near the cornea; care must be taken not to cauterize the cornea. The anterior chamber is irrigated with BSS or lactated Ringer's solution and the lens is carefully inspected (see above). Viscoelastic substances can be used to reinflate the anterior chamber and to keep it formed while suturing the cornea. Removal of the viscoelastic substances by irrigation is recommended prior to placement of the final suture to prevent ocular hypertension following surgery.

Appropriate suture material for corneal lacerations includes 7-0 to 9-0 polyglactin 910 and 8-0 to 10 nylon. Choice of suture type depends largely on surgeon preference. Nylon is easiest to handle and least reactive in the cornea initially, but it needs to be removed in most cases after 4 to 6 weeks. Large animal corneas can be sutured with 7-0 or 8-0 suture material. Small animal corneal incisions generally require 8-0 to 10-0 suture material. There are several suture patterns described for corneal wounds and each has advantages and disadvantages. Simple interrupted, simple continuous or running, shoe lace, and others have been described. Sutures should be tied in a manner that achieves apposition of the tissue; however, no compression of the tissue is required because this causes gaping of the deep wound edges. Also, a

tight suture that has been placed slightly oblique to the incision will cause the wound edges to shift along the entire wound line. When corneal sutures are placed properly, minimal shift of wound edges occurs. Proper placement involves placing the suture plane perpendicular to the corneal surface, having the needle inserted perpendicular to the tissue surface, and having the needle tip exiting the cornea perpendicular to the wound surface. Following closure of the cornea, the anterior chamber is reformed with BSS via a limbal injection using a 27- to 30-gauge needle. After wound closure, sterile fluorescein dye may be applied to the wound to ensure proper wound closure and to detect leaks (Seidel test).

## References:

1. Peiffer R, Gelatt K, Gwin R. Superficial keratectomy in the management of indolent ulcers of the boxer cornea. *Canine Pract* 1976;3:31-33.
2. Hankanson NE, Merideth RE. Conjunctival pedicle grafting in the treatment of corneal ulcers in the dog and cat. *J Am Anim Hosp Assoc* 1987;23:641-648.
3. Hacker DV. Frozen corneal grafts in dogs and cats: a report of 19 cases. *J Am Anim Hosp Assoc* 1991;27:387-398.
4. Blogg JR, Dutton AG, Stanley RG. Use of third eyelid flaps to repair full-thickness defects in the cornea and sclera. *J Am Anim Hosp Assoc* 1989;25:505-512.
5. Naumann G, Sautter H. Surgical procedures on the cornea In: F. Blodi, G. Mackensen and H. Neubauer, eds. *Surgical Ophthalmology*. Berlin: Springer-Verlag, 1988;433-508.
6. Spoor TC, Ramocki JM, Cowden JW. A periosteal-temporalis fascia pedicle flap for repairing impending ocular perforation and extruding keratoprotheses. *Am J Ophthalmol* 1989;108:704-709.
7. Markowitz GD, Orlin SE, Frayer WC, et al. Corneal endothelial polymerization of histoacryl adhesive: a report of a new intraocular complication. *Ophthalmic Surg* 1995;26:256-258.
8. Parshall CJ. Lamellar corneal-scleral transposition. *J Am Anim Hosp Assoc* 1973;9:270-277.
9. Whitley R. Long-term storage of frozen corneal tissue. Personal Communication., 1997.
10. Davidson M, Nasisse M, Jamieson V, et al. Traumatic anterior lens capsule disruption. *J Am Anim Hosp Assoc* 1991;27:410-414.



Copyright © 2001

**Waltham USA, Inc.**

All rights including that of translation into other languages, reserved. Photomechanical reproduction (photocopy, microcopy) of this publication or parts thereof without written permission from Waltham USA, Inc. is prohibited.

The opinions expressed in these proceedings are those of the authors and not necessarily those of Waltham.

Additional copies can be obtained from Waltham USA, Inc. The proceedings may also be found online at the WALTHAM® web site at <http://www.walthamusa.com> or the VIN web site at <http://www.vin.com/OSUWaltham/2001/>.

Designed and published by Veterinary Information Network (VIN).