
UNIT 3 ANATOMY OF THE MIDDLE COAT OF THE EYEBALL

Structure

- 3.0 Objectives
- 3.1 Introduction
- 3.2 Anatomy of Uveal Tract
 - 3.2.1 Anatomy of Iris
 - 3.2.2 Anatomy of Ciliary Body
 - 3.2.3 Anatomy of Choroid
- 3.3 Anatomy of Anterior and Posterior Chambers
- 3.4 Let Us Sum Up
- 3.5 Answers to Check Your Progress

3.0 OBJECTIVES

By the end of this unit, you should be able to understand:

- anatomy of middle layer of eyeball which consists of iris, ciliary body and choroid;
- various functions of different parts of middle coat; and
- brief anatomy of different chambers of eyeball.

3.1 INTRODUCTION

In the earlier units you have learnt about the embryology of eye and structure of the eyeball as a three layered structure. In previous unit you have studied about the structure of outer coat of eyeball—conjunctiva, cornea and sclera. In this unit you will learn about the anatomy of middle coat of the eyeball, i.e., iris, ciliary body and choroid. Together with these, you will study the structure of anterior and posterior chambers.

3.2 ANATOMY OF UVEAL TRACT

As already discussed, eyeball is a three layered structure. The middle coat of eyeball consists of iris, ciliary body and choroid. The main function of this layer is nourishment to the inner coat and other internal structures of the eyeball. The iris and ciliary body also helps in the process of vision. As the middle layer structures are highly vascular, these structures are more prone to damage because of any infective and inflammatory condition.

Uveal tract consists of three parts:

- 1) Anterior— Iris
- 2) Middle—Ciliary Body
- 3) Posterior—Choroid

3.2.1 Anatomy of Iris

Iris is the most anterior part of the uvea. It is a thin, membrane like structure.

- Situation: Situated in frontal plane of the eye between the anterior and posterior chambers of eyeball.
- Relation to ciliary body: Iris is attached to the ciliary body. At the point of attachment, the iris is thin and is known as root of iris. As it is thin, this part of iris is more prone to damage.
- Diameter: 12 mm approximately
- Circumference: 38 mm approximately
- Thickness: At the collarette: thickest: 0.6 mm.
At the root: thinnest: 0.5 mm
- Pupil: The central opening of the iris is called pupil.
- Size of the Pupil: Size of pupil is never constant. When light falls on the eye pupil contracts and size of the opening decreases. In dark conditions, the size of pupil increases. Main function of pupil is to control entry of light into the eye.
- Relation to Lens: The posterior surface of the iris is in touch with the anterior surface of the lens. Posterior support of iris is given by the lens. When the lens is removed, iris loses its posterior support and become flat.
- Colour of Iris: Colour of iris is chiefly determined by the amount of melanocytes in the iris. When the melanocytes are more the colour of the iris is brown. When concentration of melanocytes are less the colour of the iris is blue.
- Anterior Surface of iris : Usually anterior surface of iris is not smooth. Specific structures at the anterior surface of iris:

