ANATOMICAL STUDY OF THE CILIARY BODY

THESIS

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UNDER THE SUPERVISION OF

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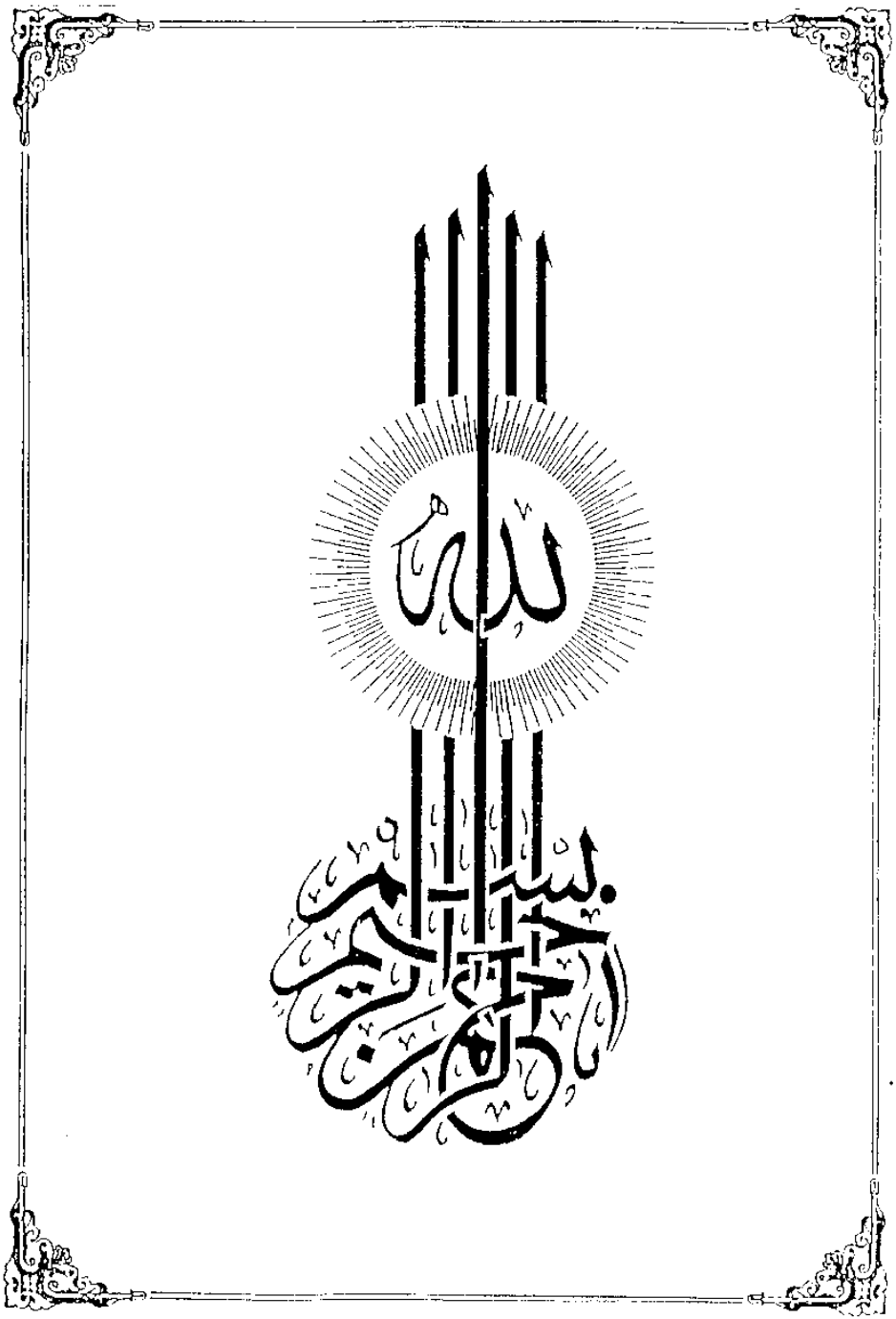

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C O N T E N T S

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HISTORICAL INTRODUCTION

The ciliary body was known to the earliest anatomists , even before the time of Galen . It was named after cilia , on account of a supposed origin from and resemblance to the eye lashes. Vesalius (1543) , who assumed that the lens lies in the middle of the eye , considered this structure as a boundary dividing the eye into two equal halves . Eustachius (1560) , who rejected the term " Vesalian tunic " , described the ciliary processes as a connection between the choroidal tunic and the crystaline lens . Its function gave rise to speculation . Eustachius (1560) , Drew and Boerhaave (1708) described the presence of muscle fibres and it was vaguely associated with the adjustments necessary for accommodation or the movements of the iris . Albrecht von Haller (1757 - 66) considered that it acted as a support for the lens ; while Ribes (1814) suggested that it was responsible for the secretion of the aqueous humour [Duke-Elder , 1961] .

