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## **PATHOLOGY OF THE REPTILE EYE AND OCULAR ADNEXA**

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### **OVERVIEW**

The insults to the eye and ocular adnexa include developmental anomalies, infectious agents, neoplastic changes, nutritional imbalances, traumatic injuries, as well as lesions that are manifestations of systemic disease. This review will cover the reported reptile ocular and periocular diseases.

### **NON-INFECTIOUS DISEASES**

#### **Husbandry Related Lesions**

Poor husbandry (such as inappropriate temperature, humidity, substrate) can result in dysecdysis especially in snakes and lizards, and retained spectacles are a common site for dysecdysis. The problem can be exacerbated by ectoparasites (mites and ticks) feeding at the peripheral margin of the spectacle. Snakes and a few lizards (some geckos and the skink, *Ablepharus* spp.) have a spectacle over the eye that develops by fusion of the eyelids during embryonic development. The retained spectacle will lose its transparency, blinding the animal. Damage to the spectacle and associated corneal lesions can occur with attempts to remove retained spectacles (eye caps) associated with dysecdysis.<sup>22</sup>

In leopard geckos (*Eublepharis macularius*) the skin of the inner eyelid may be retained with an abnormal shed. This gecko belongs to a family of geckos that have eyelids and not a spectacle. Failure to shed this skin can result in an accumulation of keratin in the conjunctival sac, subsequent irritation and infection.<sup>6,10</sup> This lesion will appear similar to squamous metaplasia secondary to hypovitaminosis A as the ocular epithelial tissues are sensitive to the effects of hypovitaminosis A.<sup>6</sup>

A colony of green anoles (*Anolis carolinensis*) developed variable thickening of the mucosa of the lips, thickened ocular palpebra from conjunctival hyperkeratosis, lethargy, and weight loss.<sup>41</sup> The lesions were linked to dietary hypovitaminosis A and squamous metaplasia of the mucosal membranes.<sup>41</sup>

Swelling of the eyelids or blepharodema is frequently one of the first observed clinical signs in chelonians (box turtles and terrapins) with hypovitaminosis A. Squamous metaplasia of the orbital glands and ducts and epithelial desquamation blocks the ducts of the orbital glands. Swelling of the orbital glands is associated with orbital and eyelid edema and

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conjunctivitis.<sup>18,42</sup> Chronic infections secondary to the epithelial changes from hypovitaminosis A can produce thick exudates that cover the cornea in chelonians.

Other nutritional imbalances can have effects on the eyes. A 9-week-old male Veiled Chameleon (*Chamaeleo calytratus*) presented with an enlarging periocular swelling. The chameleon's condition deteriorated quickly and it died within a week. On gross examination the retrobulbar venous sinus was expanded. The periocular swelling was speculated to be due to venous congestion from the heart. The histology identified poor mineralization of the skull bone and calcified, dystrophic foci in the heart. It was suspected that the lesions were due to an overdose of vitamin D leading to calcification of the myocardium and possibly heart failure.<sup>8</sup>

Chelonians appear to be very susceptible to keratopathies and cataract formation after hibernation periods. In addition exposure of hibernating chelonians to freezing temperatures can result in a number of ocular and central nervous system lesions. These have been described in Mediterranean spur-thighed tortoises (*Testudo graeca*) and Hermann's tortoise (*Testudo hermanni*). The main abnormal ocular findings include: mucoid ocular discharge, blepharitis, conjunctivitis, hypopyon, uveitis, cataracts, vitreal damage, retinopathies and central nervous damage with temporary or permanent blindness.<sup>4</sup>

Exposure to high-intensity and/or inappropriate wavelengths of UV radiation may be associated with significant morbidity, and even mortality, in reptiles. Two animals from a collection, a ball python (*Python regius*) and a blue tongue skink (*Tiliqua* spp.) presented with anorexia, lethargy, excessive shedding, corneal opacity (python), and weight loss (skink). Severe bilateral ulcerative keratoconjunctivitis with bacterial colonization was noted in the ball python. Microscopic findings within the skin and eyes were suggestive of ultraviolet (UV) radiation damage or of photodermatitis and photokeratoconjunctivitis. Removal of the recently installed lamps from the terrariums of the surviving reptiles resulted in resolution of clinical signs.<sup>23</sup>

### **Congenital/Developmental Anomalies**

Ocular malformations occur with some frequency in captive bred reptiles possibly due to inbreeding or environmental conditions.<sup>42</sup>

Anophthalmia (eyeless) snakes do well in captivity being able to locate prey/food through chemical clues. There seems to be an increased incidence of this condition in some inbred lines of snakes.<sup>47</sup> Another congenital abnormality is cyclopia. Both of these frequently occur with skeletal abnormalities.

