Volume 25 • Number 1 • January 2016

JOURNAL OF EXOTIC PET MEDICINE

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IN THIS ISSUE

The Journal of Exotic Pet Medicine Embarks in a New Direction

Modified Evisceration in a Blue-Fronted Amazon (*Amazona aestiva*) as an Ocular Treatment Option in Parrots

Radiographic Measurement of Internal Organs in Gyr Falcons (*Falco rusticolus*) and Gyr Peregrine Hybrids (*Falco rusticolus* × *Falco peregrinus*)

Effect of Supplemental Heat in Captive African Leopard Tortoises (*Stigmochelys pardalis*) and Spurred Tortoises (*Centrochelys sulcata*) on Growth Rate and Carapacial Scute Pyramiding

Aeromonas hydrophila Keratitis in Freshwater Turtles

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An Official Journal of

Association of Exotic Mammal Veterinarians

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Volume 25 • Number 1 • January 2016 www.exoticpetmedicine.com

Avian & Exotic News 1
Connie Orcutt, DVM, Dip. ABVP (Avian; Exotic Companion Mammal)

In This Issue

The Journal of Exotic Pet Medicine Embarks in a New Direction 4
Thomas N. Tully Jr., DVM, MS, Dip. ABVP (Avian), Dip. ECZM (Avian), and Mark A. Mitchell, DVM, MS, PhD, Dip. ECZM (Herpetology) (Co-Editors-In-Chief)

Letter to the Editor 6
James W. Carpenter, MS, DVM, Dip. ACZM

Modified Evisceration in a Blue-Fronted Amazon (*Amazona aestiva*) as an Ocular Treatment Option in Parrots 7
Sylke Gralla, Dr. med. vet., Dominik Fischer, DVM, Diana Vera Olerth, Dr. med. vet., Michael Lierz, Prof. Dr. med. vet., Dip. ECZM (Wildlife Population Health), Dip. ECPVS, DZooMed, and Martin Kramer, Prof. Dr. med. vet., Dr. h. c., Dip. ECVDI

Radiographic Measurement of Internal Organs in Gyr Falcons (*Falco rusticolus*) and Gyr Peregrine Hybrids (*Falco rusticolus* × *Falco peregrinus*) 13
Valentina Caliendo, DVM, CertAVP (Zoo Med), MRCVS, Rachael Middelton, BVSc, MRCVS, and Raj Raghav, BVSc & AH, MVSc, GDip., Dip. ABVP (Avian)

Effect of Supplemental Heat in Captive African Leopard Tortoises (*Stigmochelys pardalis*) and Spurred Tortoises (*Centrochelys sulcata*) on Growth Rate and Carapacial Scute Pyramiding 18
Mark L. Heinrich, MS, DVM, and Kaleb K. Heinrich, MS, DA

Aeromonas hydrophila Keratitis in Freshwater Turtles 26
Kari E. Musgrave, DVM, Katie Diehl, MS, DVM, Dip. ACVO, and Christoph Mans, Dr. med. vet., Dip. ACZM

Obesity and Gastrointestinal Impaction in Giant Burrowing Cockroaches (*Macropanesthia rhinoceros*): A Potential Effect of the Thrifty Phenotype 30
Andrew Gordon Hill, BVSC, MVSc, MACVSc

AEMV Forum

Epitheliotropic Gastrointestinal T-Cell Lymphoma With Concurrent Insulinoma and Adrenocortical Carcinoma in a Domestic Ferret (*Mustela putorius furo*) 34
Kristin M. Sinclair, DVM, Dip. ABVP (Avian), Chrissy Eckstrand, DVM, Peter F. Moore, BVSc, PhD, and Michelle G. Hawkins, VMD, Dip. ABVP (Avian)

Surgical Treatment of Prolapse of the Deep Lacrimal Gland in a Pet Rabbit 44
Vittorio Capello, DVM, Dip. ECZM (Small Mammal), Dip. ABVP (Exotic Companion Mammal)

Serological Investigation on *Encephalitozoon cuniculi* in pet Rabbits in North-Central Italy 52
Antonio Lavazza, DVM, Mario Chiari, DVM, PhD, Dip. ECZM (Wildlife Population Health), Claudia Nassuato, DVM, Daniele Giardiello, MSc, Cristiana Tittarelli, DVM, PhD, and Guido Grilli, MSc, PhD

Management of Phimosis and Balanoposthitis in a Pet Chinchilla (*Chinchilla lanigera*) 60
Anna Martel-Arquette, DVM and Christoph Mans, Dr. med. vet., Dip. ACZM

Eosinophilic Leukemia in a Pet African Hedgehog (*Atelerix albiventris*) 65
Christine T. Higbie, DVM, David Eshar, DVM, Dip. ABVP (Exotic Companion Mammal), Dip. ECZM (Small Mammal), Shambhunath Choudhary, DVM, PhD, Lisa M. Pohlman, DVM, MS, Dip. ACVP, Chanran R. Ganta, BS, MS, PhD, and Gordon Andrews, DVM, PhD, Dip. ACVP

A complete list of forthcoming issues, and other journal information, can be found at "http://www.exoticpetmedicine.com"

