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B-Mode Ultrasonography and 2D Shear Wave Elastography in Hypermature Cataract of a Pionus Maximiliani

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Case Report

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Abstract

The aim of this study was to describe the novel ultrasonographic findings obtained using B-mode ultrasonography and 2D Shear Wave Elastography of the ocular structures of a Scaly-headed Parrot (*Pionus maximiliani*) diagnosed with unilateral hypermature cataract. The bird was rescued by the Environmental Police after being removed from a municipal school. Ultrasonographic examinations were performed using only physical restraint associated with the instillation of a topical anesthetic eye drop. Both eyes were evaluated, beginning with the unaffected eye and subsequently the affected eye. B-mode ultrasonography enabled bilateral ocular biometric measurements and the identification of lens resorption and vitreous degeneration in the affected eye. Elastography allowed assessment of the stiffness of the cornea, anterior lens capsule, and lens in the healthy eye, as well as the cornea and lens capsule in the affected eye. Greater stiffness was observed in the evaluated structures of the healthy eye compared with the eye affected by hypermature cataract. These findings demonstrate that the combination of B-mode ultrasonography and elastography can be used as a non-invasive method for ocular evaluation in *Pionus maximiliani*.

Background

Psittaciformes, commonly known as parrots and parakeets, comprise a homogeneous order of birds consisting of more than 350 extant species distributed across approximately 84 genera (Collar 1997; Joseph et al. 2012). Brazil is widely recognized for its rich biodiversity and is considered the country harboring the greatest diversity of psittacine species in the world, with 87 recorded species (Pacheco et al. 2021; Spalding et al. 2026). These birds exhibit remarkable morphological characteristics, including a robust curved beak, zygodactyl feet, and a muscular prehensile tongue, adaptations mainly associated with food manipulation and locomotion (Forshaw 2010).

Ophthalmic evaluation in birds is of considerable importance, since the eyes play a fundamental role in maintaining essential functions such as flight capability, spatial orientation, rapid response to environmental stimuli, food acquisition, and reflex escape behaviors, making the integrity of the visual system indispensable for the survival of these species (Martin 2022). Among ocular disorders, cataract is one of the most frequently diagnosed conditions in parrots and is characterized by partial or complete opacification of the lens, resulting in progressive reduction of visual acuity (Hvenegaard et al. 2009).

B-mode ultrasonography, as a non-invasive, safe, and widely accessible imaging modality, has become an essential examination for the evaluation of the ocular globe in birds and other domestic animals, allowing adequate visualization of ocular anatomical structures (Mirshahi et al. 2014; Gialletti et al. 2018; Peschel et al. 2018; Kim et al. 2024). This technique provides relevant information regarding the aqueous humor, lens, vitreous body, and retina, assisting in the differential diagnosis of several ophthalmic disorders in birds (Gumpenberger and Kolm 2006; Lehmkuhl et al. 2010; Peschel et al. 2018).

In recent years, elastography has emerged as a complementary technique in the evaluation of numerous disorders in both human and veterinary medicine (Maronezi et al. 2022; Guo et al. 2023; Muzica et al.

2025). By assessing tissue elasticity and stiffness, this imaging modality expands the diagnostic capability of conventional ultrasonography. Although its application in avian ocular structures remains poorly explored, elastography may provide additional information regarding alterations of the lens and adjacent tissues, contributing to a better understanding of the underlying pathophysiological changes, especially in cataractous processes, as previously described in dogs (Abreu et al. 2021) and humans (Ozgokce et al. 2019).

Therefore, the present report aims to describe, for the first time, the B-mode ultrasonographic findings and the parameters obtained through 2D shear wave elastography in a green-rumped parrotlet (Pionus maximiliani) presenting unilateral cataract and vitreous degeneration, highlighting the applicability and relevance of these techniques in the ophthalmic evaluation of psittacine birds.