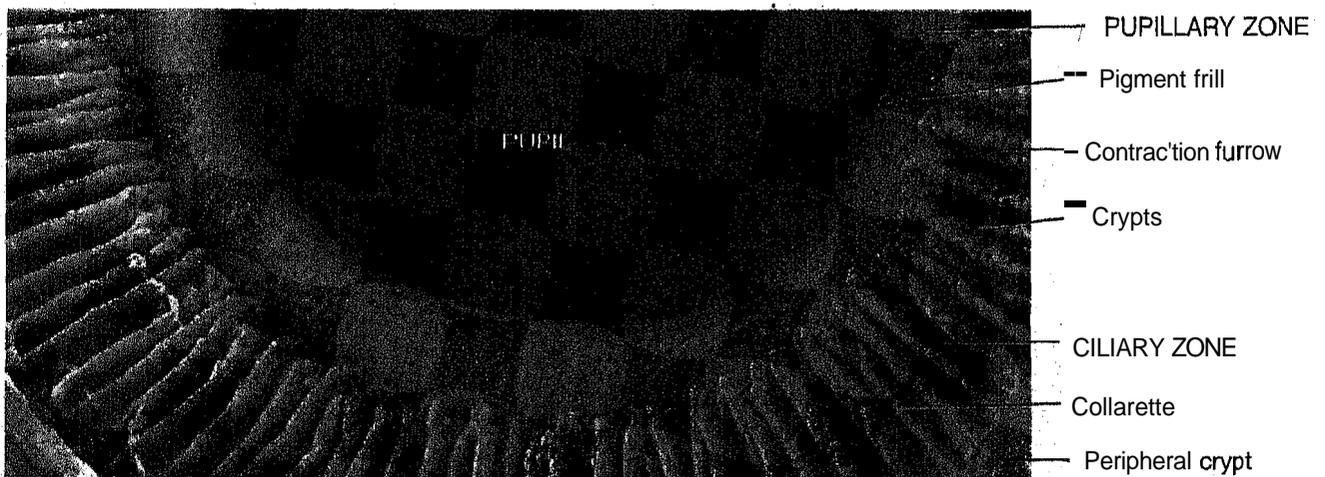


Fig. 3.1: Gross appearance of anterior surface of the iris

Collarette: Collarette consists of a series of trabeculae forming interrupted ridges on the anterior surface of iris. It is situated about 1.6 mm from the papillary margin and divides the anterior surface into two parts:

- 1) Outer part: Ciliary zone
- 2) Inner part: Pupillary zone

Posterior surface of iris: Posterior surface is smooth and colour is usually dark brown.

Layers of Iris

From anterior to posterior:

- 1) Anterior border layer
- 2) Stroma and sphincter layer
- 3) Anterior epithelium and dilator muscle
- 4) Posterior pigment epithelium

Anterior Border Layer

It is the condensation of connective tissue. Pigment cells are also found in this layer.

Stroma of Iris

Stroma of iris contains:

- Sphincter pupillae muscle
- Iris vessels and nerves
- Cells which include fibroblasts, melanocytes, mast cells.

Sphincter pupillae muscle: It is flat muscle. It is about 0.75 mm wide and 0.1-0.17 mm thick. It encircles the papillary margin. Contraction of this muscle leads to pupillary constriction.

Nerve supply: 3rd cranial nerve

Anterior Epithelium and Dilator Muscle

Anterior epithelium: It is about 12.5 μm in thickness.

- Dilator Pupillae
- Radially arranged muscle.

Length: 60 μm

Width: 7 μm

Extention: From iris root to the papillary margin.

Contraction of this muscle leads to dilatation of pupil.

Nerve supply: Sympathetic fibres.

Posterior Pigmented Epithelium

This layer is divided from the internal layer of optic cup. It is double layered epithelium. The cells of this layer are heavily pigmented. The cells are columnar.

Check Your Progress 1

1) What is the aperture in the iris diaphragm known as?

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2) What is the nerve supply of sphincter pupillae muscle of iris?

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3) Which layer of iris is heavily pigmented?

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3.2.2 Anatomy of Ciliary Body

Ciliary body is the middle part between iris and choroid. Its main constituent is ciliary muscles.