Diagnosis and Treatment of Sialectasis in a Domestic Rabbit (*Oryctolagus cuniculus*) **72**
Sara Gardhouse, DVM, David Sanchez-Migallon Guzman, LV, MS, Dip. ECZM (Avian, Small Mammal), Dip. ACZM, Olivia A. Petritz, DVM, Dip. ACZM, Mai Yee Mok, DVM, Frederick Charles Mohr, DVM, PhD, Dip. ACVP, Nathan Tong, DVM, Dip. ACVR, Miranda Sadar, DVM, Elaine D. Salinger, VMD, and Michele A. Steffey, DVM, Dip. ACVS

Therapeutic Review
Therapeutic Review: Selamectin **80**
Peter M. DiGeronimo, VMD

Diagnostic Challenge **84**
Amy Crutchfield, DVM, Rodney Schnellbacher, DVM, and Stephen J. Divers, BVetMed, DZooMed, Dip. ECZM (Herpetology and Zoo Health Management), Dip. ACZM, FRCVS

Literature Review
Backyard Poultry Medicine And Surgery: A Guide For Veterinary Practitioners **88**
Mark A. Mitchell, DVM, MS, PhD, Dip. ECZM (Herpetology)

Abstracts
JEPM Jan 2016—Abstracts **90**
Connie Orcutt, DVM, Dip. ABVP (Avian; Exotic Companion Mammal)

SURGICAL TREATMENT OF PROLAPSE OF THE DEEP LACRIMAL GLAND IN A PET RABBIT

Vittorio Capello, DVM, Dip. ECZM (Small Mammal), Dip. ABVP (Exotic Companion Mammal)

Abstract

A 5-year-old pet rabbit with a history of severe acquired dental disease and rhinitis was presented for unilateral prolapse of the deep lacrimal gland of the third eyelid. The prolapse was believed to be due to abnormalities of the alveolar bullae secondary to severe dental disease and rhinitis. The prolapse was successfully replaced using a combination of techniques used in canine ophthalmology: the creation of a pocket or envelope in adjacent mucosa to cover the gland, and anchoring the nictitans to the periosteum. Correction was successful and the gland remained in place without complications until the rabbit's death 4.5 years later. Copyright 2015 Elsevier Inc. All rights reserved.

Key words: rabbit; nictitating membrane; lacrimal glands; deep gland; prolapse

There are several lacrimal glands (lacrimal gland proper, accessory lacrimal gland, and the gland of the nictitating membrane) located within the rabbit orbit.[1-3] Most of the rabbit's lacrimal glands are divided into multiple lobes (Fig. 1A). The lacrimal gland proper is a curved aggregation of small glandular lobes, located in the caudodorsal area of the orbit. The accessory lacrimal gland is much larger and divided into 3 lobes: the orbital, the retro-orbital, and the infraorbital. The glands associated with the nictitating membrane (or nictitans) are commonly referred to as the Harderian gland and are divided into the superficial gland and the deep gland.[1,2] The superficial gland is small and lies over the anterior convex surface of the supporting cartilage of the nictitans. The deep gland is large, lies over the posterior convex surface of the cartilage, and is divided into 2 additional lobes: the dorsal white lobe and the ventral pink lobe.

The lacrimal glands and the nictitating membrane are closely associated with the globe, the orbit, and other anatomical structures within the orbital fossa (e.g., lacrimal bone and alveolar bulla).

In rabbits, the *alveolar bulla* is a unique bony structure that includes the reserve crowns and apices of the 4 caudal cheek teeth (3rd premolar and 3 molar teeth) (Fig. 1B and C).[3,4] In cases of acquired dental disease involving the maxillary cheek teeth, elongation of the reserve crowns may cause deformity and/or perforation of the alveolar bulla, creating secondary disease that subsequently includes the nictitans and its glands, or the more cranial infraorbital lobe of the accessory lacrimal gland.[2,4,5] Periapical infection of the cheek teeth associated with the alveolar bulla may also involve the glands of the nictitating membrane and lacrimal glands leading to retrobulbar or parabulbar abscesses.[5]

CASE REPORT

A 5-year-old, 1.3 kg neutered male pet domestic rabbit (*Oryctolagus cuniculus*) was presented for evaluation and treatment of chronic (2 years) advanced dental disease. The dental disease was characterized by multiple sites of periapical

From the Clinica Veterinaria S. Siro, Milano, Italy.
Address correspondence to: Vittorio Capello, DVM, Dip. ECZM (Small Mammal), Dip. ABVP (Exotic Companion Mammal), Clinica Veterinaria S. Siro, Via Lampugnano 99, 20151 Milano, Italy. E-mail: capellov@tin.it