An inherited autosomal dominant genetic trait of progressive dermatisation of the cornea and tertiary spectacle has been recognized in lined-phase gopher snakes (*Pituophis catenifer*).<sup>22</sup>

Congenital deformed eyelids have been reported in leopard geckos. The lesions lead to chronic ulceration and infection.<sup>6</sup>

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Multiple cystic structures were present around the eye of a recently born rhinoceros viper (*Bitis nasicornis*) resulting in exophthalmia. The cysts contained a large number of eosinophils, but no identifiable organisms. As these were present at birth, it was felt they were developmental anomalies.<sup>15</sup>

A case of an orbital varix has been reported in a green iguana (*Iguana iguana*). Varices are pathological enlargements of one or more venous channels. The large venous varix flowed dorsal and medial to the eye of a green iguana.<sup>54</sup> The varix produced a pronounced exophthalmos and reduced ocular motility. Enucleation resolved the condition.<sup>54</sup>

## Trauma

Corneal abrasions from substrates, prey, or conspecifics in turtles and most lizards can be treated with topical ophthalmic ointment; however, similar damage to the spectacle of snakes may require systemic medications to control ocular infections. Access to the underlying cornea, if damaged, can be made through a partial resection of the spectacle.<sup>32,36</sup>

One case of periocular swelling in a dwarf chameleon was due to a reported bee sting.<sup>9</sup>

Some plants high in oxalates (*Ficus*, *Pothos* spp.) are described as causing a contact conjunctivitis in chameleons.<sup>12</sup>

## Degenerative

While corneal lipid infiltration (corneal arcus) is better described in Cuban tree frogs (*Osteopilus septentrionalis*), it has also been reported in aged tortoises.<sup>3,21</sup> The deposition of cholesterol and other lipids results in a peripheral opaque ring in the cornea.<sup>21</sup>

Cataracts, ranging from hypermature to mature (classification by stage of development) and early lenticular (location), have been described in reptiles. Possible etiologic causes for cataracts in reptilian species include nutritional imbalances, inheritance, and trauma or uveitis.<sup>44</sup> A Savannah monitor lizard (*Varanus exanthematicus*) presented with bilateral mature cataracts and underwent successful surgical removal by phacoemulsification. The cataracts were suspected to be due to an inherited condition or nutritional imbalance.<sup>13</sup> An early lenticular cataract (opacity of the lens not affecting the capsule) was recognized in a boa.<sup>22</sup> Cataracts were identified in a small number of Mediterranean spur-thighed tortoises (*Testudo graeca*) at a rehabilitation center in Spain.<sup>3</sup>

Bilateral hypermature cataracts were removed by phacoemulsification in a loggerhead sea turtle (*Caretta caretta*).<sup>33</sup> Poor nutrition or uveitis associated with systemic disease was speculated as the cause in the sea turtle.<sup>33</sup>

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Retinal lesions are rarely recognized; however, a case of retinal degeneration was reported in a Tokay gecko (*Gekko gecko*). In the right eye, there was a loss of photoreceptor inner and outer segments, disorganization of nuclear layers, and pigment-laden macrophages in a focal area.<sup>48</sup>

Glaucoma has not been reported in reptiles, although tonometry has only recently been described for reptiles.<sup>50</sup>

## **INFECTIOUS DISEASES**

### **Virus**

Several systemic viral infections are associated with ocular lesions.