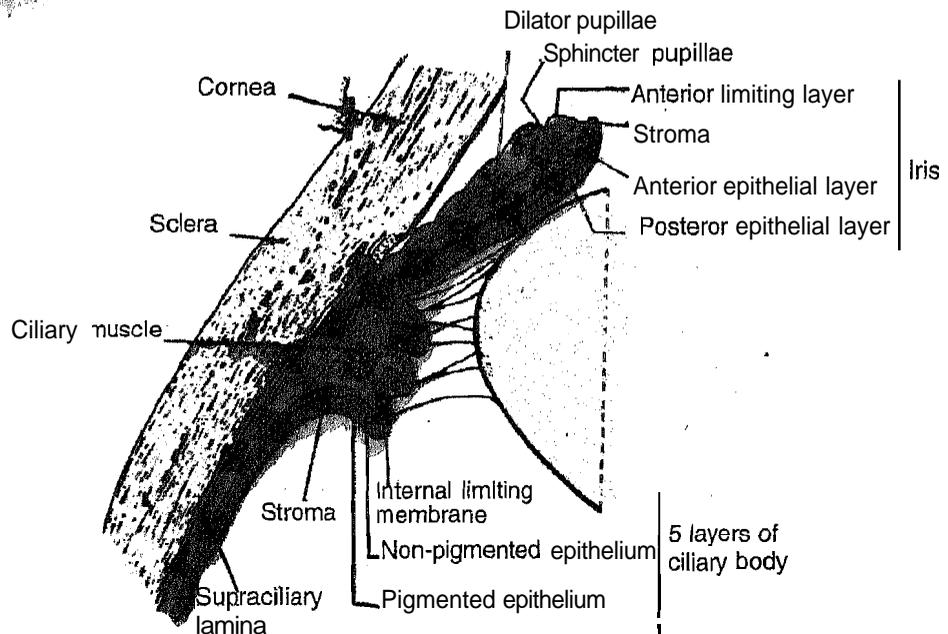


Fig. 3.2: Microscopic structure of iris and ciliary body

Extension: Starts from the ora serrata where retina and choroid ends.

Antero-posterior width: 6 mm to 6.5 mm.

Widest inferotemporally.

Narrowest superonasally.

Ciliary body starts from a point which is 2 mm from the limbus. It extends up to a distance of 8 mm from the limbus.

Colour: Black

Shape: Triangular, Apex is towards choroids and base faces interiorly

External Surface is related to sclera. The space between ciliary body and sclera is known as perichoroidal space.

Parts of Ciliary Body

Ciliary body has two parts:

- 1) Pars plicata : The anterior 1/3rd
- 2) Pars plana: The posterior 2/3rd.

Pars Plicata: Length of pars plicata is 2 mm. As compared to pars plana this part is not smooth. It contains 70-80 ridges which are called ciliary processes.

Ciliary Process: These are projections from the anterior portion of the ciliary body. These processes secrete aqueous humor. These processes are roughly symmetrical but vary in size. These processes become longer and taller with age.

Dimensions of ciliary processes:

Length : 2 mm

Width : 0.5 mm

Height : 0.8 to 1 mm

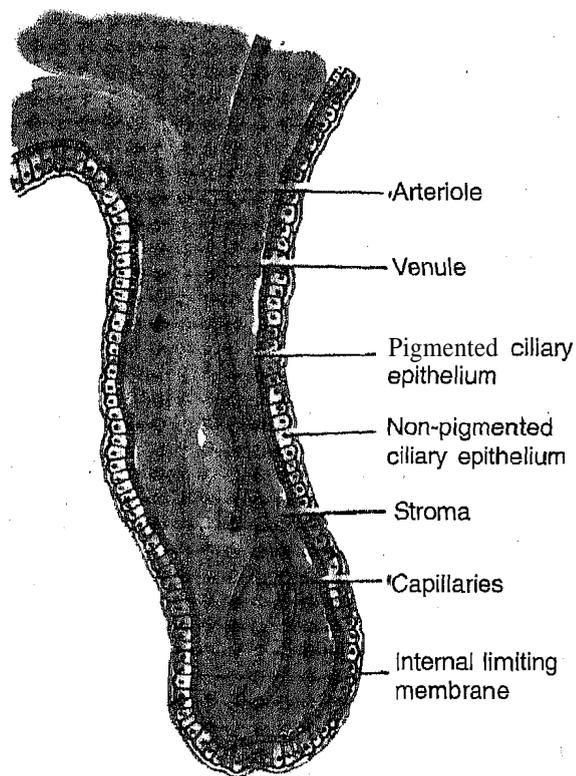


Fig. 3.3: Microscopic structure of a ciliary process

Pars Plana: Internal surface is smooth and is known as pars plana.