1557-5063/15/2101-$30.00
http://dx.doi.org/10.1053/j.jepm.2015.12.009

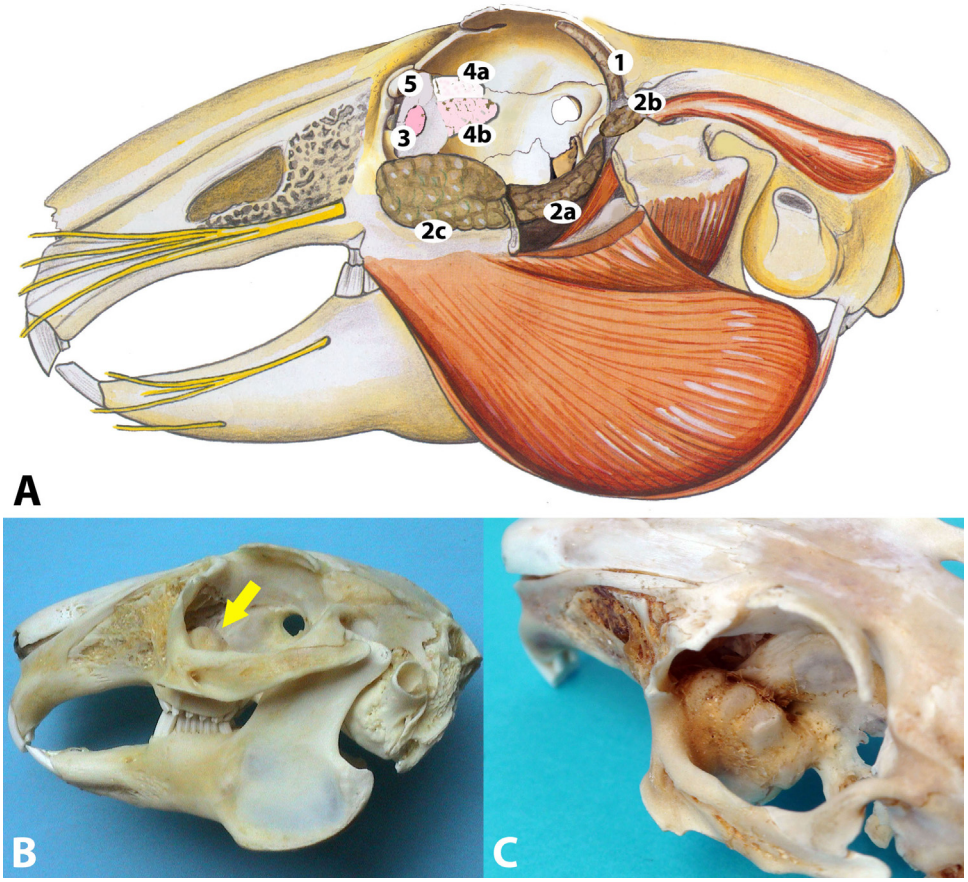

FIGURE 1. (A to C) Anatomy of the lacrimal glands and the orbit of the rabbit. (A) Lacrimal glands and glands of the nictitating membrane of the domestic rabbit, after removal of the globe. 1. Lacrimal gland proper; 2. Accessory lacrimal gland (2a orbital lobe; 2b retro-orbital lobe; and 2c infraorbital lobe); 3. Superficial gland of the nictitating membrane; 4. Deep gland of the nictitating membrane (4a, white dorsal lobe and 4b, pink ventral lobe); 5. Nictitating membrane. Adapted and modified from Popesko et al.[3] (B) Alveolar bulla (arrow). (C) Caudodorsal view of the orbit, showing the anatomic relationship with the alveolar bulla. (B and C, used with permission from Vittorio Capello, DVM.)

infection, osteomyelitis, and abscesses of the left maxilla and both mandibles, which resulted in fractures to the bodies of both mandibles. Chronic, end-stage dental disease was managed effectively with frequent dental re-evaluations and treatments (coronal reduction and extractions) supported by adequate supportive feeding (pelleted food and assisted feeding formula for herbivores [Critical Care for Herbivores; Oxbow Animal Health, Murdock, NE USA], ensuring a good quality of life. The rabbit developed clinical signs consistent with bilateral rhinitis including mucopurulent nasal discharge, sneezing, matted fur around the nose and the forelimbs, and labored breathing, 6 months before nictitans prolapse.

Medical treatment of rhinitis included injectable procaine penicillin (40,000 IU/kg, subcutaneously once a day for 3 weeks, Procacillina; Merial Italia, Milano, Italy) and acetylcysteine (nebulization once a day for 10 days, Fluimucil; Zambon Group, Milano, Italy). Labored breathing improved following decrease of the nasal discharge, but the clinical signs did not resolve.

The patient was re-examined 4 weeks following the initiation of therapy. Rhinitis was still present, and the rabbit was presented with protrusion of the nictitating membrane of the left eye, associated with prolapse of the deep gland (Fig. 2). The prolapse did not appear to elicit discomfort, and mild epiphora was present. Inspection of the posterior side of the nictitating membrane was performed after topical application of oxybuprocaine 0.4% ophtalmic solution (Novesina, Novartis, Italy). It was determined at that time the prolapse involved the dorsal white lobe of the deep gland, while the right eye was normal.

The rabbit was scheduled for computed tomography (CT) to further evaluate the nasal cavities. The patient was premedicated with

FIGURE 2. Clinical presentation of protrusion of the nictitans and prolapse of the deep gland in a 5-year-old neutered male domestic rabbit. (Used with permission from Vittorio Capello, DVM.)

butorphanol (0.3 mg/kg, subcutaneously, Dolorex; Intervet, Boxmeer, The Netherlands). General anesthesia was induced with ketamine (20 mg/kg, intramuscularly, Ketavet; Intervet, Boxmeer, The Netherlands) and dexmedetomidine (40 µg/kg, intramuscularly, Dexdomitor, Pfizer, NY USA). Oxygen was delivered by a face mask, but removed during the scanning procedure. Atipamezole (200 µg/kg, intramuscularly Antisedan, Pfizer NY USA) was administered at the end of the diagnostic procedure. The following abnormalities were detected by CT of the skull: severe bilateral obstruction of the middle and ventral nasal meatuses, bilateral empyema of the maxillary and dorsal recesses, and deformity, perforation, and