A systemic infection with a Siadenovirus in Sulawesi tortoises (*Indotestudo forsteni*) resulted in high morbidity and mortality. The most obvious clinical signs included chronic rhinosinusitis with oronasal fistulae, ulceration of the tongue and oral mucous membranes, and nasal and ocular discharge. Rarely the intranuclear viral inclusions were identified within areas of Harderian gland necrosis.<sup>46</sup>

Systemic infections by herpesvirus in several reptile groups can present with a conjunctivitis, tracheitis, and pneumonia.<sup>44</sup> Caseous conjunctival exudate was found in a group of juvenile green sea turtles (*Chelonia mydas*) with lung, eye, and trachea disease (LETD).<sup>29</sup> The associated lesions of squamous metaplasia of the trachea in the fatal herpesviral outbreak (LETD) are similar to metaplastic lesion of vitamin A deficiency.<sup>29</sup>

In a group of Hermann's tortoises (*Testudo hermanni*) a fatal herpesviral infection presented with stomatitis and rhinitis with nasal and ocular discharge, necrotic lesions of the tongue, swelling of the neck and lower jaw, anorexia and lethargy.<sup>38</sup> Imported Argentine tortoises (*Geochelone chilensis*) developed clinical signs of nasal and ocular discharge, regurgitation, anorexia, and necrotizing lesions within their oral cavities, with increased mortality 1 mo after arrival. Intranuclear viral inclusions were present in the degenerating epithelium of the necrotizing stomatitis, supporting a herpesviral infection.<sup>28</sup>

Iridovirus, also a systemic fatal infection in reptiles, generally presents with clinical signs of an upper respiratory tract disease of respiratory distress, nasal discharge, and oral ulcerations. The associated lesions are of a conjunctivitis and necrotizing pharyngitis-stomatitis in chelonians.<sup>31</sup> In transmission studies box turtles developed a thick, translucent ocular discharge and red-eared sliders (*Trachemys scripta elegans*) developed exophthalmia, conjunctivitis, hyphema, and caseous diphtheric plaques in the oral cavity and tongue.<sup>31</sup> Unfortunately viral inclusion bodies may be an inconsistent finding by histologic examination.<sup>31</sup>

Poxvirus presenting with lesions on the palpebra has been described in recently imported

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spectacled caimans (*Caiman crocodilus*).<sup>30</sup>

## **Bacteria**

Normal conjunctival flora of free ranging and captive Mediterranean spur-thighed tortoises (*Testudo graeca*) have been evaluated. Bacteria were recovered from all animals in both groups. *Micrococcus luteus* was the most common microorganism isolated in free ranging tortoises, and fewer *Corynebacterium striatum*, *Pseudomonas fluorescens*, and *Pseudomonas* spp. In the captive and clinically healthy tortoises, the isolates were *Staphylococcus xylosus* followed by *Staphylococcus capitis*. *Mycoplasma* spp. was not isolated.<sup>39</sup>

Similar studies have been run on clinically normal captive green iguanas (*Iguana iguana*). The most common isolates were *Staphylococcus aureus*, *Escherichia coli*, and *Bacillus* species.<sup>51</sup>

A number of bacteria are associated with ocular lesions.

From a collection of Mediterranean spur-thighed tortoises (*Testudo graeca*), with rhinitis and positive immunologic evidence of herpesvirus, a number of ocular lesions were identified.<sup>3</sup> These lesions included: blepharidema, ocular discharge, conjunctivitis, corneal edema, and conjunctival bubbling. The bacteria isolated from these cases were *Pasteurella testudini*, *Pseudomonas* spp., *Aeromonas hydrophila*, *Micrococcus roseus*, *Micrococcus luteus*, *Aerococcus viridans*, *Staphylococcus* spp., *Staphylococcus capitis*, *Staphylococcus hominis*, *Staphylococcus auricularis*, *Corynebacterium striatum*, and *Corynebacterium kutscheri*. *Mycoplasma* spp. were not present in these tortoises.<sup>3</sup>

The presence of degenerative heterophils or a puslike fluid in the anterior chamber of the eye (hypopyon) suggests a bacterial infection and is generally associated with systemic disease. This has been described in red-footed tortoise (*Geochelone carbonaria*) with unilateral hypopyon and pneumonia that responded to systemic and topical antibiotics.<sup>53</sup>

A bacteria pneumonia due to *Klebsiella pneumoniae* was associated with the development of buphthalmos and hypopyon in a tokay gecko (*Gekko gecko*).<sup>5</sup>

In snakes and geckos, infections can develop in the subspectacular space, resulting in progressive bulging of the spectacle.<sup>22</sup> Accumulations of debris and inflammation can block the nasolacrimal ducts resulting in distention of the space between the cornea and the spectacle (bullous spectaculopathy or pseudobuphthalmos). Secretions of the harderian gland directly enter the subspectacular space or lacrimal duct. These drain into the mouth or duct of Jacobson's organ via the lacrimal duct. Typically the bulging spectacle will appear cloudy. Often culture of the fluid reveals bacteria such *Aeromonas* spp. and *Pseudomonas* spp.<sup>42</sup> The accumulation of fluid can also occur secondary to oral cavity inflammation that blocks the

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nasolacrimal duct.

