References

1. Schefler AC, Shields CL, Shields JA, Demirci H, Maus M, Eagle RC Jr. Lacrimal sac lymphoma in a child. Arch Ophthalmol 2003;121:1330-33.
2. Köksal Y, Kiratli H, Varan A, Akçören Z, Büyükpamukçu M. Primary lacrimal sac non-Hodgkin's lymphoma in a child. Int J Pediatr Otorhinolaryngol 2005;69:1551-3.
3. Carlin R, Henderson JW. Malignant lymphoma of the nasolacrimal sac. Am J Ophthalmol 1974;78:511-13.
4. Lal N, Bisen S, Sucheta V. Primary large B-cell lymphoma of the orbit: a case report and review of literature. Indian J Pathol Microbiol 2007; 50:575-6.
5. Liang X, Stork LC, Albano EA. Primary ocular adnexal lymphoma in pediatric patients: report of two cases and review of the literature. Pediatr Dev Pathol 2003;6:458-63.
6. Shields JA, Bakewell B, Augsburger JJ, Donoso LA, Bernardino V. Space-occupying orbital masses in children: a review of 250 consecutive biopsies. Ophthalmology 1986;93:379-84.

Oral doxycycline and azithromycin in the management of recurrent conjunctival dehiscence following glaucoma drainage implantation in a child

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Aqueous drainage devices play an important role in the treatment of refractory glaucomas; however, they can be associated with early and late postoperative complications, including conjunctival dehiscence, which must be repaired surgically. Recurrent dehiscence despite surgical repair is uncommon and can be sight threatening. We discuss possible causes and management options of recurrent conjunctival dehiscence in a 2-year-old and the role of oral doxycycline and azithromycin in its management.

Case Report

A 2-year-old boy with anterior segment dysgenesis and secondary glaucoma was referred to L V Prasad Eye Institute for keratoplasty. The child had undergone combined trabeculotomy with trabeculectomy in both the eyes 1 year previously at a local hospital and was currently on a single glaucoma medication. Examination under anesthesia revealed a flat bleb, grade 3 corneal haze with central corneal scar in both eyes, and peripheral iridocorneal adhesions. Horizontal corneal diameter was 10.5 mm in the right eye and 10 mm in the left eye. Intraocular pressure (IOP) was 12 mm Hg in the right eye and 14 mm Hg in the left eye by Perkins tonometry. The child underwent penetrating keratoplasty in each eye 3 months apart and, 4 months later, cataract surgery in both eyes. After keratoplasty and cataract surgery, the IOP increased to 34 mm Hg in the right eye and 28 mm Hg in the left eye. There was an increase in disk cupping from 0.3 to 0.6 in both eyes. Maximal medical therapy and repeat trabeculectomy with low-dose (0.02%) mitomycin-C failed to control IOP; hence, surgery with Aurolab Aqueous Drainage Implant (AADI; Aurolab, Tamil Nadu, India), an indigenous nonvalved implant (similar to Baerveldt), was planned in the right eye. After limbal-based conjunctival incision, the implant was placed in the inferonasal quadrant and fixed to the underlying sclera. The tube was ligated using two 6-0 polyglactin 910 sutures and inserted into the anterior chamber through a 3 mm tunnel, and the tube was covered using a scleral patch graft. The conjunctiva was closed in a continuous fashion using 8-0 polyglactin 910 suture on a tapered round-bodied needle.

Five days after AADI implantation, the child presented emergently with a whitish appearance in the right eye noticed since that morning. Examination under anesthesia revealed an 8 × 4 mm conjunctival dehiscence with broken polyglactin 910 suture. The underlying scleral patch graft was exposed; there was no leak or tube exposure (Figure 1A). There was no history of ocular trauma or eye rubbing. Due to a large conjunctival defect, resuturing was planned. Conjunctival margins were freshened and sutured using 8-0 polyglactin 910 in a continuous fashion; additional interrupted 10-0 nylon sutures were applied (Figure 1B). Topical medications were continued, and the parents were instructed to shield the eye, to avoid retraction of the lower lid for eye drop instillation and an elbow-splint to prevent eye rubbing.

