DOI: https://doi.org/10.53350/pjmhs22166739

ORIGINAL ARTICLE

Comparative Study Between Eye Retina of Falcon (Falco Columbarius) and Owl (Bubo Bubo)

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ABSTRACT

The eye is one of the most important sensory systems in the body because of its importance and it plays an important role in communication between animals and their environment. In recent study collect ten eye of falcon and ten eye of owl from Najaf desert during April 2020 to March 2021. By using Hematoxylin and Eosin staining (H&E) have been obtained sections of retina of falcon (Falco columbarius) and owl (Bubo bubo) which consist of ten layers, we measured thickness of three layers for both birds and have got differences between them. Falcon has less thickness layers from owl but there are different in retinal ganglion layers, in falcon which have surface area more than owl. That's depended to nature of life which falcon and owl have.
Keywords: retina, retinal layers, falcon and owl.

INTRODUCTION

The eye is one of the most important sensory systems in the body, and it is crucial for animals to communicate with their environment (Moore et. al., 2017). Invertebrates' eyes are easy to structure since they function to discern between light and dark environments, but vertebrates' eyes (fish, amphibians, reptiles, birds, and mammals) are more sophisticated because they enable extremely sensitive vision.

In terms of basic composition, all birds' eyes are identical, but there are a few differences that reflect their environmental needs (Olsson, P., 2016). The three tunics from the outside to the inside, the fibrous tunica, which is dense and fibrous, and the cornea, which is avascular and transparent, are comparable to those of other vertebrates, while the sclera, which is thick and opaque, is similar to that of other vertebrates (Ali, 2016).

The eyes are a complex organ with the primary function of collecting and focusing light onto the photosensitive retina (Altunay, 2004).

In most vertebrates' eyes, the retina (Latin: rete "net") is the light-sensitive innermost layer of tissue. The optics of the eye create a two-dimensional focused picture of the visual world on the retina, which is converted into electrical nerve impulses and transferred to the brain to give visual perception. The retina functions similarly to a camera's film or image sensor. The neural retina consists of numerous layers of neurons connected by synapses and supported on the outside by a layer of pigmented epithelial cells. (William,2005).

Birds, particularly birds of prey, have well-known retinal architecture. Although the retinal layers are organized similarly in birds and other vertebrates, the architecture of the retina, the areas of maximal visual acuity, and retinal vascularization varies significantly (Jones et al., 2007).

MATERIALS AND METHODS

Animal Anatomy: The birds were sedated with chloroform, and the feathers were cut using scissors. The skull was then fractured with a cutter, and the skull bones were carefully separated and removed with delicate forceps and sharp scissors, cutting the associated nerves with the brain, then the eye was removed from the orbit by removing a portion of the optic nerve by sharp scissors (Al-Nakeeb and Jasim, 2018).

Slides Preparation: The slides were prepared in the following procedures, according to Al-Attar et al. (1982): Fixation, Dehydration, Clearing, Infiltration and Embedding, Trimming and Sectioning, and Hematoxylin and Eosin staining (H&E).

RESULT AND DISCUSSION

Retina of both birds consists of ten layers (from outside to inside) 1- epithelium layer. 2- layer of rods and cones 3- the restricting membrane on the outside. 4- the nuclear layer on the outside 5- a plexiform layer on the outside 6- nuclear layer on the inside 7- internal plexiform layer 8- ganglionic cells layer 9- nerve fiber layer 10- internal limiting membrane figure (1 and 2).

We have been measured thickness only three layers of retina of each bird (rods and cones layer, outer nuclear layer and ganglion cell layer), in falcon, rods and cones layer have thickness (131± 0.48305 µm), outer nuclear layer (100± 0.48305 µm) and ganglion cell layer (40± 0.48305 µm).

In owl, rods and cones layer have thickness (177± 0.48305 µm), outer nuclear layer (135± 0.48305 µm) and ganglion cell layer (46± 0.48305 µm).

Our finding, all three layers which measured of falcon is less thickness from owl, but there are differences among surface area of retinal layers of falcon and owl, we note surface area of rods and cones layer and outer nuclear layer for falcon are less than owl while the surface area of ganglion cell layer in falcon is more than owl, Table (1).

Differences between falcon (diurnal bird) and owl were discovered in our research (nocturnal bird). We were able to quantify and measure the thickness of three layers (cone and rod layer, outer nuclear layer, and ganglion layer) using a light microscope with hematoxyline and eosin staining, and the results were similar to study published in 2017 (Alix et. al., 2017).

Table 1: show thickness and Surface area of three layers of falcon and owl retina. Our result show thickness and surface area of rods and cones layer of owl were more than falcon, also thickness and surface area of outer nuclear layer were more than falcon. While ganglion cell layer in owl was thicker than in falcon, but surface area of ganglion cell layer in falcon was more than owl.