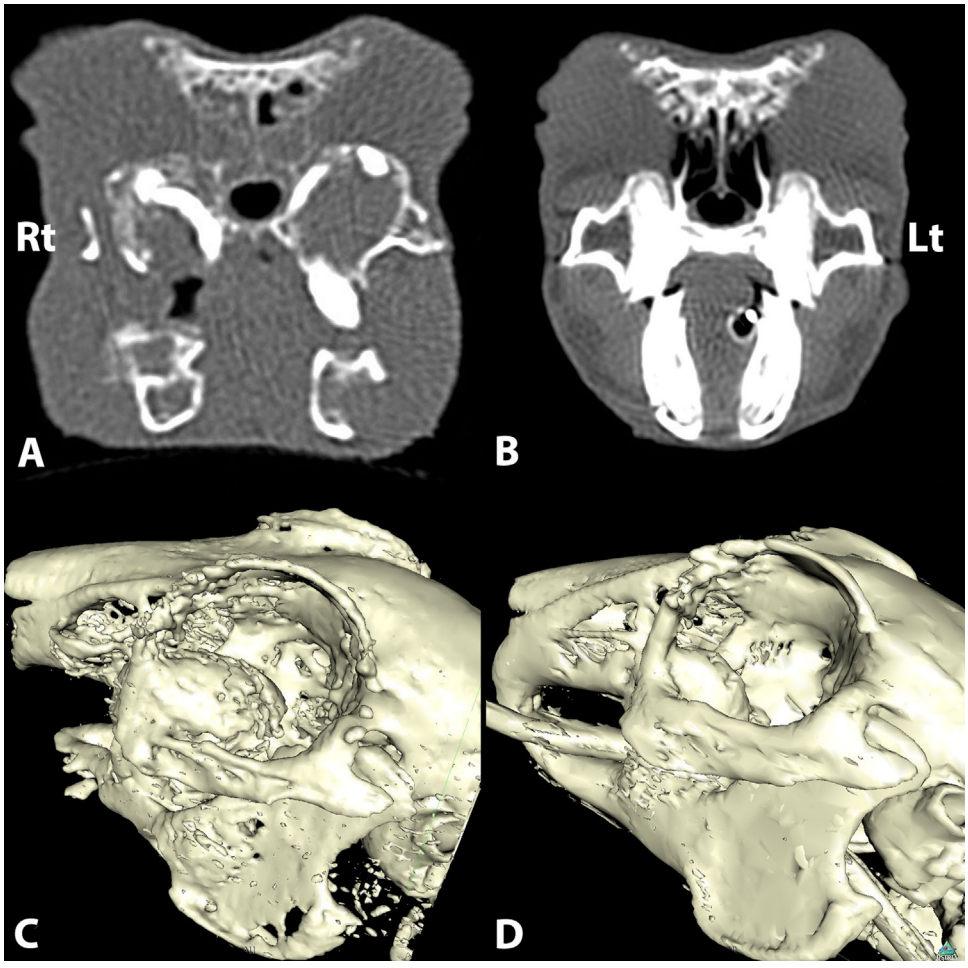

FIGURE 3. (A to D) Computed tomography of the skull in a 5-year-old neutered male domestic rabbit demonstrating severe dental disease and rhinitis. (A and B) Axial view crossing the alveolar bullae at the level of the first maxillary molar tooth (CT4) in the reported case (A), and comparison with a normal rabbit (B). Bilateral deformities of the alveolar bullae are visible, more evident on the left side. Radiographic findings consistent with bilateral chronic rhinitis and unilateral empyema of the right tympanic bulla were also present. (C and D) 3D (three dimensional) surface rendering of the skull of the reported case (C), and comparison with a normal rabbit (D). This particular view emphasizes the enlargement and deformity of the left alveolar bulla, and possible role on the prolapse of the nictitating membrane. (Used with permission from Vittorio Capello, DVM.)

empyema of both alveolar bullae with the left bulla more severely deformed and prominent (Fig. 3). Volume reconstruction demonstrated minimal bilateral patency of the nasal passage and complete bilateral obliteration of maxillary recesses. CT also detected empyema of the left tympanic bulla.

To prevent additional damage to the prolapsed deep gland of the nictitans, nictitans, and cornea, the rabbit was scheduled for surgical correction.

General anesthesia was induced with the same protocol used for CT, and was maintained with oxygen and isoflurane 1% to 2% delivered by a 2.0-mm uncuffed orotracheal tube. Intravenous perfusion was maintained at 10 mL/kg/hour with a balanced electrolyte solution (Rehydrating Electrolytic Solution, ACME, Cavriago, Italy) via a 24-gauge intravenous catheter placed in the right cephalic vein. A circulating warm-water blanket was used as a conductive heat source to prevent hypothermia.

To perform the procedure, the patient was placed in right lateral recumbency. The cornea was protected with a drop of ophtalmic lubricant (Epigel, Vetem, Agrate Brianza, Italy) (Fig. 4A). Two stay sutures (Monocryl 5.0; Ethicon, Johnson & Johnson Medical, Langhorne, PA USA) were placed superficially in the skin 2 mm from the lid margins of both eyes (Fig. 4B). The ends of the stay sutures were secured with 2 fine hemostats. A cotton-tipped applicator moistened with saline solution was used to determine that both the prolapsed deep gland and the nictitating membrane could be reduced into their normal positions (Fig. 4C and D).

The surgical procedure consisted of following 2 steps: reduction of the prolapse of the deep gland (Fig. 5), and reduction of the protrusion (prolapse) of the nictitating membrane (Fig. 6).

