Lip commissure to eyelid transposition for repair of feline eyelid agenesis

C. J. G. Whittaker,* David A. Wilkie,† D. J. Simpson,‡ A. Deykin,§ J. S. Smith* and C. L. Robinson†

*Eye Clinic for Animals, 64 Atchison St, Crows Nest, NSW, Australia, †The Ohio State University, Columbus, OH, USA, ‡The Animal Referral Hospital, 444 Liverpool Rd, South Strathfield, NSW, Australia, §Brisbane Veterinary Specialist Centre, Cnr of Old Northern Rd and Keong Road, Albany Creek, QLD, Australia

Abstract
Repair of eyelid agenesis in nine eyes of five cats using a lip commissure to eyelid transposition is described. The procedure is a modification of the technique described by Pavletic for reconstruction of the canine inferior eyelid and provides skin, mucosa, a mucocutaneous junction, and muscle to reconstruct the superior and inferior eyelid and lateral canthus. The technique was successful in all eyes and resulted in improvement in corneal protection, cosmesis and in several cats a return of the palpebral reflex.

Key Words: agenesis, coloboma, eyelid, feline, reconstruction, surgery

INTRODUCTION
A coloboma is a congenital defect in which a portion of the globe, lens or adnexa is absent or fails to form appropriately. In general, these occur as a result of failure of the embryonic fissure to close correctly. Typical colobomas occur inferonasally in the region of the fetal fissure while those in other regions are considered atypical.

Eyelid colobomas, also termed eyelid agenesis, have been described in various human and non human species.1–8 Eyelid colobomas may occur alone or as part of a syndrome of multiple ocular abnormalities.1,9–13 In domestic felines these may include colobomas of the iris, choroid and optic nerve, persistent pupillary membranes, as well as choroidal hypoplasia. Feline eyelid colobomas may be bilateral and involve a variable amount of the superior temporal eyelid and associated conjunctiva.

Eyelid agenesis may result in secondary corneal disease because of a combination of factors including exposure keratitis, lagophthalmos, and trichiasis.9,10 Medical and surgical treatment of eyelid agenesis is indicated primarily to address and prevent the secondary keratitis. The management of eyelid agenesis depends on the amount of eyelid affected and the severity of secondary keratitis. For small eyelid colobomas, without significant corneal disease, no therapy may be required.14 With mild keratitis, topical lubricants and various epilation procedures for trichiasis may suffice.14 For colobomas involving less than 25% of the eyelid length, relatively minor surgical intervention, such as excision of the colobomatous region followed by primary apposition can be used.1,15 Severe colobomas affecting a greater portion of the superior eyelid may require the use of more complicated surgical techniques such as advancement and rotational flaps.15–20

Surgical repair of eyelid agenesis should satisfy specific criteria as they relate to corneal protection and eyelid restoration.20 Successful eyelid reconstruction includes providing an outer layer of skin and a middle layer of muscle and support which are lined by a mucus membrane to protect, moisten, and cover the cornea.21 The repair should provide a stable eyelid margin, avoid trichiasis prevent corneal irritation, provide cosmesis, and if possible maintain or restore the ability to blink. This paper will describe a lip to eyelid transposition surgery that achieves all of these goals.

MATERIALS AND METHODS
Nine eyes of five cats had lip to eyelid transposition surgery performed for eyelid agenesis. All were domestic short hair cats. At the time of surgery, four cats were ≤8 months old, and one cat was 9 years old. There were two males and three female cats. All cats had bilateral eyelid agenesis of both upper eyelids. The extent of involvement of the upper eyelid was ≥50% of the eyelid margin in all cats (Fig. 1). Surgical intervention was performed to control pain associated with corneal ulceration, keratitis, and trichiasis. Four cats had bilateral lip to eyelid procedures performed. One cat had a unilateral lip to eyelid transposition because of the prolonged surgery and anesthesia time. The contralateral eyelid had cryosurgery and epilation of trichiasis hairs. The prolonged anesthesia in this cat was a result of the learning curve associated with the surgery (first surgery performed) also because this cat had a modification of the basic

© 2010 American College of Veterinary Ophthalmologists
transposition surgery which included a parotid duct transposition (PDT).

Surgical technique
All cats were routinely premedicated and anesthesia was maintained with isoflurane. At induction three cats were given intravenous carprofen (4 mg/kg) (Rimadyl® Pfizer Animal Health, West Ryde, NSW, Australia) whereas two cats were given subcutaneous meloxicam (0.3 mg/kg) (Metacam® Boehringer Ingelheim, St Joseph, MO, USA) 60 min prior to surgery. A wide area was clipped around the eye, side of the face, and the lateral commissure of the mouth. The length of the agenesis of the superior/inferior eyelid was measured to determine to length of superior/inferior lip required to correct the eyelid defect (Fig. 2). The length of superior and inferior lip to be harvested was slightly longer (~1 mm) than the superior and inferior eyelid defect to be corrected to allow for tissue contracture (Fig. 3). A surgical pen was used to delineate the incision lines (Fig. 4). To identify and avoid damage during dissection, the parotid salivary duct was cannulated with 3/0 PDS (Fig. 5). After the incisions were marked, routine ocular and oral preparation was performed with 1:50 dilute iodine solution and the surgical site was draped.

