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Original Study

Ophthalmic Parameters of Healthy White-Eyed Parakeets (*Psittacara leucophthalmus*)

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Abstract: White-eyed parakeets (*Psittacara leucophthalmus*) are medium-sized birds that are diurnal and arboreal and eat a predominantly fruit-based diet. Although white-eyed parakeets are frequently presented with ocular lesions, information about ophthalmological parameters for this species is limited. Therefore, this study aimed to characterize the baseline ophthalmic parameters of healthy, white-eyed parakeets to contribute to a better understanding of their ocular health. This study evaluated the modified Schirmer tear test I (mSTTI), standardized endodontic absorbent paper point tear test (EAPPTT), intraocular pressure (IOP), central corneal thickness (CCT), and measurement of the palpebral fissure length (PFL) of 24 adult white-eyed parakeets under manual restraint. The same evaluator examined both eyes of each bird. To avoid any interference for the tear tests, 12 birds were assigned to mSTTI and 12 to EAPPTT. There was a significant difference ($P = 0.031$) in the PFL between eyes, with right eyes measuring 7–9 mm and left eyes 6–8 mm. There was no significant difference ($P = 0.435$) in CCT between eyes. There was a significant difference ($P < 0.001$) between the mSTTI and EAPPTT values, with EAPPTT values being higher than mSTTI values. There was no significant difference ($P = 0.157$) for these measures within bird. There was a significant difference ($P < 0.001$) in the IOP values between the different species parameters, with significant differences (all $P < 0.001$) recorded between all species measures except dog and rabbit ($P = 0.09$). There was no significant difference ($P = 0.157$) for the IOP measures within bird. The ophthalmic parameters obtained from the adult, white-eyed parakeets in this study can be used to expand our knowledge about the species and help distinguish healthy eyes from diseased eyes.

Key words: avian, eye, ophthalmic, psittacine, *Psittacara leucophthalmus*, white-eyed parakeet

INTRODUCTION

Psittacines are found in all tropical regions of the world, with Brazil having the highest number of representatives, totaling about 85 different species.[1,2] Trafficking and habitat loss represent the primary threats to these birds.[3]

Similar to most birds, psittacines have relatively large eyes compared with their body mass.[1,4] The orbit consists of frontal bones, the squamosal-orbital process, and the suborbital arch, with the intraorbital space almost totally occupied by the eye.[1] In addition, the extraocular muscles are thin, underdeveloped, and do not show differentiation.[5,6] This causes a limitation in eye mobility that is compensated by wide head movements.[5,7] There is an extensive infraorbital sinus and cervicocephalic air sac system that can predispose the bird to sinusitis and, consequently, conjunctivitis and orbital diseases.[1,8] Additionally, owing to their long lifespan, these birds frequently develop cataracts.[1]

Among the birds of the Psittacidae family are the white-eyed parakeets (*Psittacara leucophthalmus*).[9,10] These medium-sized birds are diurnal, arboreal, have a predominantly fruit-based diet, and live in pairs or flocks.[2,11] The plumage is mainly olive green with red feathers on the head and neck, which are not present when young, and the eyes are surrounded by bare white skin.[12]

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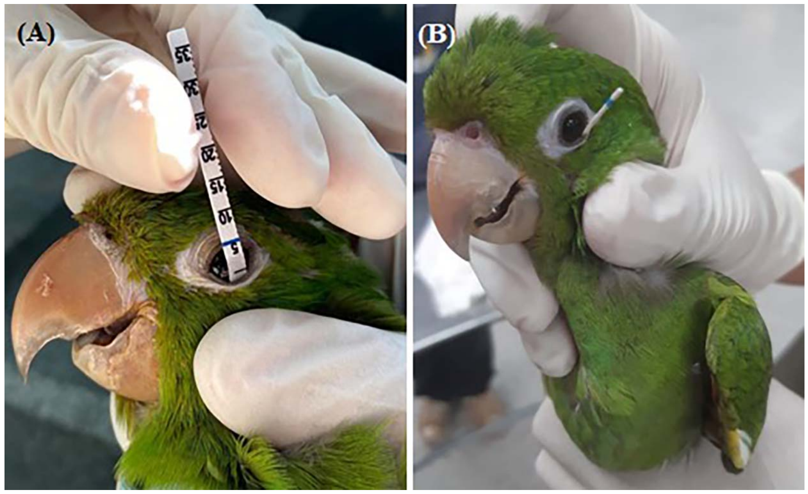

Figure 1. Modified Schirmer tear test I (A) and standardized endodontic absorbent paper point tear test (B) being used to measure tear production in white-eyed parakeets (*Psittacara leucophthalmus*) under manual restraint.