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GROSS ANATOMY

In the living eye the ciliary body can be located by measurement . The anterior insertion is at the scleral spur , which is about 1.5 mm. posterior to the corneolimbal junction . The posterior limit is at the ora serrata , 7.5 to 8.0 mm. From the limbus on the temporal side , 6.5 to 7.0 mm. on the nasal side, and 7.0 superiorly and inferiorly .

Anteriorly the ciliary body forms part of the posterior surface of the anterior chamber angle . On the anterolateral side it is attached to the scleral spur and is joined by bands from the trabecular meshwork . The iris is attached to its anteromedial side. The ciliary body and iris , therefore , form the posterior surface of the anterior chamber angle ; the ciliary body forms the angle through its connection to the trabecular meshwork and scleral spur.

On the lateral side the ciliary body is connected to the sclera by the supraciliary lamellae . The supraciliary space , lies between these two layers . Posteriorly on the lateral side are the long posterior ciliary arteries and nerves . Anterior to the rectus muscle insertions , the anterior ciliary arteries pierce the sclera and enter the outer ciliary body to form the major circle of the iris. A ciliary nerve branch (the nerve loop of Axenfeld) often passes through the sclera to the surface from the supraciliary space in the pars plana region , then loops back through the sclera into the supra-ciliary region .

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The posterior chamber is medial to the ciliary body in the region of the pars plicata , and the zonules and vitreous are medial to it in the pars plana region . The lens is close to the ciliary processes , being separated from them by an area containing the zonules and their surrounding vitreous matrix . The zonules arising from the posterior pars plana lie close to the ciliary epithelium through much of their course and are in intimate relation to each other in the valleys between the ciliary processes .

Posteriorly the junction of the ciliary body with the choroid does not form a distinct boundary . The dentate processes of the retinal ora serrata terminate rather abruptly in the unpigmented ciliary epithelium at the posterior border of the ciliary body .

The ciliary body is a circular structure , conforming on its outer aspect to the curvature of the sclera and presenting a somewhat triangular shape in cross-section . The base of the triangle faces the anterior chamber and the apex is at the ora serrata . The inner surface presents two zones , the corrugated pars plicata anteriorly and the smoother pars plana posteriorly (Fig. 1) . The inner surface is free , whereas the outer surface is joined loosely to the sclera by long ribbon-like processes . The antero-posterior length of the ciliary body is shorter nasally , where it has a dimension of 4.5 to 5.2 mm. , its least length is in the upper nasal area . The ciliary body is longer temporally , where it measures

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Fig. (1) : Low power view of ciliary body . Arrow indicates region of pars plicata ; P, region of pars plana; S , sclera ; AC , anterior chamber (x 50) . (Quoted from Peyman et al. 1980) .

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5.6 to 6.3 mm. , the length being greatest inferiorly and temporally.

The inner surface of the ciliary body has a dirty grey color , owing to the pigment in the outer layer of the ciliary epithelium . Epithelial cysts are often found along this surface , especially in the pars plana of older eyes . Cysts of a congenital type are also common in the anterior pars plicata portion .

The ciliary body commonly is subdivided into two portions , the pars plana (orbiculus ciliaris) , and the pars plicata (Corona ciliaris) . The pars plana is about 3.5 to 4.0 mm. long and extends from the choroid -retinal termination to the posterior edge of the ciliary processes . At the posterior margin of the pars plana the retina terminates in the unpigmented epithelium of the ciliary body in a serrated fashion . The apices of the serrations are known as teeth or dentate processes , and the intervening scalloped zones are called bays . The termination of the retina is more distinct at the apices of the teeth , and linear markings (ciliary striae of Schultze) continue from the apices forward over the surface of the ciliary body into the valleys between the ciliary processes . The posterior zonules arise from the inner ciliary body about 1.5 mm. anterior to the termination of the retina , their zone of origin having a width of about 1.5 mm. The base of the vitreous is also attached to the posterior ciliary epithelium , with its zone of attachment extending forward over the epithelium 1.5 to 2.0 mm. from

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the ora serrata . Posterior to this, the vitreous base attaches to the inner retina .

The pars plicata (Fig. 2) has a meridional width of about 2 mm. It is so named because of the presence of about 70 to 80 prominent folds, the ciliary processes , which are oriented in a meridional direction and separated from each other by deep valleys. The processes are fairly symmetrical around the circumference of the ciliary body , but differ somewhat in their configuration and size , some being large and long , others small and short . The processes measure around 2 mm. in length and 0.5 mm in width . Their height is about 0.8 to 1.0 mm. but there are large variations in all dimensions . In the valleys between the processes are intermediate processes .

