THE MORPHOLOGY AND MORPHOMETRY OF THE PECTEN OCULI IN DIURNAL AND NOCTURNAL BIRDS: A COMPARATIVE STUDY

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SUMMARY

The pecten oculi of two diurnal birds the Black Kite (*Milvus migrans*) and the Domestic Fowl (*Gallus gallus domesticus*) and one nocturnal bird, the Spotted Eagle Owl (*Bubo africanus*) were investigated by light microscopy, scanning and transmission electron microscopy and the tissue components analyzed by applying morphometric techniques. The pecten in these three species was of the pleated type and projected freely into the vitreous humour in the ventral half of the eye at the point of exit of the optic nerve.

Basically the pecten oculi consisted of blood vessels, interstitial pigmented cells and a superficial membrane. The pecten oculi of the Black Kite was the largest in volume and surface area although after normalizing these parameters with eye weight, the volume was comparable to that of the pecten of the Domestic Fowl. The pecten of the nocturnal Spotted Eagle Owl was the smallest in volume and surface area when compared with the two diurnal species, the Black Kite and the Domestic Fowl. The pecten oculi of the Domestic Fowl had the highest number of pleats (17-18) although it had a lower surface area than that of the Black Kite with fewer pleats (12-13). Generally the pecten of the Spotted Eagle Owl was the least developed with very few pleats (5-6) and of very small size relative to the size of the eye.

Although in all the three species the pecten consisted of a highly vascularised and pigmented pleated lamina covered with a superficial membrane, the structure of the pecten and distribution of pigments was unique to each species. Whereas in the Spotted Eagle Owl the pectineal folds were almost uniformly covered by pigment from the base to the apex, in the Black Kite pigmentation was most intense at the apical half and less so in the basal half. There was a characteristic paucity of pigmentation on the pectineal folds of the Domestic Fowl, although the pigmentation was generally higher apically than basally in the Domestic Fowl. At the apical end of the pecten in the Black Kite and the Domestic Fowl, the pleats were held together by a highly pigmented tissue (bridge) that run across their tips but in the Spotted Eagle Owl the pleats merged at their apical end and no bridge was observed. Arterioles with attenuated endothelium gave rise to an exceedingly dense anastomosing capillary network. The cell membrane of the capillary endothelium was thrown into microfolds both luminally and basally. On the luminal surface, the capillary endothelium displayed an extensive array of interdigitating, branching and closely disposed microplicae that projected into the capillary lumen to form a complex pattern of plications with no definite orientation with reference to the longitudinal axis or transverse plane of the capillary. These cell membrane infoldings were most

pronounced in the Black Kite, moderately so in the Domestic Fowl and least pronounced in the Spotted Eagle Owl. This probably indicates a lowered activity of the pecten of the nocturnal Spotted Eagle Owl as compared to that of the diurnal Black Kite and the Domestic Fowl. The endothelial cells were joined by tight junctions and their cytoplasm contained a moderate number of mitochondria and pinocytotic vesicles. All the capillaries were surrounded by a thick fibrillar perivascular membrane which was thought to be important for structural support and in acting as a semi-permeable membrane. Pericytes were a common feature, and were located within the thickened perivascular membrane. The capillary lamina was drained by venules. The endothelium of the venules resembled the blood capillary endothelium except that in venules, the endothelial cell membrane infoldings were conspicuously low. Overlying and within the vascular network, a close association between blood vessels and melanin-bearing melanocytes was evident. It is conjectured that such an association may be involved in augmenting the structural reinforcement of the pecten in order to keep it firmly erectile within the gel-like vitreous humour. Such erectility may be an essential prerequisite for optimal functioning of the pecten. The melanin granules may also be acting as a protective shield against the effects of ultraviolet light, which otherwise might lead to damage of the pectineal vessels.

On the external surface of the superficial membrane of the pecten of the Domestic Fowl but not in the Black Kite and the Spotted Eagle Owl were located macrophage-like cells, the hyalocytes.

The system of blood vessels in the pecten of the diurnal Black Kite and the Domestic Fowl respectively accounted for 67.70% and 66.92% of the entire volume of the pecten while in the nocturnal Spotted Eagle Owl the value was 62.58%. The pigmented intervascular tissue constituted the rest of the pecten 32.30% (Black Kite), 33.08% (Domestic Fowl) and 37.42% (Spotted Eagle Owl). The pectineal capillary luminal surface area was highest in the Black Kite and lowest in the Spotted Eagle Owl but on normalizing the values with eye weight, the Domestic Fowl pecten gave the highest capillary luminal surface area. The arithmetic mean blood vitreous barrier thickness was significantly higher in the Spotted Eagle Owl than in the Domestic Fowl. However, the arithmetic mean blood vitreous barrier thickness was not significantly different in the Black Kite and the Spotted Eagle Owl. The harmonic mean blood vitreous barrier thickness was significantly greater in the Spotted Eagle Owl than in the Domestic Fowl and the Black Kite, and greater in the Black Kite than in the Domestic Fowl. The greater arithmetic and harmonic mean blood vitreous barrier thickness in the Spotted Eagle Owl was due to the relatively high pigmentation of the pecten oculi in this species. It is

conjectured that the size of the pecten is dictated by the functional need and the critical space it can occupy in the eye without interfering with optical function of the eye, a fact that is borne out by the near constancy of the proportions of the pectineal component in the three species studied.

From the morphological and morphometric observations made on the pecten of the species investigated in this study, it is concluded that the design of the pecten oculi strongly suggests that it is heavily involved in transport of materials from it to the vitreous and vice versa.