Although white-eyed parakeets are frequently presented with ocular lesions to veterinarians, information about ophthalmological parameters is limited in this species.[13–15] Therefore, this study aimed to evaluate the ophthalmic parameters of healthy, white-eyed parakeets to contribute to a better understanding of the adult eye in the species. The specific hypothesis in this study was that there would be no differences in ophthalmic parameters between eyes.

MATERIAL AND METHODS

This study was approved by the Ethics Committee for Use of Animals of the School of Veterinary Medicine Animal Science, UNESP, Botucatu campus (CEUA - no. 408/2023). All procedures were conducted in accordance with the Association for Research in Vision and Ophthalmology statement for the use of animals in ophthalmic and vision research. The birds were housed in a 3 × 3.5–m masonry enclosure at the Center for Medicine and Research in Wild Animals at the School of Veterinary Medicine and Animal Science (Botucatu, SP, Brazil). The diet provided to the birds consisted of commercial food for psittacine birds (Megazoo, Betim, MG, Brazil), fruits, and vegetables, and water ad libitum.

A total of 32 white-eyed parakeets were evaluated in this study. The study was conducted during routine bird physical examinations aided by manual restraint. The same evaluator examined both eyes of each bird. Inclusion criteria used to select birds for the study included that they were in good general health and had no signs of lesions in the eyes and adnexae; birds showing any signs of eye disease, systemic disorders, or both were excluded.

The ocular structures and pupillary reflexes were assessed with the aid of slit-lamp biomicroscopy (Kowa SL-15; Kowa Optimed Inc, Torrance, CA, USA). Then, the sequence of additional procedures carried out was as follows: modified Schirmer tear test I (mSTTI), standardized endodontic absorbent paper point tear test (EAPPTT), intraocular pressure (IOP), central corneal thickness (CCT), measurement of the palpebral fissure length (PFL), and fluorescein eye staining. Twelve birds were assigned to solely undergo mSTTI, and the other 12 were assigned to EAPPTT to avoid interference between tests.

The mSTTI test was conducted using STT sterile paper strips (Tear Touch, Ophthalmos S.A., São Paulo, SP, Brazil). The absorbent paper strips were cut lengthwise in half (reducing the width from 5–2.5 mm) because of the small palpebral fissures of the white-eyed parakeets (Fig 1A).[5] The paper strip was placed in the lower conjunctival sac and removed after 1 minute to measure the wetted portion of the paper strip. The EAPPTT (Roeko Color size 30; Langenau, Baden-Württemberg, Germany) was placed into the lower conjunctival sac and removed after 1 minute (Fig 1B). A ruler with a millimeter scale was used to measure the wetted portion of the paper. The IOP was measured using rebound tonometry (TonoVet Plus; Icare, Äyritie, Vantaa, Finland) with the dog, cat, rabbit, and horse calibrations (Fig 2A). Three measurements were collected at each calibration and averaged. The readings were performed in the same order as the equipment configuration, with readings recorded in series and a 30-second wait between each new calibration.