A group of tokay geckos (*Gekko gecko*) suffered a systemic *Proteus* infection with a few lizards developing subspectacular exudates.<sup>44</sup> In a blood python (*Python curtus*), the exudate in the distended subspectacular space contained numerous flagellates, *Pseudomonas* bacteria, and inflammatory cells.<sup>43</sup> *Staphylococcus* spp. was isolated from a subspectacular infection in a king snake.<sup>17</sup>

*Aeromonas liquefaciens* resulted in a persistent and aggressive eye infection in a colony of *Lacerta viviparta* used in experimental studies. The infection started with a clear fluid discharge from the eye and progressed to sealing of the eyelids. The lizards would stop eating and would die. The primary lesions were of a conjunctivitis, mucopurulent discharge within the conjunctival sac and a unilateral to bilateral pneumonia. Many animals did not respond to either systemic or topical therapy.<sup>16</sup> A group of alligators with uveitis and hypopyon had a bacteremia due to *Aeromonas*.<sup>44</sup>

An *Escherichia coli* abscess was surgically removed from the lower lid of a common iguana (*Iguana iguana*).<sup>44</sup> An orbital abscess produced exophthalmos, enophthalmos, and strabismus in one green iguana. From the mass an unidentified Gram-negative bacterial rod was isolated.<sup>25</sup> A bilateral exophthalmos in another iguana was due to an *Enterococcus* spp. abscess.<sup>40</sup>

*Pseudomonas* species was isolated from a periorbital abscess that severely displaced and compromised function of the globe in a three-horned chameleon (*Chamaeleo jacksonii*).<sup>49</sup>

Surgical debridement and systemic antibiotics resulted in complete resolution. Disseminated *Pseudomonas* bacteremia in an Indonesian blue tongue skink (*Tiliqua gigas*) caused a uveitis and hypopyon.<sup>44</sup>

Mycobacterium is a rarely described infection. A granuloma developed within the orbit of an aged box turtle (*Terrapens carolina*) resulting in effacement of the globe and thickening of the palpebra. The eye was removed surgically and the animal had no recurrence over 10 mo.<sup>35</sup>

The classic clinical signs of *Mycoplasma agassizii* infection in gopher tortoises (*Gopherus polyphemus*) and desert tortoises (*Gopherus agassizii*) include serous, mucoid, or purulent discharge from the nares, excessive tearing to purulent ocular discharge, conjunctivitis, and edema of the eyelids and ocular glands.<sup>7</sup>

Clinical signs of a *Mycoplasma* spp. infection in free-ranging Eastern box turtles (*Terrapene carolina carolina*) included unilateral to bilateral serous to mucopurulent nasal discharge, epiphora, ocular edema, and conjunctival injection. The infection was unrelated to the development of aural abscesses.<sup>19</sup>

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## Chlamydia

Exudative conjunctivitis is a common clinical sign of chlamydial infection in many animals. Repeated outbreaks of chlamydial infections in juvenile Farmed Nile crocodiles (*Crocodylus niloticus*) presented with conjunctivitis progressing to a fatal hepatitis.<sup>27</sup>

## Fungus

Fungal infections in snakes more commonly affect the spectacle and are associated with poor management. A granulomatous fungal keratitis developed after several weeks of antibiotic and corticosteroid therapy on the cornea of a python (*Python reticulatus*).<sup>14</sup> The keratitis progressed to a panophthalmitis and the eye was enucleated. In one king snake (*Lampropeltis* spp.) a *Penicillium* spp. was isolated from the spectacle lesion.<sup>44</sup> A rainbow boa (*Epicrates chenchria maurus*) had an infection of the spectacle of the eyes that was caused by the fungus *Fusarium oxysporum*. The eye was enucleated.<sup>55</sup>