The free border of the nictitating membrane was clamped with the tips of 2 fine hemostats, and retracted from the ocular surface, exposing the prolapsed gland (Fig. 5A). Fine forceps were used to confirm that the mucosal surface could be pulled over the deep gland (Fig. 5B).

Reduction of the prolapse of the gland was performed by creating two 5-mm long incisions in the posterior nictitans conjunctiva, parallel to

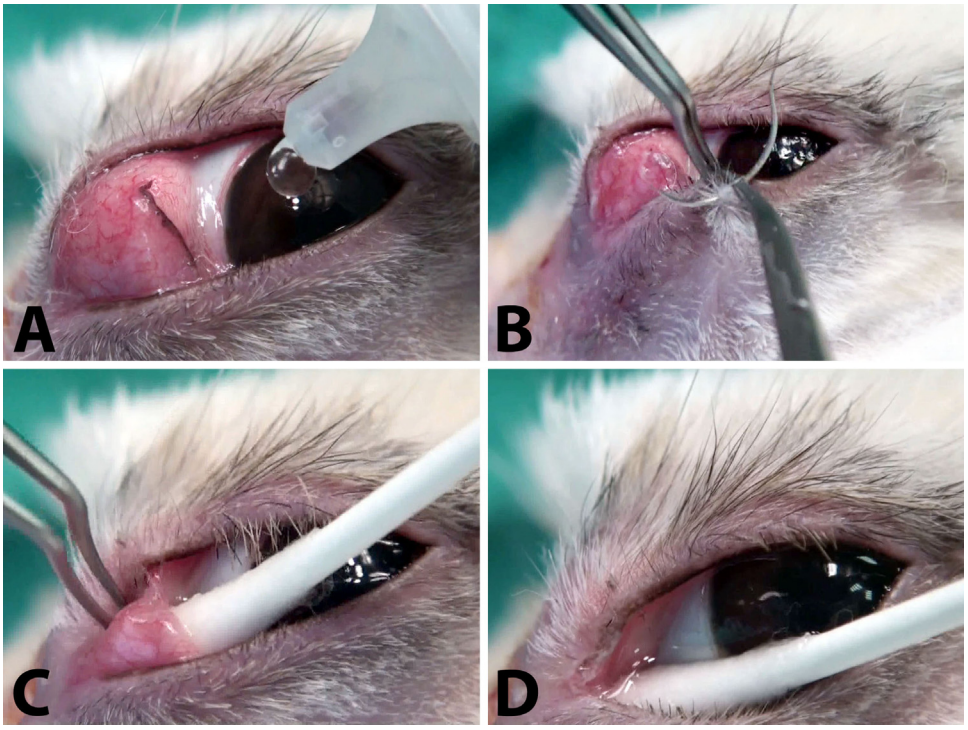

FIGURE 4. (A to D) Surgical technique for replacement of the prolapse of the deep gland and of the protrusion of the nictitating membrane in this rabbit—Step 1: Preparation. (A) The patient is placed in right lateral recumbency. The cornea is protected with a drop of sterile humectant and protective ophthalmic solution. (B) Skin stay sutures are placed 2 mm from the margin of the eyelids. The needle and the suture are inserted superficially through the epidermic layer of the skin, not full thickness. Stay sutures are secured with 2 fine hemostats. (C) A cotton-tipped applicator moistened with saline solution is used to determine if the gland can be replaced before beginning surgery. (D) Similarly, the applicator is used to determine if the nictitating membrane can be replaced. (Used with permission from Vittorio Capello, DVM.)