Length: 4 mm

Layers of Ciliary Body

- 1) Supraciliary layers
- 2) Ciliary muscle
- 3) Stroma
- 4) Epithelial layers

Supraciliary Layers

It consists of:

- a) External limiting membrane
- b) Pigmented epithelium
- c) Non-pigmented epithelium

Ciliary Muscle

Types of ciliary muscles

- i) Longitudinal
- ii) Radial
- iii) Circular

Longitudinal Muscle

These muscle fibres run antero-posteriorly and form the bulk of the muscle fibres. They mainly arise from scleral spur and posteriorly extend into the suprachoroid to the level of equator or beyond it. Contraction of ciliary muscle leads to relaxation of suspensory ligaments. This helps in the suspension of lens within the ball. This process occurs during the process of accommodation.

Radial Muscles

These muscles pass in a radial manner. These run deep into the longitudinal fibres and form interdigitating v-shaped bundles towards the inner side of the eye and become continuous with circular fibres.

Circular Muscles

These fibres occupy the anterior and inner part of the ciliary body. At their origin they form a tendinous ring. They run concentric to cornea and lie close to the periphery of the cornea.

Stroma

It is connective tissue containing vessels, nerves and cells. It separates different parts of ciliary muscle. Ciliary muscle stroma is minimal at birth, but increases with age.

Epithelial Layers

Epithelial layers are embryologically derived from the optic cup. The outer layer is pigmented and inner layer is nonpigmented. These pigment layers are continuous with the pigmented epithelial layers of iris. The posterior non-pigmented epithelium form the blood aqueous barrier.

Nerve Supply to the Ciliary Body and Iris

Both iris and ciliary body is supplied by the short posterior ciliary nerves. Near the ora serrata the short posterior ciliary nerves form a rich plexus of myelinated and nonmyelinated nerves which supply iris and ciliary body. Both iris and ciliary body are supplied by parasympathetic and sympathetic nerve supply,

Parasympathetic Nerve Supply

Source: Edinger-westphal nucleus.

Course: Come through inferior division of oculomotor nerves.

Type: Contain both myelinated and nonmyelinated fibres.

Relation to Ciliary Ganglion: Fibre ends at the nucleus of ciliary ganglion. The postganglion fibres supply ciliary muscle and also the iris sphincter of the iris.

Sympathetic Fibres

Source: Cervical sympathetic trunk.

These fibres 1st end in superior cervical ganglion and distributed to the ciliary and iris muscles by long ciliary nerve.

Sensory Supply to Iris and Ciliary Body

These run from the nasociliary branch of ophthalmic division of trigeminal nerves and then run in long ciliary nerves. These fibres enter the ciliary body and terminate in iris, cornea and ciliary muscle.

Check Your Progress 2

1) Which part of ciliary body secretes aqueous humor?

.....
.....

2) What are the parts of ciliary body?

3) Which layer of ciliary body forms blood-aqueous barrier?

3.2.3 Anatomy of Choroid

Choroid is the posterior most part of the uveal tissue. It is situated between the sclera externally and retina internally. Choroid is composed almost entirely of blood vessels.