Central corneal thickness was evaluated using an ultrasonic pachymeter (Hady Pachymeter SP-100;

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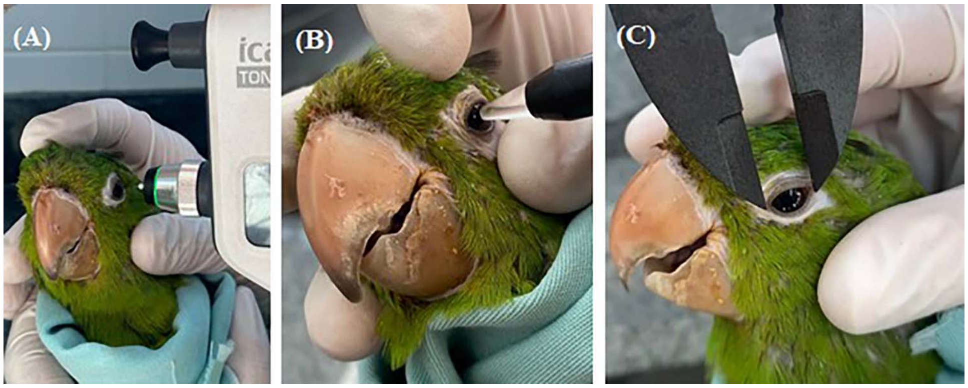

Figure 2. Measurements of intraocular pressure using a rebound tonometer (A), central corneal thickness with an ultrasonic pachymeter (B), and palpebral fissure length with a stainless-steel manual caliper (C) in a white-eyed parakeet (*Psittacara leucophthalmus*) under manual restraint and local anesthesia with proxymetacaine hydrochloride 0.5% eye drops to measure the central corneal thickness.

Tomey Corporation, Nagoya, Aichi-ken, Japan). After local anesthesia with proxymetacaine hydrochloride 0.5% eye drops (Anestalcon; Alcon Farma, São Paulo, SP, Brazil), the probe was positioned perpendicular to the central region of the cornea (Fig 2B). Mean CCT was calculated for each eye after 8 measurements. After all these examinations were completed, a fluorescein test was performed with a fluorescein strip (Fluoro Touch, Fluorescein Sodium Ophthalmic Strip; Ophthalmos S.A.). Palpebral fissure length was measured between the medial and lateral canthi (Fig 2C) with a stainless-steel manual caliper with an LCD display and an accuracy of ±0.02 mm (Neiko Tools, Klamath Falls, OR, USA).

The distributions of the data were evaluated by the Shapiro-Wilk test, skewness, kurtosis, and q-q plots. Comparisons between the right and left eyes for CCT and PFL were made by paired samples *t*-tests (CCT) or Wilcoxon paired rank tests (PFL) because of the codependence of this data and based on the data distribution. A repeated measures ANOVA was used to compare the mSTTI and EAPPTT values while considering the within-subject factor of the eye (right and left) and the technique as the between-subjects factor. Mauchly's test was used to test for sphericity. If a significant difference was found, a post-hoc Bonferroni test was used to further characterize the difference. A repeated measures ANOVA was also used to compare the difference between subject IOP calibration methods (dog, cat, rabbit, horse) to the within-subjects factor for the eye (right and left). Commercial software (SPSS 24.0, IBM Statistics, Armonk, NY, USA) was used to analyze the data. Significance was set at $P < 0.05$.

RESULTS

Twenty-four adult white-eyed parakeets of unknown sex met the inclusion criteria, and 8 birds were excluded from the study. All birds were considered adults based on plumage and feathering. There was a significant difference ($P = 0.031$) in the PFL between eyes, with right eyes measuring 7–9 mm and left eyes 6–8 mm (Table 1). Although statistically significant, there does not appear to be any biological significance to this difference. There was no significant difference ($t = -0.794$, $P = 0.435$) in CCT between eyes (Table 1). There was a significant difference ($F = 115.6$, $P < 0.001$) between the mSTTI and EAPPTT values, with EAPPTT values being higher than mSTTI values (Table 1). There was no significant difference ($F = 2.1$, $P = 0.157$) for these measures within bird. There was a significant difference ($F = 7865.5$, $P < 0.001$) in the IOP values between the different species parameters, with significant differences (all $P < 0.001$) recorded between all species measures except dog and rabbit ($P = 0.09$) (Table 2). There was no significant difference ($F = 2.1$, $P = 0.157$) for the IOP measures within bird.