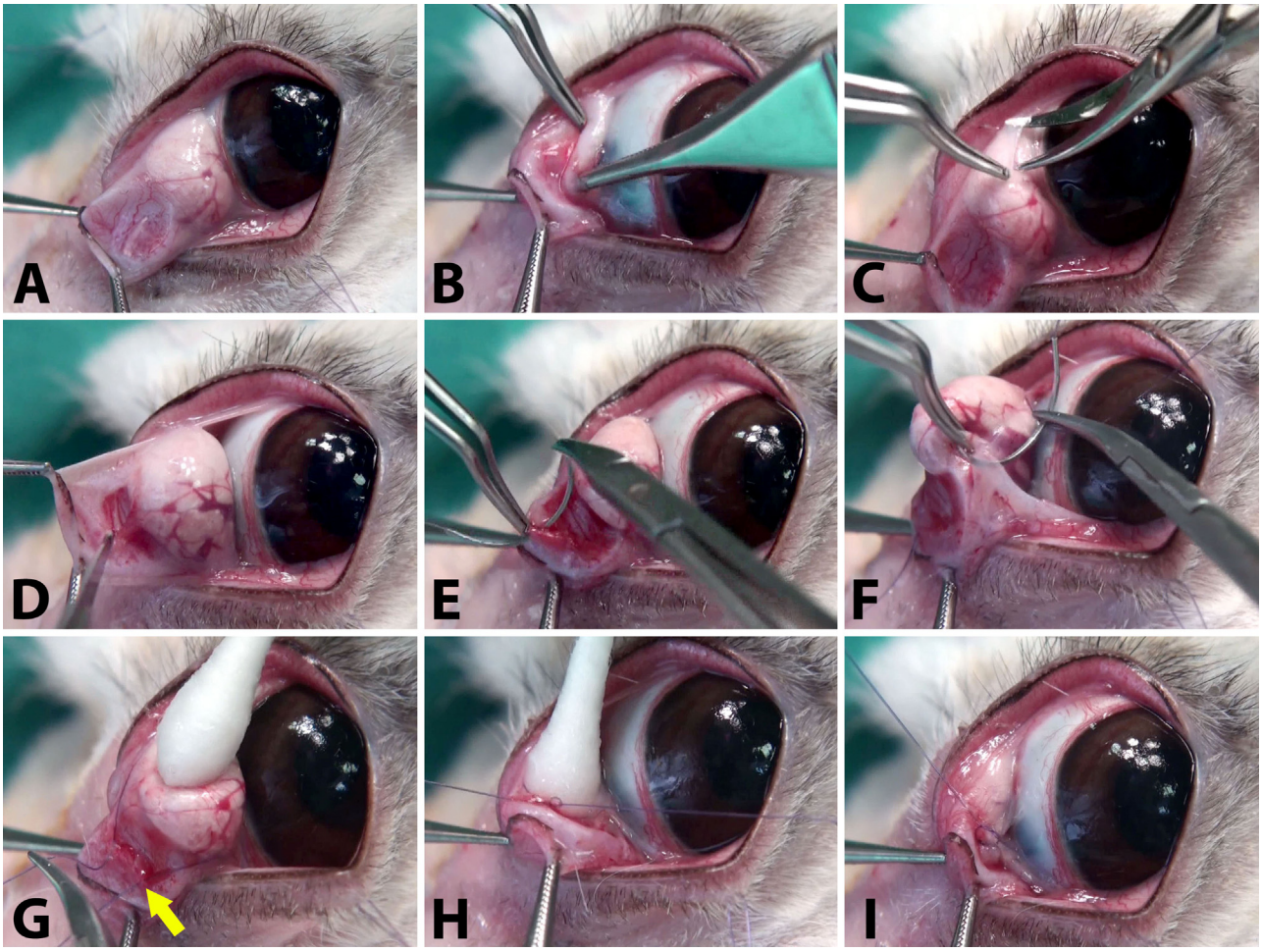

FIGURE 5. (A to I) Surgical technique for replacement of the prolapse of the deep gland and of the protrusion of the nictitating membrane in this rabbit—Step 2: Replacement of the deep gland. (A) The free border of the nictitating membrane is clamped with the tip of 2 fine hemostats, and retracted from the ocular surface, exposing the prolapsed gland. (B) The thin bulbar conjunctiva is pulled over the prolapsed gland to test whether or not the gland can be covered. (C) In the posterior nictitans conjunctiva on either side of the gland, 2 small linear incisions are created. Here, the incision medial to the gland is performed with sharp scissors. (D) In this case, the rostral incision is made with the tip of a 11 scalpel blade. Bleeding is minimal, and is controlled with a cotton-tipped applicator. (E) The needle is passed through the lateral margin of the lateral incision to begin suturing the mucosal over the prolapsed gland, using 5.0 poliglecaprone suture. (F) The needle is passed through the medial margin of the medial incision twice, in a horizontal "U-shaped" fashion. (G) The U-shaped is completed by passing the needle again through the lateral margin of the lateral incision (arrow). (H) The prolapsed gland is gently reduced using a wet cotton-tipped applicator, while the U-shaped suture is tightened, suturing the conjunctiva over the gland. (I) While the knot is tightened, the cotton-tipped applicator is removed, and the gland remains embedded beneath the mucosa. (Used with permission from Vittorio Capello, DVM.)

either side of the prolapsed gland and about 2 to 3 mm from each side of the gland (Fig. 5C and D). Bleeding was minimal and controlled with a cotton-tipped applicator. The mucosal incisions were sutured over the prolapsed gland with monofilament, absorbable 5.0 poliglecaprone suture (Monocryl; Johnson & Johnson Medical, Langhorne, PA USA). The needle was passed through the lateral margin of the lateral incision, then through the medial margin of the medial incision twice, in a horizontal mattress fashion (Fig. 5E and F). The prolapsed gland was gently reduced using a wet cotton-tipped applicator, whereas the horizontal mattress suture was simultaneously tightened over the gland on the posterior aspect of the nictitans (Fig. 5G to I). The nictitans was reduced with a single transfixing suture through the "T-shaped" cartilage using the same absorbable 5.0 poliglecaprone suture, anchoring the nictitating membrane to the periosteum of the orbital bone to help prevent reprolapse. The needle was initially passed from the anterior to the posterior aspect of the nictitating membrane at the level of the dorsal arm of the "T"