Case presetation

A Scaly-headed Parrot (*Pionus maximiliani*), weighing 265 g, was referred to the wildlife service of the Veterinary Hospital. The animal had been found by the Environmental Police in the courtyard of a municipal school presenting difficulty flying. During physical examination, the bird was apathetic and showed less than 5% dehydration. In addition, the left eye presented a whitish area within the pupillary region (Fig. 1), associated with absence of menace response, although the pupillary light reflex was preserved. The right eye appeared within normal limits (Fig. 1), with positive reflex responses and no pupillary abnormalities.

Considering the possibility of previous trauma, radiographic examination of the celomic cavity, wings, and pelvic limbs was requested, and no abnormalities were identified. Due to the patient's clinical condition, nutritional support was initiated with hand-feeding formula for birds (Alcon®), administered orally using a syringe, in addition to 1 mL of 50% glucose solution. After two days of nutritional management, the animal voluntarily resumed ingestion of fruits, vegetables, and pine seeds, demonstrating clinical improvement.

A fluorescein test was performed on the affected eye, yielding a negative result and ruling out the presence of a corneal ulcer. Due to the ocular alteration, the animal was referred for ultrasonographic evaluation of both eyes. Ultrasonographic images were obtained using an Aplio A ultrasound system (model CUS-AA000, Canon®) equipped with a multifrequency linear transducer (10–14.0 MHz). During the examination, the bird was physically restrained. The examination was performed in the horizontal plane with the aid of topical anesthetic eye drops followed by direct application of ultrasonographic gel onto the ocular surface.

In the right eye, it was possible to observe the cornea, anterior chamber, anterior lens capsule, lens, and vitreous body without abnormalities. B-mode measurements demonstrated a corneal thickness of 0.38 mm, anterior chamber depth of 1.22 mm, anterior lens capsule thickness of 0.44 mm, lens thickness of 3.25 mm, vitreous chamber depth of 6.61 mm, and axial globe length of 11.86 mm (Fig. 2). In the left eye, complete lens resorption was identified, with visualization only of the lens capsule, characterizing a

hypermature cataract. In addition, echogenic structures were observed within the vitreous chamber, consistent with vitreous degeneration (Fig. 2). B-mode measurements of the left eye revealed a corneal thickness of 0.35 mm, anterior chamber depth of 2.0 mm, lens capsule thickness of 0.32 mm, vitreous chamber depth of 10.70 mm, and axial globe length of 12.87 mm (Fig. 2).

After conventional ultrasonography, the ocular structures were further evaluated using 2D shear wave elastography. In the qualitative assessment, colored elastograms were obtained, in which blue areas represented more elastic tissues, green and yellow indicated intermediate stiffness, and red represented stiffer areas. Examination quality was assessed by the device, in which parallel and equidistant wave patterns indicated high technical quality. In the right eye, shear wave elastography demonstrated a mean corneal stiffness of 5.39 m/s, anterior lens capsule stiffness of 1.54 m/s, and lens stiffness of 2.19 m/s. In the left eye, the cornea presented a mean stiffness of 2.50 m/s, while the lens capsule demonstrated a mean stiffness of 1.11 m/s (Fig. 3). After 20 days of hospitalization associated with nutritional management, the animal gained 15 g of body weight and presented adequate flight performance, being considered fit for release into a native forest area.

Discussion and conclusions

This report describes, for the first time, the B-mode ultrasonographic findings related to cataract and vitreous degeneration in a Scaly-headed Parrot (*Pionus maximiliani*). Additionally, it was possible to obtain 2D shear wave elastography parameters of the cornea and lens capsule without the need for sedation, demonstrating the feasibility and potential of this technique as a complementary tool for non-invasive ophthalmic evaluation in psittacine birds. These findings contribute to expanding the current knowledge regarding the application of advanced diagnostic imaging methods in avian medicine, demonstrating their feasibility and clinical relevance without compromising the rehabilitation and subsequent release of the animals.