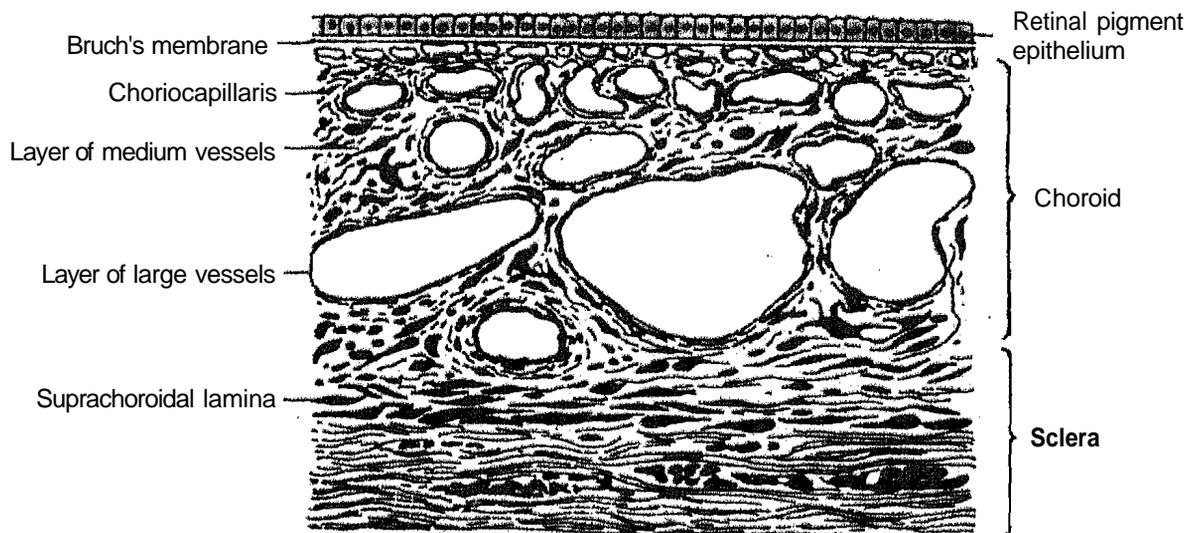


Fig. 3.4: Microscopic structure of choroid

Extension

Extends from the margin of the optic disc posteriorly to the ora serrata anteriorly.

Thickness

Anteriorly: 100 μm

Posteriorly: 220 μm

Greatest thickness at the macula

Thinner in myopia

Attachments

Firm attachment to the margin of the optic nerve. Attachment to the sclera is strongest behind the equator.

Suprachoroidal Space: The space between the sclera and choroid is called suprachoroidal space. Anteriorly it is continuous as supra-ciliary space (space between sclera and ciliary body). This space is traversed by long and short ciliary arteries and nerves which supply the uveal tract.

Layers of Choroid

It consists three layers:

- 1) Suprachoroidal lamina
- 2) Stroma: Containing larger and medium sized blood vessels, and choriocapillaries (layer of capillaries)
- 3) Bruch's membrane (Non-cellular layer)

Suprachoroidal Lamina

It is thin membrane of collagen fibres, melanocytes and fibroblasts.

Stroma (Substantia Propria)

This layer contains blood vessels, nerves, cell and connective tissue. Cells present includes melanocytes, fibroblasts.

Vascular Layer of Choroid

Classically three layers of vascular system are present in the choroids.

- 1) Outer
- 2) Middle
- 3) Inner

Outer Vascular Layer: This layer consists of large blood vessels. This layer is also called **Haller's layer**.

Middle Vascular Layer: This layer contains medium sized blood vessels and is also called **Sattler's layers**.

Inner Vascular Layer: This layer consists of smaller size blood vessels and is known as **choriocapillaries**.

Bruch's Membrane

A membrane like structure situated between choroids and retinal pigment epithelium. It separates the choriocapillaries from direct contact with retinal pigment epithelium.

Extensions: From the margin of the optic disc.

Thickness: Average thickness is 2 μ m in early adult life. Its size increases with age. It is thicker near the disc (2-4 μ m) and tapers at the periphery to 1-2 μ m.

Surface: Smooth and regular.

Blood Supply of Choroid

From posterior and anterior ciliary arteries.

Functions of Choroid

Main function of choroid is to give nourishment to the retina. The outer layers of the retina are supplied by the choroid.

1) Which layer separates choriocapillaries and retinal pigment epithelium?

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2) What is the main function of choroid?

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3.3 ANATOMY OF ANTERIOR AND POSTERIOR CHAMBERS

Space between corneal endothelium and anterior capsule of lens containing aqueous humor is divided into two parts—anterior and posterior chambers, by iris diaphragm.

Anterior Chamber of Eyeball

Anterior Boundary: Posterior surface of the cornea.

Posterior Boundary: Anterior surface of the iris and anterior surface of the lens within the pupillary area.