The colobomatous area and trichiasis hairs affecting the upper and lower eyelids and lateral canthus were excised with a combination of sharp dissection and tenotomy scissors (Fig. 6). Care was taken to preserve as much of the conjunctiva as possible. A full-thickness incision of the superior and inferior lip was made with a No. 15 scalpel blade to include the lateral oral commissure and oral mucosa. The flap was reflected to expose the oral mucosa. The oral mucosa was incised leaving 1 cm of buccal mucosa attached to the lip margin around the lateral oral commissure to be used to form the new conjunctival fornix. The skin incisions were continued posteriorly in a diverging manner to

Figure 1. Agenesis of the superior eyelid. The agenesis was bilateral and involved approximately 80% of the superior-lateral eyelid.

Figure 2. The length of the superior eyelid agenesis to be repaired is determined.

Figure 3. The tissue to be harvested from the superior and inferior lip is measured and marked.

Figure 4. A surgical marking pen has been used to outline the areas to be excised and the graft to be harvested.
ensure adequate blood supply to the tip of the graft (Fig. 7). Dissection of the pedicle was continued caudally at approximately a 45° angle from the oral commissure. Dissection continued to a distance just posterior to the lateral canthus, ensuring a graft of adequate length that could be rotated without compromising its blood supply. The parotid salivary duct is situated on the lateral aspect of the face beneath the skin graft and care must be taken to avoid damaging the duct during dissection.

A bridge incision was made extending caudoventrally from the lateral canthus of the eye to posterior aspect of the dorsal donor graft incision. Separation of this incision was performed to accommodate the width of the donor pedicle as it is rotated upwards (Fig. 8). Note that minimal blunt dissection of the skin from the underlying subcutaneous tissue is important, not only to maximize nutritional support to the skin, but also to decrease dead space which may lead to seroma formation and graft necrosis.

The graft was rotated into place and the buccal mucosa was sutured to the conjunctival mucosa of the recipient bed using a combination of single interrupted and continuous sutures using 8/0 polygalactin 910. The skin layer was closed with a combination of cruciate and continuous sutures of 6/0 PDS or polypropylene (Figs 9 and 10). Minimal and delicate handling of the edges of the graft is advised, especially at the junction between the buccal and conjunctival mucosa to minimize the chances of necrosis and dehiscence. The oral defect was closed in three layers with single interrupted and continuous 6/0 polygalactin 910 sutures in the mucosal and subcutaneous tissues, and 6/0 PDS or polypropylene sutures in a cruciate pattern in the skin.

In one cat, the parotid salivary duct was cannulated with 3/0 PDS (Fig. 5) and as the dissection of the oral mucosa and subcutaneous tissue of the pedicle graft was performed, care

Figure 5. The parotid salivary duct is cannulated to identify the duct and avoid inadvertent surgical trauma.

Figure 6. The colobomatous area and trichiasis hairs affecting the upper and lower eyelids and lateral canthus have been excised to prepare the recipient bed.

Figure 7. A graft is harvested from the lateral commissure and diverging skin incisions are used to create a rotational pedicle.

Figure 8. A bridge incision has been made to connect the lateral canthus to the rotational pedicle graft allowing the pedicle to be transplanted and correct the agenesis defect.
was taken to preserve the parotid duct and leave it attached to the gingival mucosa and subcutaneous tissues of the graft. When suturing the donor buccal mucosa to the recipient conjunctival mucosa, care was taken to preserve the patency of the parotid papillae (Fig. 11). The transposition of the parotid duct with the transposed lip commissure represented a modification of the basic technique described. In all remaining cases, care was taken to avoid the parotid salivary duct during graft dissection, leaving the parotid duct and papillae in situ.

Postoperatively, a broad spectrum systemic and topical antibiotic were administered and an Elizabethan collar was used. Two of the five cats were noted to rub the surgical sites, necessitating further sedation overnight with dormosedan. This resolved within 24 h postoperatively. Two of the cats that had received preoperative meloxicam were given oral meloxicam (0.1 mg/kg) every 24 h for 5 days. All cats appeared comfortable with minimal swelling and a normal appetite 24 h postoperatively. Warm compresses on the surgical sites were used three to four times daily after surgery to facilitate blood flow in the grafts. The day after surgery, the cat with the concurrent parotid duct transposition was noted to be producing a good quantity of saliva-based tears in response to application of a few drops of a bitter drug (atropine) orally.