DISCUSSION

The mean values of tear production measurements were significantly higher with EAPPTT than with mSTTI, showing that the techniques impacted tear analysis differently. The mSTTI used in the present study allowed the Schirmer tear test to be performed on these small birds.[1,7] Another study identified STTI mean values of 6.36 ± 3.59 and 6.42 ± 3.73 mm/min for right and left eyes, respectively, in 19 white-eyed parakeets; however, details on the width of the Schirmer tear strips were not provided.[14] Blue-fronted

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Table 1. Descriptive statistics for modified Schirmer's tear test, endodontic absorbent paper point tear test, central corneal thickness, and palpebral fissure length in 24 white-eyed parakeets (*Psittacara leucophthalmus*). Manual restraint was used to measure all parameters, except central corneal thickness. For central corneal thickness, both manual restraint and corneal anesthesia with proxymetacaine hydrochloride 0.5% were used.

	mSTTI (mm/min)	EAPPTT (mm/min)	CCT (µm)	PFL (mm)
Mean ± SD Interval (min–max)				
OD	4.3 ± 2.7 (0–9)	14.3 ± 2.6 (12–19)	173.3 ± 6.5 (162.4–185.4)	7.5 ± 0.6 (7–9)
OS	5.7 ± 2.4 (1–9)	15.0 ± 3.3 (9–19)	173.9 ± 7.3 (163.0–192.6)	7.2 ± 0.6 (6–8)
OU	5.0 ± 2.6 (0–9)	14.6 ± 3.0 (9–19)	173.6 ± 6.8 (162.4–192.6)	7.3 ± 0.6 (6–9)

Abbreviations: OD, right eye; OS, left eye; OU, both eyes; SD, standard deviation; min–max, minimum–maximum values; mSTT1, modified Schirmer's tear test; EAPPTT, endodontic absorbent paper point tear test; CCT, central corneal thickness; PFL, palpebral fissure length.

Amazon parrots (*Amazona aestiva*), neotropical birds that are larger in size than white-eyed parakeets, had mean ± SD mSTTI values of 6.2 ± 0.1 mm/min.[16] The values identified in the study reported here are within the range found in both these studies.

A standardized endodontic absorbent paper point tear test is considered useful for psittacines because lower eyelid traction is not necessary.[1] The mean ± SD for blue-fronted Amazon parrots using EAPPTT was 13.1 ± 1.4 mm/min,[17] comparable to the values in the current study. The phenol red tear test has already been used to quantify the tear film in 8 white-eyed parakeets.[15] This method was not tested in the present study because the mobility of the lower eyelid and rapid movement of the nictitating membrane of psittacine birds make the test more difficult to use[1] and could compromise the data.

Rebound tonometry can be used in small birds, as measured in the current study. All calibration modes of the rebound tonometer were tested in the present study because there is no bird calibration mode. The values were significantly different between the species' calibrations because calibration adjustments are based on the eye anatomy and corneal thickness of each animal species.[18,19] Considering the eyeball size and corneal thickness of the white-eyed parakeets,[20] the rabbit calibration (14.0 ± 1.5 mm Hg) appeared the most adequate calibration to evaluate the bird eye, but further study is necessary. Values of 6.4 ± 0.1 mm Hg were found in 35 blue-fronted Amazon parrots using a rebound tonometer that did not allow for the selection of a specific calibration.[17] The mean ± SD IOP using applanation tonometry in 9 white-eyed parakeets was 19.75 ± 4.09 mm Hg,[15] while IOP values from 16 blue-fronted Amazon parrots using the same device were 9.7 ± 1.7 mm Hg. However, IOP measurements obtained with applanation tonometers are more dependent on the examiner than those obtained with rebound tonometers, which could influence the data.[1,21] Furthermore, the small corneal size of white-eyed parakeets may make the use of applanation tonometers less suitable for this species. A study in rabbits also showed that rebound tonometry resulted in less variability in IOP values compared with applanation tonometry.[22] It is important to establish the method and standardization for each species evaluated.