Posterior Chamber of Eyeball

Anterior Boundary: Posterior surface of the iris.

Posterior Boundary: Anterior surface of the lens.

Aqueous humour, the fluid which is secreted by the ciliary processes of the ciliary body passes from the posterior chamber to the anterior chamber through the pupillary opening.

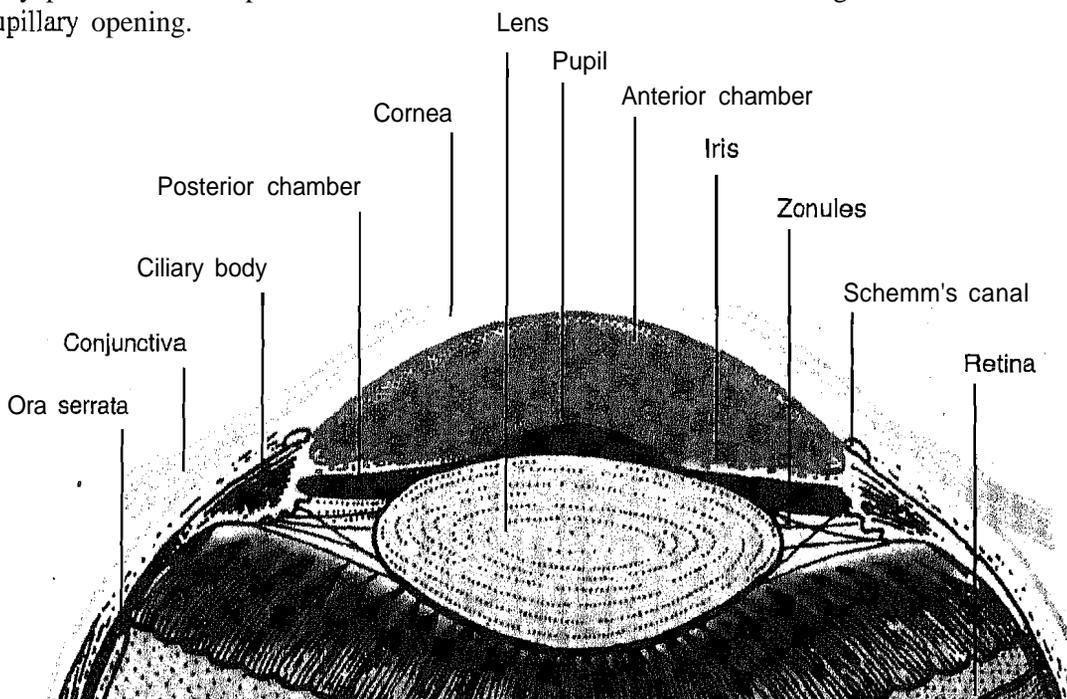


Fig. 3.5: Horizontal section of the eyeball

Check Your Progress 4

- 1) Mention the boundaries of posterior chamber of eyeball.

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- 2) Aqueous is secreted into which chamber?

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3.4 LET US SUM UP

In this unit you have learnt that middle coat of eyeball consists of iris, ciliary body and choroid. Central opening in the iris is called pupil. Function of pupil is to control the entry of light in to the eye. When exposed to bright light pupillary size decreases and exposed to dim light pupillary size increases. Middle part of middle coat is called ciliary body. It is a triangular structure. It helps in the formation of aqueous and also helps in the process of accommodation. Posterior most part of middle coat is called choroid. It consists of layers of blood vessels. Its main function is to supply blood to the outer part of retina. In the next unit you will learn about the anatomy of lens.

3.5 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

- 1) Pupil
- 2) 3rd cranial nerve
- 3) Posterior epithelium

Check Your Progress 2

- 1) Ciliary processes
- 2) Pars plicata and pars plana
- 3) Posterior non-pigmented epithelium

Check Your Progress 3

- 1) Bruch's membrane
- 2) Nourishment to retina

Check Your Progress 4

- 1) Anteriorly posterior surface of iris and posteriorly anterior surface of lens
- 2) Posterior chamber