At discharge the surgical sites were slightly edematous, but all grafts appeared viable with no obvious necrosis. An Elizabethan collar was used and the cats were discharged on a broad spectrum systemic and topical antibiotic, as well as instructions to feed soft food initially and keep the wounds clean using warm compresses.

Initial postoperative reports suggested that all cats were far more comfortable after surgery than before surgery. Follow-up ranged from 1–15 months (mean 11 months). Two cats with bilateral lip commissure to lid transposition were available for follow-up 15 months after surgery (Fig. 12). Interestingly a palpebral reflex had returned bilaterally in both of these cats. Clinical symptoms and corneal disease were improved in all cats available for follow-up. Clinically, corneas had improved luster and appeared clearer and there were no instances of corneal ulceration postoperatively. All owners were pleased with the outcome and felt the cats were more comfortable. Unfortunately two out of the five cats were lost to long-term follow-up.

**DISCUSSION**

Feline eyelid agenesis while uncommon is a cause of chronic keratitis, pain, and possible blindness. The etiology of feline eyelid agenesis is unknown, with genetic, viral, and teratogenic etiologies suggested.1,11,22 Several techniques have been described for repair of severe eyelid defects in feline, canine, and other species.1,7,16–19,23–34 In eyelid repair, reconstruction of the
superior lip and oral mucosa. This technique was described for repair of a full-thickness defect of the inferior eyelid in the dog using the parotid duct in the first case in which this technique was used. With the superior-temporal location of the agenesis, it is unknown, as the close proximity of the respective lateral commissures of the lip and the eyelid, as well as the anatomical nature of the lip itself seems to particularly favor cats.

In feline eyelid agenesis with only minor eyelid defects, simple excision of the affected area with closure may be sufficient. More severe eyelid agenesis may require use of a rotational skin graft from the inferior eyelid lined by conjunctiva, use of a cross-lid flap and mucocutaneous subdermal plexus flap, cryoepilation, subdermal collagen injection, excision with second-intention healing. Some disadvantages of these techniques may include the need for multiple surgical procedures, potential for trichiasis and failure to restore a functional palpebral reflex. The authors have used other surgical modalities of treatment for feline eyelid agenesis. These techniques are less satisfactory as they do not adequately address the lack of a lateral commissure, have problems associated with misdirection of the transplanted hairs, often require multiple surgeries, do not provide good mechanical support, can cause cicatrical entropion, fail to provide a muscle layer, and often there is still the need for life long medical treatment.

The current technique does not have a problem with misdirected hairs as the hairs from the transplanted tissue are directed away from the cornea. In addition, this technique provides a lateral commissure allowing a more functional and cosmetic appearance, creates a stable eyelid margin, only requires one surgery if done well, is able to provide complete corneal coverage while providing a mucous membrane, does not require lifelong medical treatment, has the potential to allow the return of the ability to blink, and may allow the provision of a tear supply in the modified version of the technique. The ability to provide a mucocutaneous junction and to use tissue with a central muscular layer (buccinator and orbicularis oris muscles) allows a more normal restoration of both anatomy and function. This technique also is able to be adjusted for superior and inferior eyelid defects of varying lengths, and it is conceivable that almost the entire upper and lower eyelid could be replaced using this procedure.

The disadvantage of the lip commissure to eyelid transposition is the technical skill and equipment needed to do the surgery, the alteration of the size of the mouth, the length of time it takes to perform the procedure compared to some of the easier techniques such as cryosurgery (especially if the modified version of the technique is used transplanting the parotid duct) and potential for graft dehiscence. In the author’s experience, however, none of these factors have been insurmountable, and the technique is justified by the superior functional and cosmetic results achieved compared to other techniques.

With the superior-temporal location of the agenesis, it is not known if there is a viable lacrimal gland and ductules present in affected cats. If there is significant compromise of these structures, then the modified version of this surgical technique involving parotid duct transposition may be indicated. One of the authors (CJGW) was concerned about this possibility and so chose to transplant the parotid duct in the first case in which this technique was used. Unfortunately, the quality and quantity of feline tears is difficult to evaluate and the results are highly variable. The Schirmer tear test and tear break-up times were not evaluated in these cats, but this may be of interest in future to decide if inclusion of the parotid duct is indicated in selected cases.

Future work in these cases could include performing electromyographic studies on the transplanted lip. Re-innervation of transplanted oral muscle fibers to other parts of the eye has already been demonstrated to occur by 6 months. This may occur in the current technique as several of the cats had a return of the palpebral reflex within several months following surgery.

The lip commissure to eyelid transplant is another technique to correct eyelid defects in cats. Whether lip commissure to eyelid transplant could also be used in other species is unknown, as the close proximity of the respective lateral commissures of the lip and the eyelid, as well as the anatomical nature of the lip itself seems to particularly favor cats.

REFERENCES


