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Preliminary Investigation of the Ocular Macroscopic Structure of a Bowmouth Guitarfish (*Rhina ancylostoma* Bloch & Schneider 1801)

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Abstract

The present study is a preliminary investigation of the macroscopic structure of the eye and its adnexa of a female two-year-old bowmouth guitarfish, *Rhina ancylostoma* Bloch & Schneider 1801, from which very limited information is available. We documented the characteristics of the cornea, the eyeball, the optic pedicle and the extraocular muscles. We also compared the sizes of the horizontal and vertical extraocular muscles and speculated that they were more similar to elasmobranch species that reside near the seafloor. The cornea of the guitarfish also resembled that of the elasmobranch in the ray family.

Keywords: *Rhina ancylostoma* Bloch & Schneider 1801; Ocular anatomy; Elasmobranch; *Chondrichthyes*

Introduction

Bowmouth guitarfish is one of the rare and endangered aquatic species [1] in class *Chondrichthyes*, subclass *Elasmobranchii*, which includes sharks and rays (Batoidea), order Rajiformes, and the only species in the family Rhinidae and genus *Rhina* [2]. Its habitats include the Indian and the Pacific oceans and have been reported from Australia to the south of the Arabian Peninsula. An adult guitarfish can measure up to 2.7 m and weigh 135 kg. Its most prominent features are thorny ridges on its dorsum (one median ridge and two lateral ridges). There are also two pairs of small ridges; one pair craniomedial to the lateral ridges and the other pair caudal to the lateral ridges [3]. Its torso resembles that of a shark, hence another common name "shark ray". The eyes are located within eye sockets immediately below the cranial end of each lateral ridge. There is also a clearly defined spiracle caudal to the eye socket, which connects to the oral cavity [4].

The objective of this study is to document the macroscopic features of the eye and its adnexa of a rare *Rhina ancylostoma* Bloch & Schneider 1801. Despite the poor condition of the specimen, which had been frozen prior to the necropsy, the authors feel that the findings are somewhat valuable since there is very little documentation concerning such unique species. Some basis from this study may shed light into other related aquatic species for further investigation.

Materials and Methods

A female, approximately two years old, bowmouth guitarfish (*Rhina ancylostoma* Bloch & Schneider 1801) specimen was presented to the pathology unit at Chulalongkorn University Faculty of Veterinary Science. The fish was primarily stranded at a shore in Rayong province, which is part of the Gulf of Thailand before taken to the nearby aquatic centre but died after a few days. The fish was then frozen and transported to the pathology unit where post mortem was performed.

Both eyeballs and their adnexa were excised and fixed in 4% paraformaldehyde at room temperature overnight before investigation of the ocular structures. The vertical and equatorial dimensions were measured using veneer calibre and photographed.

Results and Discussion

The bowmouth guitarfish eyeball appeared spherical. The loose skin surrounding the eye socket also covered and attached to the conjunctiva around the cornea to form incomplete eyelid, which is one of the characteristics of Elasmobranch [5]. The cornea was rectangle with elliptical rounded corners, and dorsal invagination due to the ventrally curved indentation of the rough sclera (Figure 1). There appeared to be pupillary operculum structure ventral to this curve, resemble those of batoids [6]. The sclera was composed of cartilage cup with a thick area caudally where the optic pedicle anchored by connective tissue (Figure 2). The optic pedicle, a thick rectangular cartilaginous process connecting the eyeball to the orbit, lay in an angle to the vertical axis from medial to the insertion of the dorsal rectus to lateral to the insertion of the ventral oblique muscle. The optic nerve projected caudally from the optic disc, laterally to the lower end of the optic pedicle. The six extraocular muscles varied in sizes. The ventral oblique muscle appeared the largest, followed by dorsal oblique. Tomita et al. [7], studied the extraocular muscles in a giant guitarfish and speculated that the oblique muscles played an important role in retraction of the eyeball, hence a protective mechanism to protect the eye. This mechanism is different from other vertebrates such as marine mammals and amphibians, which use the retractor bulbi muscles for ocular retraction [8,9]. Dorsal, medial and lateral rectus muscles were similar in size, slightly smaller than the dorsal oblique, and the ventral rectus was significantly smaller than the others (Figure 3). These findings were comparable to those previously described in two elasmobranch species, which hypothesised that horizontal eye muscles in seafloor dwelling sharks i.e., the same habitat as *Rhina ancylostoma,* were smaller than vertical eye muscles whereas deep sea dwellers, pelagic dogfish, had larger horizontal eye muscles to accommodate three dimensional visual fields [10].

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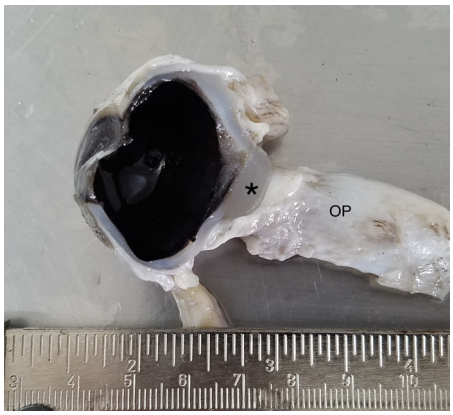

Figure 1: The elliptical rectangular cornea of the guitarfish, with possible pupillary operculum ventral to the dorsal indentation of the sclera.

Figure 2: Crossed sections through the vertical geometric centre of the eye. The optic pedicle (OP) anchored to the posterior pole of the eyeball where the scleral cartilage was thickened (*).

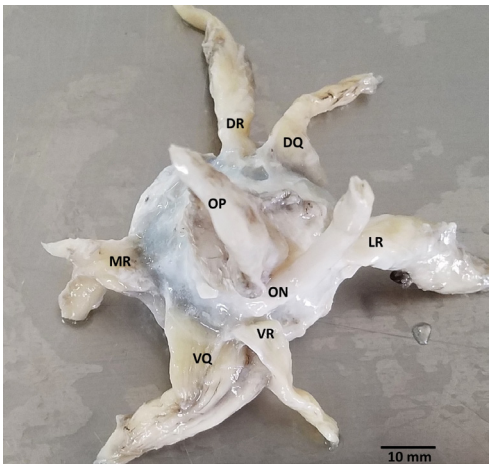

Figure 3: Six extraocular muscles arranged around the Optic Nerve (ON) and the Optic Pedicle (OP) at the posterior pole of the eyeball. DQ: Dorsal Oblique; VQ: Ventral Oblique; DR: Dorsal Rectus; VR: Ventral Rectus; MR: Medial Rectus; LR: Lateral Rectus.

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