A fungal keratitis was diagnosed in a free-ranging gopher tortoise (*Gopherus polyphemus*) presented for traumatic lesions (puncture wounds and scarring on the carapace) and blindness.<sup>45</sup> Fibrinous exudate covered the conjunctival fornices, through the palpebral fissure. Once removed there were bilateral corneal ulcerations and phthisis bulbi of the left globe. On histology, there was a necrotizing conjunctivitis and intralesional fungal hyphae. These cultured out as a mixed flora of *Curvularia* spp. and *Aspergillus* spp. The right eye recovered after treatment.<sup>45</sup>

A unilateral periocular swelling and buphthalmos was due to *Exophiala* species in a captive Galapagos tortoise (*Geochelone nigra*). The condition of the animal deteriorated and euthanasia was elected. The phaeohyphomycosis was a disseminated infection.<sup>37</sup>

An unidentified fungi was isolated from around the eyelids of mariculture-raised green sea turtles secondary to trauma.<sup>44</sup>

## Protozoa

Rare protozoal infections have been described involving the eyes. In an unusual presentation of *Entamoeba invadens*, the protozoa were associated with blisters on the skin and proliferative tissue of the eyelids on an *Iguana iguana*. The infection was unusual in its lack of intestinal involvement.<sup>20</sup>

*Trypanosoma* spp. was in the exudates within the subspectacular space of an Eastern indigo snake (*Orymarchon corais couperi*).<sup>44</sup>

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## Metazoans

Wild caught animals may present with nematodes within the globe. Many but not all are filarid nematodes.<sup>22</sup> The intestinal nematode larvae, *Hexametra angusticaecoides*, was found widespread in the liver, coelomic cavity, subcutaneous skin, and retrobulbar space in a veiled chameleon (*Chamaeleo calypttratus*).<sup>11</sup> *Foleyella furcata* and *F. brevicauda* are filariid worms that have an extensive migration pattern. An Oustlet's chameleon (*Chamaeleo oustaleti*) is described with a *Foleyella* spp. in a fluctuant swelling of an upper eyelid.<sup>52</sup> Numerous unidentified nematode larvae were packed within the choroid of the eye of a red-eared slider (*Pseudemys scripta elegans*). The bloodstream was the suspected route of entry.<sup>44</sup>

A number and variety of parasites can be found on the surface of the eye and adenexa. Leeches of the genus *Ozobranchus* can be found adhered to the conjunctiva in mariculture green sea turtles.<sup>44</sup>

A variety of parasites will aggregate on the eyelids. Large aggregations of the trombiculid mite, *Neotrombicula californica*, were found on the upper eyelids in a wild population of side-blotched lizard (*Uta stansburiana*). Acute inflammation was associated with the mites.<sup>24</sup> In snakes, the recess between the periphery of the spectacle and the periocular scales frequently supports a population of mites, usually *Ophionyssus* spp., as this site provides a source of blood for the parasites through the thin, nonkeratinized skin.<sup>44</sup>

Ticks can often be found around the eyes of all reptiles.<sup>10</sup> In snakes the ticks may attach to the spectacle and in lizards, the conjunctiva.<sup>44</sup>

## TUMORS

No primary ocular tumors were found in the reptile literature and only a few periocular tumors have been described.

An acquired lacrimal cyst (dacryops) in a red-eared slider (*Chrysemys scripta elegans*) presented with unilateral exophthalmus, engorged episcleral vessels, periocular swelling superior of the globe, and reduced ocular motility.<sup>2</sup>

A Chinese box turtle (*Cuora flavomarginata*) presented with a ventral periorbital swelling that impaired vision and was traumatized. The mass, debulked surgically, was a lacrimal cystadenoma.<sup>34</sup>

A royal boa constrictor presented with retained spectacle of the right eye and a solid, scaly mass on the left spectacle. On histology it was a cup-shaped tumor with a central keratin plug consistent with a keratoacanthoma.<sup>26</sup>

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A squamous cell carcinoma developed in the periocular skin of a veiled chameleon (*Chamaeleo calyptratus*).<sup>1</sup> Complete surgical removal of the mass resulted in resolution until the animal's death of unrelated cause 3 mo later.

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