The CCT has been measured in birds most frequently with an ultrasonic pachymeter[23–26] because it is an easy-to-use method that is quick, portable, and requires modest training to operate.[24] The mean ± SD CCT value of 0.173 ± 6.8 mm obtained in this study was very similar to that described in 8 white-eyed parakeets from another study (right eye, 0.175 ± 9.8 mm; left eye, 0.176 ± 7.3 mm).[14]

The PFL value (7.3 ± 0.6 mm) found in the present study was higher than that identified in the study evaluating 8 white-eyed parakeets (3.09 ± 0.37 mm).[15] Although the age of the birds was not specified in the previous study, one hypothesis is that younger, smaller birds were evaluated in that study compared with this study. Values of 10.1 ± 0.1 mm were described in 35 blue-fronted Amazon parrots,[16] whose body size is much larger than white-eyed parakeets. While the PFL values

Table 2. Values of intraocular pressure (mm Hg) using a rebound tonometer with 4 different calibration modes (dog, cat, rabbit, horse) in 24 white-eyed parakeets (*Psittacara leucophthalmus*).

	Dog	Cat	Rabbit	Horse
Mean ± SD Interval (min–max)				
OD	13.3 ± 1.7 (10–16)	7.3 ± 1.0 (5–9)	14.1 ± 1.4 (11–16)	9.8 ± 0.7 (9–11)
OS	12.9 ± 1.8 (8–16)	7.4 ± 1.5 (4–10)	13.9 ± 1.7 (9 – 17)	9.8 ± 1.1 (7–12)
OU	13.1 ± 1.7 (8–16)	7.3 ± 1.3 (4–10)	14.0 ± 1.5 (9–17)	9.8 ± 0.9 (7–12)

Abbreviations: OD, right eye; OS, left eye; OU, both eyes; SD, standard deviation; min–max, minimum–maximum values.

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in the present study were significantly different between eyes, the authors do not believe there is a biological reason for this difference, and it is possible that slight movements during measurements accounted for this difference.

In conclusion, the ophthalmic measurements obtained from healthy, adult, white-eyed parakeets in this study can serve as a baseline to increase the knowledge about the species and help distinguish healthy eyes from diseased eyes.