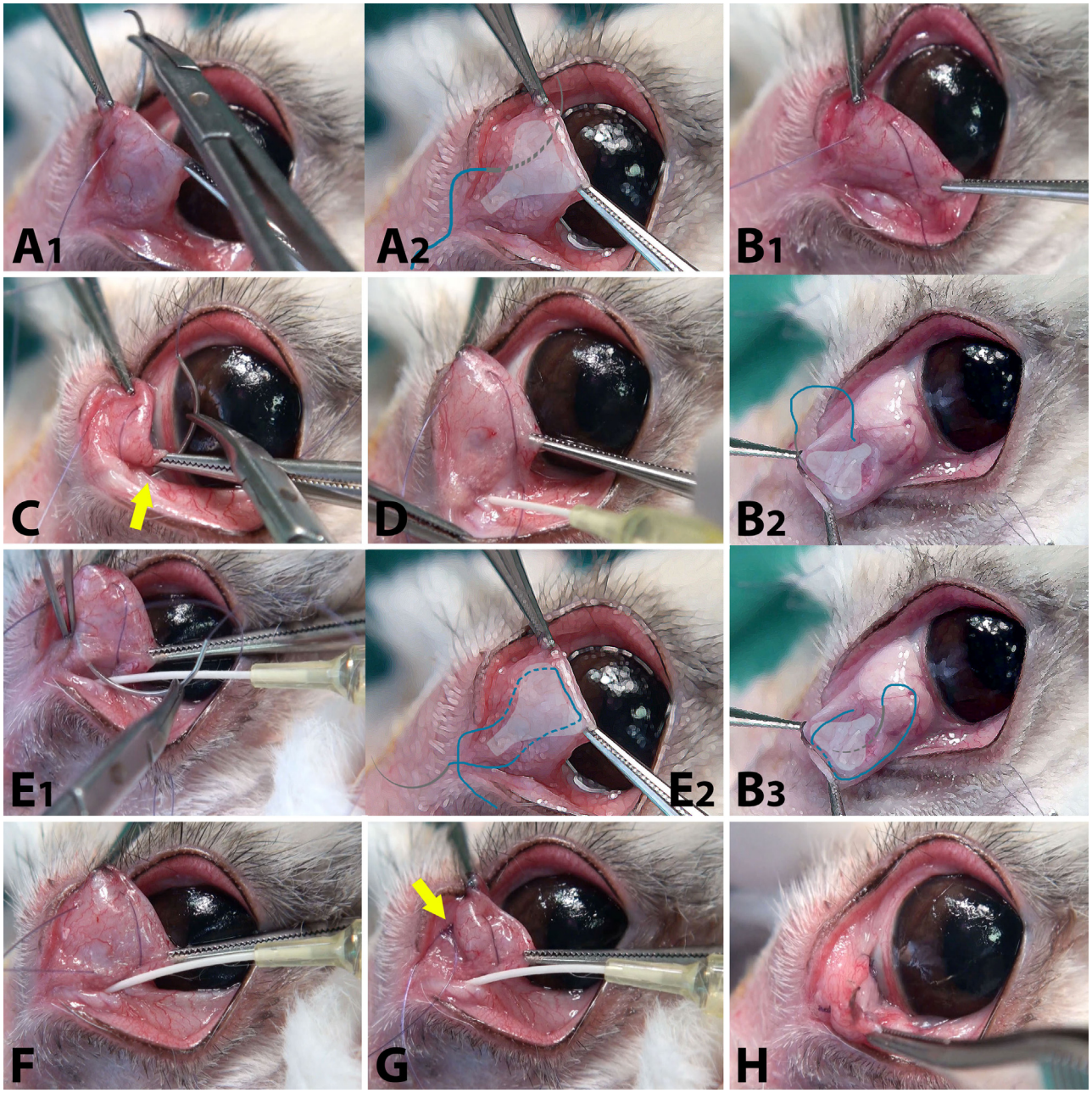

FIGURE 6. (A to H) Surgical technique for replacement of the prolapse of the deep gland and of the protrusion of the nictitating membrane in this rabbit—Step 3: Replacement of the third eyelid with a transfixing suture through the "T-shaped" cartilage, anchoring the nictitans to the periosteum of the orbital bone. (A1) Initially, the needle of the 5.0 poliglecaprone suture is passed through the 3 mucosal-cartilaginous-mucosal layers from the anterior to the posterior aspect, at the level of the dorsal arm of the "T" cartilage of the nictitating membrane. Note the suture pattern and position of the cartilage indicated in A2. (B1) The suture is then passed from posterior to anterior; again from anterior to posterior at the level of the ventral arm of the "T" cartilage of the nictitating membrane. The suture pattern and position of the cartilage are indicated in B2 and B3. (C) Before completing the "T-shaped" suture, the suture is anchored to the periosteum of the dorsomedial border of the orbital bone (arrow). (D) Before completion, the ostium of the nasolacrimal duct is cannulated with a 24-gauge intravenous polytetrafluoroethylene catheter to verify patency, and to preserve it from possible stricture. (E1) The suture is completed by passing the needle through the mucosa of the nictitating membrane on the anterior side. Patterns are shown in E2. (F) The "T-shaped" suture pattern is complete before tightening. (G) The "T-shaped" suture is tightened on the anterior surface of the nictitating membrane, while the ostium of the nasolacrimal duct is maintained with the polytetrafluoroethylene catheter. The knot is indicated by the arrow. (H) The posterior aspect of the nictitating membrane is inspected to confirm replacement of the gland. (Used with permission from Vittorio Capello, DVM.)