Cataract is considered one of the main ophthalmic disorders described in Psittaciformes and may significantly compromise visual acuity and, consequently, the quality of life of affected animals (Hvenegaard et al. 2009). In the present report, because the lesion was unilateral, no difficulties related to feeding behavior or flight ability were observed during the period of hospitalization and clinical management, despite the chronic nature of the condition. Although evaluations were not performed in *Pionus maximiliani* presenting different stages of cataract development, the authors believe that ultrasonographic examination has the capability to identify early lens alterations, enabling early diagnosis of the disease and assisting in the clinical follow-up and management of the lesion throughout its progression.

Ultrasonographic examination assists in the evaluation of lens impairment according to the stage of cataract progression in both humans and dogs, with a progressive increase in lens echogenicity being observed as the lesion becomes more severe (Ozgokce et al. 2019; Abreu et al. 2021). However, despite the possibility of ultrasonographic characterization of cataracts, in this animal it was not possible to

identify the lens, probably due to complete lens resorption secondary to a hypermature cataract, as previously described in humans (Tomar et al. 2025). Although it was not possible to determine the etiology of the cataract, the authors believe it was of senile origin, since the patient showed good recovery following clinical management. In addition, concomitant with the lens alteration, vitreous degeneration was observed, a finding frequently associated with the aging process in medicine (Ankamah et al. 2020).

During the B-mode ultrasonographic evaluation, differences in biometric measurements between the eyes were observed, particularly regarding the depth of the anterior chamber and vitreous body, with increased measurements identified in the eye affected by cataract when compared to the contralateral eye. The authors suggest that this divergence may be associated with lens resorption, which possibly led to the approximation of the anterior and posterior lens capsules, resulting in an apparent increase in the depth of the anterior chamber and vitreous segment.

Elastography has been described as a complementary technique in the evaluation of cataracts in dogs, assisting in the interpretation of lens stiffness alterations and in the differentiation of the distinct stages of disease progression (Abreu et al. 2021). In birds, to the best of the authors' knowledge, there are no reports describing the use of elastography as an auxiliary method for cataract diagnosis, nor studies involving the longitudinal evaluation of this condition. Although the present report involves only a single animal, it was possible to obtain high-quality images and measurements, suggesting that this technique may be applicable for ophthalmic evaluation in birds, including small-sized individuals.

Although normal lenses in dogs commonly present poor image quality and lack of color homogeneity, making elastographic evaluation difficult or even impossible (Abreu et al. 2021), in this bird it was possible to obtain adequate images for analysis, which may be related to the size of the ocular globe and the evaluated structures. When comparing the elasticity of the anterior capsule of the healthy eye with that of the affected eye, lower mean stiffness was observed in the compromised eye. This finding may be associated with the degenerative process of cataract formation, possibly related to structural disorganization and alterations in the biomechanical properties, leading to decreased tissue stiffness (Abreu et al. 2021).

Some limitations of this study should be considered, including the use of only one animal, which may not provide representative and reliable quantitative data for the species. In addition, the absence of previous clinical information regarding the patient limited the comparative evaluation of the current findings, both in relation to the B-mode ultrasonographic examination and the quantitative parameters obtained through elastography. Another relevant limitation was the lack of other individuals of the species Pionus maximiliani presenting different stages of cataract, which prevented a comparative analysis of the progression of tissue stiffness alterations and ultrasonographic features observed throughout the distinct phases of the disease. Nevertheless, ultrasonographic examination associated with advanced techniques allowed a detailed and non-invasive ophthalmic evaluation of a Scaly-headed Parrot, subsequently favoring the release of the animal back into the wild.

Declarations

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Competing interests

The authors declare no competing interests

Author contributions

M.P.L.S.M, A.F.A, L.C.C, M.E.B.S.S, D.V.S, A.N.M and R.K.C: Conceptualization, Formal Analysis, Investigation, Methodology, Writing - original draft preparation. R.K.C: Supervision, Project administration, Writing - review and editing. All authors have read and approved the final version of the manuscript.

Data availability

No datasets were generated or analysed during the current study.

Ethics approval

Not applicable, since the bird was evaluated during routine diagnostic procedures for the clinical investigation of cataract.