Ten days after resuturing, the conjunctival dehiscence recurred at the same location. Repeat conjunctival closure was performed using 8-0 polyglactin 910, and additional 10-0 nylon sutures were used to anchor the conjunctiva to the underlying scleral patch graft. Because of recurrent dehiscence and possible altered wound healing response, we started the patient on systemic immunomodulators. Based on our experience with oral doxycycline (tetracycline antibiotic) in adults with conjunctival retraction and wound gape following implant surgery,[1] we planned to use it in this child, although its pediatric use is controversial in view of its dental side effects in children. After consulting the patient's pediatrician and with informed consent of the parents, oral doxycycline and azithromycin

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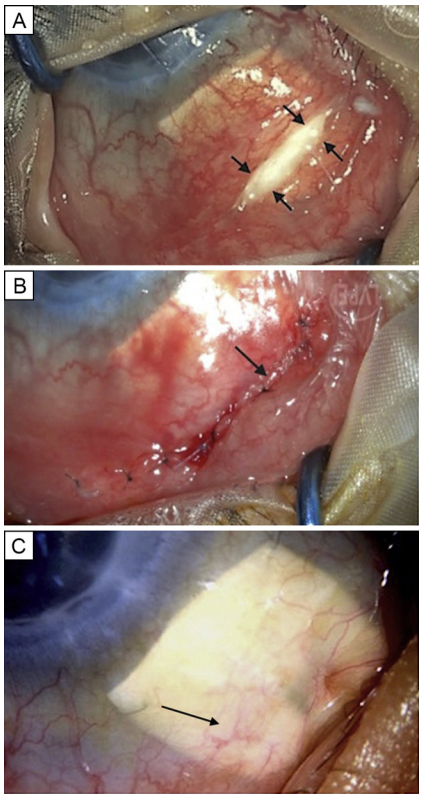

FIG 1. A, Clinical photograph showing conjunctival dehiscence, with exposure of underlying scleral patch graft in inferonasal quadrant of right eye. B, Conjunctiva sutured in a continuous fashion with 8-0 polyglactin 910 and additional interrupted 10-0 nylon sutures. C, Well-healed conjunctival dehiscence covering the underlying scleral patch graft after resuturing and treatment with oral immunomodulating agents.

(macrolide antibiotic) were started. The child weighed 10 kg; hence oral doxycycline 20 mg in 1 mL twice daily (100 mg doxycycline tablet in 5 ml distilled water) for 1 week and syrup azithromycin suspension at 10 mg/kg/day in two divided doses (100 mg in 5 ml [2.5 mL twice daily]) for 5 days was prescribed. The child was reviewed every 3 days, and by 10th day the conjunctiva had healed completely (Figure 1C), and the corneal graft was clear. At 3 months' follow-up the IOP was 16 mm Hg.

Discussion

Conjunctival dehiscence is an uncommon complication of aqueous drainage device implantation. Recurrent conjunctival dehiscence and nonhealing conjunctival defects predispose to serious complications, such as leak, tube or implant exposure, and infection.[2] Various options to manage conjunctival dehiscence are, based on size of defect, presence of leak or implant exposure, close observation, wound resuturing, amniotic membrane grafting, or conjunctival autograft.[3]

Oral doxycycline is used in treating early post-implant/trabeculectomy conjunctival complications in adults.[1-4] However, its use in children is controversial because of its adverse effects (eg, tooth discoloration, dental enamel hypoplasia). Doxycycline is a broad-spectrum antibiotic, exhibits anti-inflammatory and anti-collagenolytic properties. It promotes healing without scarring and is used in management of ocular surface disorders, including recurrent epithelial erosions, keratitis sicca, meibomian gland disease, and sterile corneal melts.[5]

Matrix metalloproteinases (MMPs) play a vital role in wound healing by degrading extracellular matrix and basement membrane, causing tissue remodeling, altering inflammatory and immunological reactions.[5] Collagenases and MMPs require cations (calcium, zinc, magnesium) for functional activity. Doxycycline chelates these metal cations, inhibits MMPs and proinflammatory cytokine interleukin-1, thereby decreasing inflammation and collagenolysis and promoting wound healing.[5,6]

There is limited literature on use of doxycycline in children. The Centers for Disease Control and Prevention recommended use of oral doxycycline to treat acute and chronic Q fever at a dose of 2.2 mg/kg/day in two divided doses for 2 weeks, in children <8 years.[7] Lochary and colleagues[8] reported no dental side effects in a small sample of 10 children with Rocky Mountain spotted fever, treated with oral doxycycline.

Our case had recurrent conjunctival dehiscence despite meticulous resuturing and precautions to prevent mechanical trauma to the eye. Since a low dose of doxycycline was used for a short period, azithromycin was also prescribed simultaneously for its additive effect. Macrolides provide immunomodulatory action by decreasing proinflammatory cytokines, MMPs and chemokines and expression of adhesion molecules.[9] After 10 days, the conjunctival defect healed completely, covering the scleral patch graft. We believe that immunomodulation helped in healing this recurrent conjunctival dehiscence; additionally, the caretaker's increased efforts to restrain the child may have contributed to the healing. We also acknowledge that a double layered suturing of tenons and conjunctiva may have prevented recurrent dehiscence.