A cross-section of the ciliary body reveals the differences in architecture between the pars plicata and the pars plana . The former is much thicker , the latter tapers from anterior to posterior, where it meets the choroid and retina . The pars plicata is readily divisible into an outer muscular portion and an inner portion containing the stroma and processes . The pars plana shows a thick muscular and much thinner stromal and epithelial portion . The ciliary processes lengthen and become taller with increasing age (Reese , 1934) .

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Fig. (2) : High magnification light micrograph of the ciliary body . Major ciliary processes (a) and smaller accesory or intermediate processes (b) . The paras plana (c) , scalloped bays (d) and dentate processes (e) are shown . Striae or linear markings (f) extend towards the valleys of pars plicata (arrow) .
(Quoted from Hogan et al. 1971) .

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MINUTE ANATOMY

In its general structure the ciliary body is a continuation forwards of the choroid and retina . It is formed, from without inwards , from the following layers : (1) supra-choroidal lamina or " supraciliaris " (2) ciliary muscle (3) stroma . (4) the epithelium. (pigmented and non pigmented) (5) The internal limiting membrane.

1. Supraciliaris :

The supraciliary portion of the ciliary body is composed of pigmented ribbon-like layers of connective tissue which arise from the longitudinal portion of the ciliary muscle . They course outward from their origin at various angles to become continuous with the sclera . If the ciliary body is separated from the sclera these ribbons remain attached to the ciliary body, leaving their tag ends on the sclera . If fluid accumulates in the supraciliary region , the layers become more distinct in microscopic sections. Ganglion cells are common in this area, especially in the region of the pars plana .

The bands of the supraciliary lamellae are composed of collagen of the usual type . Melanocyres and fibroblasts are enmeshed in this collagen , with no real endothelium covering their outer surfaces . At the juncture with the ciliary body , the collagen and cells are continuous with the connective tissue of the ciliary muscle . Under the sclera they blend with the collagen of the inner sclera .

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2. The Ciliary Muscle :

The ciliary muscle in a meridional section has the form of a right-angled triangle , the right angle being internal and facing the ciliary processes . The posterior angle is acute and points to the choroid , the hypotenuse runs parallel with the sclera. The form of the whole ciliary body depends on that of the muscle , which consists of flat bundles of non straiated fibres , the most external being longitudinal or meridional, the intermediate fibres oblique or radial , the most internal being circular or " sphincteric " (Fig. 3) . The concept that the ciliary muscle is considered to have three portions , meridional , radial and circular has been disputed , mainly by Rohen (1964), who thinks there is little justification for dividing the muscle into three parts . Rohen believes that the whole muscle is interconnected , the muscle bundles forming a three-dimensional reticulum with considerable interweaving of the muscle cells from layer to layer. Externally in the longitudinal or meridional portion , the muscle cell bundles cross at acute angles , creating a narrow meshwork . In the mid portion (radial muscle)bundles cross at less acute angles to form a wider mesh , in the inner portion (circular portion) , the muscle groups cross at very wide angles . The pattern of crossing of the muscle bundles at various levels differs because of the considerable interweaving from

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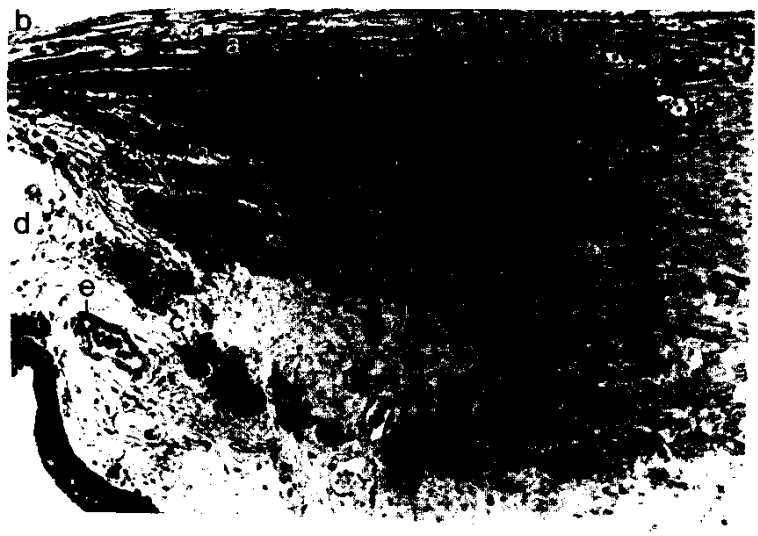

Fig. (3) : Ciliary muscle , meridional section . The longitudinal ciliary muscle (a) scleral spur (b) . The circular muscle (c) is near the anterior chamber angle (d), and the major arterial circle of the iris (e). Some emissaries of this artery (f) are seen near the radial muscle (g). (x 200) .
(Quoted from Hogan et al. 1971) .

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