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Figures

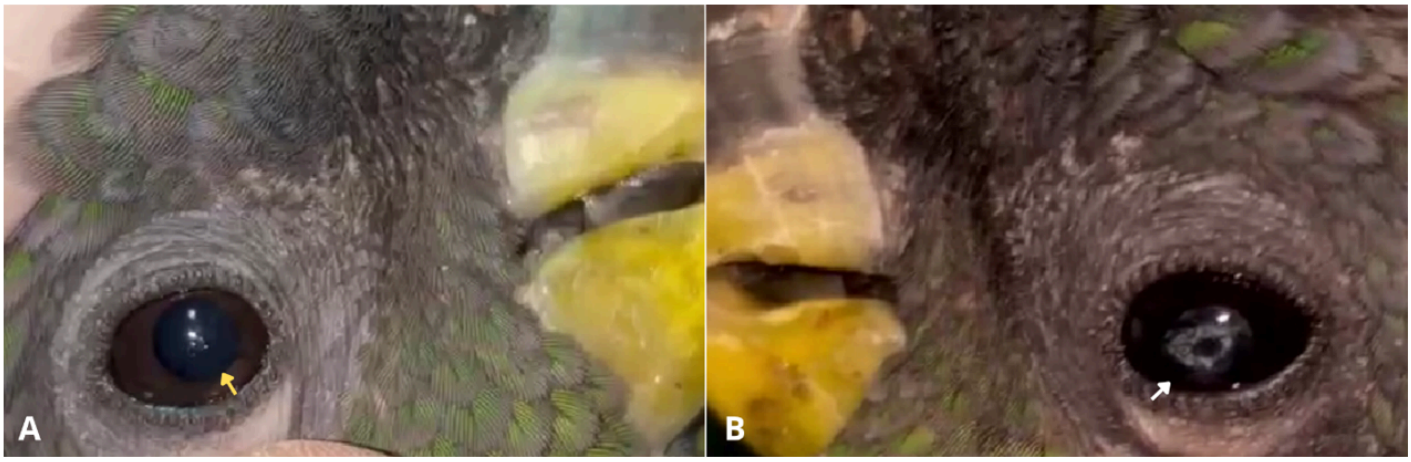


Figure 1

Eyes of a Scaly-headed Parrot (*Pionus maximiliani*), in which the right eye (A) appears normal (yellow arrow), while the left eye (B) shows a whitish area in the pupillary region (white arrow).