Falcon retina	rods and cones layer	Thickness(µm)	131± 0.48305
		Surface area (10000 µm2)	7.9± 0.87560
	outer nuclear layer	Thickness(µm)	100± 0.48305
		Surface area (10000 µm2)	16.5. ±052705
	ganglion cell layer	Thickness(µm)	40± 0.48305
		Surface area (10000 µm2)	3.2±0.78881
Owl retina	rods and cones layer	Thickness(µm)	177± 0.48305
		Surface area (10000 µm2)	18.6±1.26491
	outer nuclear layer	Thickness(µm)	135± 0.48305
		Surface area (10000 µm2)	18.5000±1.08012
	ganglion cell layer	Thickness(µm)	46± 0.48305
		Surface area (10000 µm2)	2.0 ±0.0000

In 2011, we conducted comparison research of nocturnal and diurnal birds (owl and hawk) and came to the same conclusions ((). 2011). Because of their adaptability to their visual environs, nocturnal animals are more active when light levels are low, but diurnal animals are not limited by light availability (Land & Nilsson, 2002).

In another study, researchers compared the thickness of retina ganglion layers (RGL) in a variety of owl species. They

discovered that the thickness of RGL varies between species (Lisney, Iwaniuk, Bandet, Wylie, & evolution, 2012).

Improved light sensitivity but poor visual acuity would come from increased retinal summation, or the number of photoreceptors per retinal ganglion cell (Corfield, 2009; Rojas et al., 2004)

Many bird species have areas of the retina with a higher density of functioning photoreceptors and a greater proportion of cones than rods. (Samuelson, 1991). Also, our results match with other study which proved retina of falcon was consist of ten layers and have greater ganglion cell layer and outer nuclear layer beside to one row of photoreceptors (Al-Robaae, 2012).

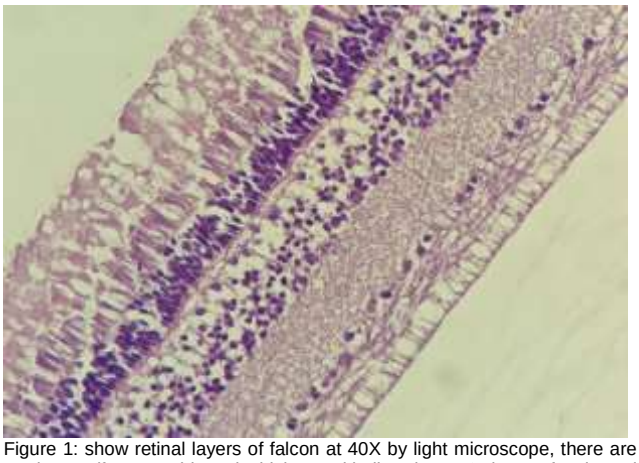

Figure 1: show retinal layers of falcon at 40X by light microscope, there are ten layers (from outside to inside) 1- epithelium layer. 2- layer of rods and cones 3- the restricting membrane on the outside. 4- the nuclear layer on the outside 5- a plexiform layer on the outside 6- nuclear layer on the inside 7- internal plexiform layer 8- ganglionic cells layer 9- nerve fiber layer 10- internal limiting membrane.

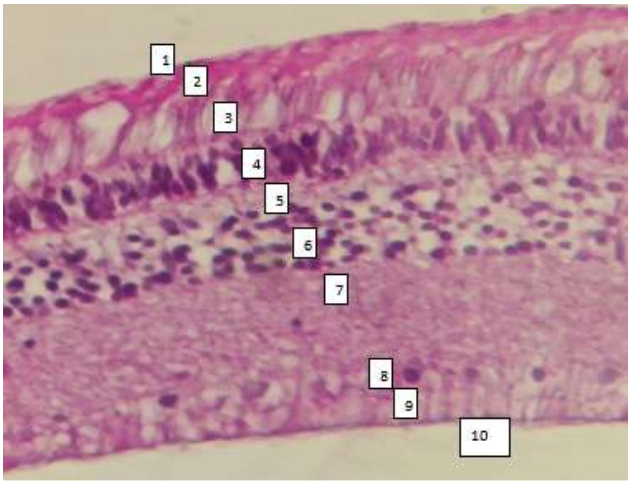

Figure 2: show retinal layers of owl at 40X by light microscope, there are ten layers (from outside to inside) 1- epithelium layer. 2- layer of rods and cones 3- the restricting membrane on the outside. 4- the nuclear layer on the outside 5- a plexiform layer on the outside 6- nuclear layer on the inside 7- internal plexiform layer 8- ganglionic cells layer 9- nerve fiber layer 10- internal limiting membrane.

CONCLUSION

Our opinion depending our results and other studies, falcon have low concentration of photoreceptors when compare it with owl, because of nature of living of both birds. During night, owl need to high concentration of photoreceptors to capture light, and have high rods more than cones cause to highly sensitive to dark inapposite cones which be responsible for color vision would be not needed like falcon which have cones more than rods depending on that living style. In contrast, outer nuclear layers for owl are more than falcon which be depending on density of rods and cones because this layer have nuclei of photoreceptors, so this differentiation due to numbers of these cells.

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