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REFERENCES

1. Moore BA, Oriá AP, Monntiani-Ferreira F. Ophthalmology of psittaciformes: parrots and relatives. In: Montiani-Ferreira F, Moore BA, Ben-Shlomo G, eds. *Wild and Exotic Animal Ophthalmology, Volume 1: Invertebrates, Fishes, Amphibians, Reptiles, and Birds*. Berlin, Germany: Springer Nature; 2022:349–391.
2. Godoy SN. Psittaciformes (Arara, Papagaio, Periquito). In: Cubas ZS, Silva JCR, Catão-Dias JL eds. *Tratado de Animais Selvagens: Medicina Veterinária*. São Paulo, Brazil: Roca; 2007:222–251.
3. Hvenegaard AP, Safatle AMV, Guimarães MB, et al. Retrospective study of ocular disorders in Amazon parrots. *Pesqui Vet Bras*. 2009;29:979–984.
4. Hall MI. The anatomical relationships between the avian eye, orbit and sclerotic ring: implications for inferring activity patterns in extinct birds. *J Anat*. 2008;212:781–794.
5. Bayón A, Almela RM, Talavera J. Avian ophthalmology. *Eur J Companion Anim Pract*. 2007;17:253–265.
6. Kern TJ, Colitz CMH. Exotic animal ophthalmology. In: Gelatt KN, Gilger BC, Kern TJ, eds. *Veterinary Ophthalmology*. Hoboken, NJ: Wiley Blackwell; 2013: 1765–1782.
7. Williams DL. The avian eye. In: Williams DL, ed. *Ophthalmology of Exotic Pets*. Chichester: Wiley-Blackwell; 2012:119–158.
8. Evans HE, Martin GR. Organa sensuum. In: Baumel JJ, ed. *Handbook of Avian Anatomy: Nomina Anatomica Avium*. Cambridge, UK: The Nuttall Ornithological Club; 1993:585–611.
9. Collar NJ. Family psittacidae (parrots). In: Del Hoyo J, Elliott A, Sargatal J, eds. *Handbook of the Birds of the World*. Barcelona, Spain: Lynx Edicions; 1997:280–479.
10. Galetti M, Guimarães P Jr, Marsden S. Padrões de riqueza, risco de extinção nos psitacídeos. In: Galetti M, Pizo MA, eds. *Ecologia e Conservação de Psitacídeos no Brasil*. 1st ed. Belo Horizonte, Brazil: Melopsittacus Publicações Científicas; 2002:17–26.
11. Nishida SM, Fonseca RCB, Boato JPS, et al. *Guia de Aves*. Botucatu, Brazil: Fundibio; 2018.
12. Forshaw JM. *Parrots of the World*. Princeton, NJ: Princeton University Press, 2010.
13. Hall MI, Iwaniuk NA, Gutiérrez-Ibáñez C. Optic foramen morphology and activity pattern in birds. *Anat Rec*. 2009; 292:1827–1845.
14. Merlini NB, Hippolito AG, Akemi D, et al. Schirmer tear test and central corneal thickness in the white-eyed parakeet – *Aratinga leucophthalmus*. Abstract presented at: *44th Annual Meeting of the American College of Veterinary Ophthalmologists*. November 4–9, 2013; Puerto Rico.
15. Souza JOT, Lices L. Ophthalmic parameters in Pionus (*Aratinga leucophthalmus*), true parrots (*Amazona aestiva*) and peach-fronted parakeet (*Aratinga aurea*). Paper presented at: *Annual Scientific Meeting of the European College of Veterinary Ophthalmologists*. May 18–21, 2017; Estoril, Portugal.
16. Falcão MSA, Monteiro RV, Oriá AP, et al. Modified Schirmer tear test and rebound tonometry in blue-fronted Amazon parrot (*Amazona aestiva*). *Pesqui Vet Bras*. 2017;37:871–873.
17. Monção-Silva R, Ofri R, Raposo AC, et al. Ophthalmic diagnostic tests in parrots (*Amazona amazonica*) and (*Amazona aestiva*). *J Exotic Pet Med*. 2016;25:186–193.
18. Gordon ME, Ziegler KM. Intraocular pressure measurement in animals. *J Vet Ophthalmol*. 2001;4:12–18.
19. Park YW, Jeong MB, Kim TH, et al. Effect of central corneal thickness on intraocular pressure with the rebound tonometer and the applanation tonometer in normal dogs. *Vet Ophthalmol*. 2011;14:169–173.
20. Carvalho CM, Rodarte-Almeida AC, Santana MIS, et al. Avian ophthalmic peculiarities. *Ciênc Rural*. 2018;48:1–10.
21. Sahin A, Niyaz L, Yildirim N. Comparison of the rebound tonometer with the Goldmann applanation tonometer in glaucoma patients. *Clin Exp Ophthalmol*. 2007;35:335–339.
22. Murillo JD, Robledo SM, Montaño J, et al. Variation of intraocular pressure comparing rebound (TONOVET Plus®) and applanation (TONO-PEN VET®) tonometry in New Zealand rabbits treated with Amlodipine®. *CES Med. Zootec*. 2021;16:10–27.
23. Westmoreland LSH, Hadfield CA, Clayton LA, et al. Ocular examinations and investigation of intraocular pressure, tear production, central corneal thickness, and corneal touch threshold in a captive flock of Atlantic puffins (*Fratercula arctica*). *J Avian Med Surg*. 2020; 34:123–131.
24. Montiani-Ferreira F, Cardoso F, Petersen-Jones S. Postnatal development of central corneal thickness in chicks of *Gallus gallus domesticus*. *Vet Ophthalmol*. 2004;7:37–39.
25. Rodarte-Almeida AC, Machado M, Baldotto SB, et al. The eye of the striped owl: morphologic observations, biometric findings and reference values for selected ophthalmic diagnostics tests. *Pesqui Vet Bras*. 2013;33:1275–1289.
26. Gonzalez-Alonso-Alegre EM, Martinez-Nevado E, Caro-Vadillo A, et al. Central corneal thickness and intraocular pressure in captive black-footed penguins (*Spheniscus dermersus*). *Vet Ophthalmol*. 2015;18:94–97.

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