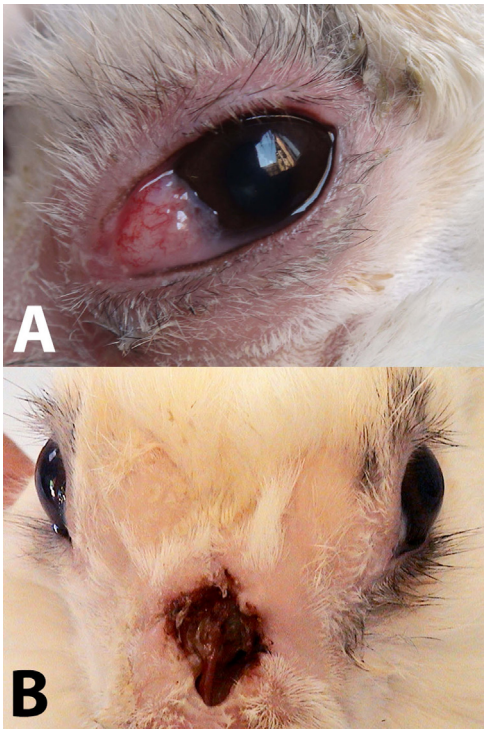

FIGURE 7. (A and B) Follow-up 2 days and 10 weeks after surgery. (A) Patient at recheck 2 days following the surgical procedure. Note that mild inflammation and edema of the nictitans resolved completely after 3 days. (B) Re-examination of the patient 10 weeks after replacement of the nictitans prolapse and 6 weeks post–bilateral rhinostomy. Healing by second intention and remodeling of the initial stoma of the nose are also visible. (Used with permission from Vittorio Capello, DVM.)

cartilage (Fig. 6A). The suture was then passed from medial to lateral, and again from lateral to medial at the level of the ventral arm of the "T" cartilage of the nictitating membrane (Fig. 6B). Before completing the "T-shaped" suture, the suture was anchored to the periosteum of the dorsomedial border of the orbital bone (Fig. 6C). Before tying off this suture, the opening of the nasolacrimal duct was identified with a 24-g intravenous teflon catheter (Surflo, Terumo Medical Corporation, Tokyo, Japan) to verify patency and avoid obstructing the duct with the suture (Fig. 6D to G). The stay sutures were removed at the end of the procedure. A topical antibiotic, tobramycin (Stilbiotic; Vetem Agrate Brianza, Italy), and a topical nonsteroidal anti-inflammatory agent, piroxicam 5 mg/mL (Flogostil; Vetem Agrate Brianza, Italy), were applied to the surgical site at the end of the surgery.

Recovery from anesthesia was uneventful, and the patient was discharged the same day with instructions to topically administer both the tobramycin and piroxicam every 8 hours, for 7 days.

Re-examinations of the patient were performed daily for 2 days, and then at each presentation for treatment of dental disease (Fig. 7). The rabbit underwent bilateral rhinostomy for the treatment of the empyema of the nasal cavities 4 weeks after the surgical correction of the nictitans prolapse. Reprolapse of the nictitating membrane and/or of the deep gland did not occur before the patient's death 4.5 years later.

DISCUSSION

In dogs, displacement of the nictitans and related superficial gland are defined as protrusion, prolapse or eversion. This condition is commonly referred to as "cherry eye."[6] Pathogenesis is unclear, but may be associated with primary or secondary adenitis, fascial attachment abnormalities, or specific pathogens affecting the glands.[6] Dogs lack the deep gland of the nictitating membrane present in the domestic rabbit.[6]

Swelling, protrusion, and prolapse of the nictitans (the latter following prolapse of the deep gland) may occur in rabbits.[1,2] Other than adenitis and periocular infections, the underlying cause of atypical nictitans presentation may be due to the abnormal laxity of the connective tissue that attaches the gland to the surrounding orbital structures.[1] As a result of the close anatomical relationship, a critical predisposing factor of the nictitans prolapse could be alveolar bulla deformity and periodontal disease as was present in this patient.[5,7,8] This condition likely played a role in prolapse in the rabbit described in this report.

Although prolapsed glandular tissue can be removed, reduction of the prolapse is preferable, as the physiologic function of this tissue is preserved for ocular health.[2] In dogs, removal of the gland of the nictitating membrane often results in keratoconjunctivitis sicca, and therefore is not recommended.[6] The deep gland of the nictitans is composed of 2 lobes, and incomplete removal of a single lobe may be followed by subsequent prolapse of the remaining glandular tissue.

The goal of surgery is to replace the protruding or prolapsed gland, prevent further protrusion, maintain mobility of the nictitans, and preserve glandular tissue.[6] In rabbits, preserving the anatomy and function of the proximal lacrimal punctum is also of paramount importance as the rabbit possesses a single lacrimal punctum.

Surgical techniques described in dogs replace the protruding or prolapsed nictitans include creation

of a pocket in the adjacent mucosa to cover the gland or anchoring the nictitans to the ventral oblique muscle, sclera, periorbital fascia, or the periorbital rim.[6,9] The pocket technique may be more effective when used alone in cases of mild protrusion.[6] Anchoring procedures help to keep the nictitating membrane from protruding until associated inflammation and swelling resolve, but may interfere with mobility of the nictitans.[6] One case of bilateral prolapse of the deep gland in a 1-year-old lop rabbit was treated exclusively with the pocket technique.[1] A Schirmer's tear test was not performed in this patient, but evaluation of tear production before and after surgery represents a useful diagnostic addition.[1]

Considering both prolapse of the deep gland and protrusion of the nictitating membrane, and severe deformity of the underlying alveolar bulla, this rabbit was treated with a combined technique. The prolapsed white (dorsal) lobe of the deep gland was repositioned utilizing the pocket procedure, and the nictitans was secured by anchoring it to the periosteum of the orbital rim. Even if the knot of the mattress suture used for the pocket technique was placed on the posterior aspect, corneal trauma did not occur because of additional reduction of the nictitans. The procedures were successful in preventing reoccurrence of both prolapse of the deep gland and protrusion of the nictitating membrane in this case.

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