Recurrent conjunctival dehiscence is rare clinical entity and has not been reported following nonvalved implants. Although surgical management remains the primary approach to repair conjunctival dehiscence, healing may be promoted (or augmented) by careful use of low-dose oral doxycycline and azithromycin, even in young children, although the long-term dental effects must be carefully considered.

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References

1. Gupta P, Senthil S, Srirampur A, Mittal P. Role of oral doxycycline in the management of conjunctival dehiscence following glaucoma drainage device. Int J Surg 2017;4:2369-71.

2. Dubey S, Prasanth B, Acharya MC, Narula R. Conjunctival erosion after glaucoma drainage device surgery: a feasible option. Indian J Ophthalmol 2013;61:355-7.
3. Geffen N, Buys YM, Smith M, et al. Conjunctival complications related to Ahmed glaucoma valve insertion. J Glaucoma 2014;23: 109-14.
4. Kiranmaye T, Garudadri CS, Senthil S. Role of oral doxycycline and large diameter bandage contact lens in the management of early post-trabeculectomy bleb leak. BMJ Case Rep 2014;2014.
5. Smith VA, Cook SD. Doxycycline-a role in ocular surface repair. Br J Ophthalmol 2004;88:619-25.
6. Wong TT, Sethi C, Daniels JT, Limb GA, Murphy G, Khaw PT. Matrix metalloproteinases in disease and repair processes in the anterior segment. Surv Ophthalmol 2002;47:239-56.
7. CDC. Diagnosis and management of Q fever-United States. Recommendations from CDC and the Q fever working group. MMWR Recomm Rep 2013;2013:1-29.
8. Lochary ME, Lockhart PB, Williams WT. Doxycycline and staining of permanent teeth. Pediatr Infect Dis J 1998;17:429-31.
9. Enomoto F, Ichikawa G, Nagaoka I, Yamashita T. Effect of erythromycin on otitis media with effusion in experimental rat model. Acta Otolaryngol Suppl 1998;539:57-60.

Securing extraocular muscles in strabismus surgery: biomechanical analysis of muscle imbrication and knot tying technique

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An experimental study was performed to quantitatively evaluate the tensile strength implications of two important steps in extraocular muscle surgery: muscle imbrication and knot configuration. The study was conducted in a controlled fashion using fresh ex vivo pig eyes with extraocular muscles attached and a precision digital force gauge. The study provides clinically translatable data to inform optimal surgical technique. The results suggest that imbrication of the muscle edge is most secure when the suture is looped around itself in a manner that allows it to be tightly cinched and locked and that granny knots possess similar tensile strength to square knots.

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Strabismus surgery requires a strategy to secure extraocular muscles to sclera until adequate scarring develops. There are several possible points of failure, including the suture thread, the scleral fibers, the imbrication of the muscle by the suture, and the surgical knot itself. Prior studies have addressed the maximum forces generated by extraocular muscles[1] and the time course of healing between a reattached muscle and sclera.[2-6] A series of recent studies has also evaluated the tensile characteristics of the sclera,[7] the position of the imbricating suture,[8] and various aspects of the suture itself.[9] The current study was performed to objectively address two additional yet important aspects of surgical technique related to extraocular muscle reattachment, for which biomechanical data is lacking: imbrication technique and configuration of the surgical knot. The purpose of these studies is to facilitate surgical decisions that are evidence based in order to optimize surgical efficiency and success.

Methods

Fresh pig eyes (n = 5 per imbrication technique) were mounted in a model styrofoam orbit, and medial rectus extraocular muscles were identified and dissected free of surrounding connective tissues. A double-armed 6-0 polyglactin 910 suture (Vicryl, Ethicon Inc, Sommerville, NJ) on an S-14 spatula needle was passed partial thickness from the center of the muscle to each edge, 2 mm posterior to the cut edge. This was followed by full-thickness passes 2 mm central to the muscle edge. The imbrications were completed and tightened using two distinct techniques. In the first the leading end of the thread was pulled directly between the partial and full-thickness passes without forming a loop (Figure 1). In the second, the leading end of the thread was pulled under and over the partial-thickness pass in order to form a knot-like loop configuration that would lock down and resist loosening (Figure 1). The ends of the suture were pulled to tighten the imbrications and then connected to the transducer of a precision digital force gauge (Chattilon-Ametek, model DFS2-010, Largo, FL). Longitudinal tension on the sutures was gradually increased until rupture occurred. In a second set of experiments two strands of 6-0 Vicryl suture were tied in a 2-1-1 knot (ie, a double throw followed by two single throws), using either a square knot or granny knot configuration (Figure 2). The strands were then secured and traction applied until rupture occurred.

Differences in mean rupture values between groups (n = 5 per group) were compared using a *t* test (two-tailed).

Results

Since rectus extraocular muscle contraction in humans is known to produce forces up to 100 g, it is reasonable to seek at least 100 g of support from every component of