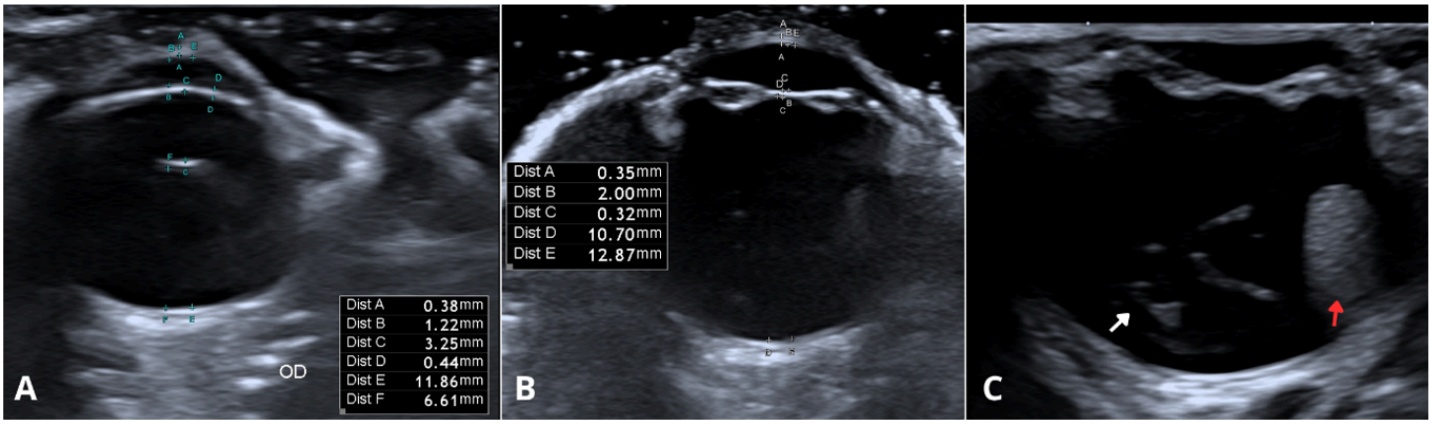


Figure 2

Ophthalmic ultrasonographic evaluation of a Scaly-headed Parrot. In “A”, the healthy right eye (OD) is shown, with a corneal thickness of 0.38 mm (Dist A), anterior chamber depth of 1.22 mm (Dist B), lens thickness of 3.25 mm (Dist C), anterior lens capsule thickness of 0.44 mm (Dist D), axial globe length of 11.86 mm (Dist E), and vitreous chamber depth of 6.61 mm (Dist F). In “B”, ultrasonography of the left eye affected by hypermature cataract is shown, with a corneal thickness of 0.35 mm (Dist A), anterior chamber depth of 2.0 mm (Dist B), lens capsule thickness of 0.32 mm (Dist C), vitreous chamber depth of 10.70 mm (Dist D), and axial globe length of 12.87 mm (Dist E). C) Identification of vitreous degeneration (white arrow) and the ocular pecten (red arrow) in the left eye.

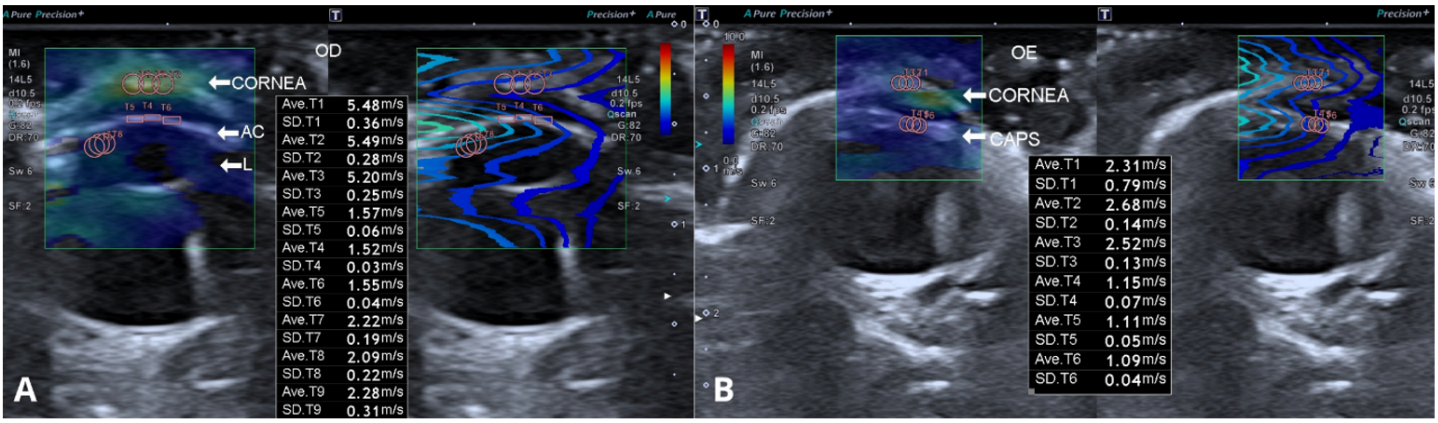


Figure 3

2D Shear Wave Elastography of ocular structures in a Pionus maximiliani. (A) Healthy right eye (OD), showing mean stiffness values of 5.39 m/s for the cornea (CORNEA), 1.54 m/s for the anterior lens capsule (AC), and 2.19 m/s for the lens (L). (B) Left eye (OE) affected by hypermature cataract, demonstrating mean stiffness values of 2.50 m/s for the cornea (CORNEA) and 1.11 m/s for the lens capsule (CAPS).