DENOYER-GEPPERT

Giant Eye in Bony Orbit

Numerical Identification Key for Model 0182-00

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Presentation of the Model

Dissection of the Model

As a general rule, start dissecting from the top and work downward. DO NOT FORCE ANYTHING. Be patient. Be gentle. After the first time, the process is simple.

- Remove the superior rectus muscle by lifting the anterior end first and then disengage the posterior end.
- In removing the external rectus muscle, disengage the pin at the posterior end of the muscle by a lateral outward movement and then the anterior end may be disengaged.
- To remove the upper part of the eyeball , take hold of the lacrimal gland and lift the entire portion carefully upward and slightly outward. There is a vertical pin between the two parts of the eyeball at the point of attachment of the external rectus muscle. This pin should be disengaged as the part is lifted upward.
- Hold the crystalline lens in place with one hand while removing the cornea and iris.
- The vitreous humor and optic nerve are removed by rotating the ball slightly upward, outward and forward.

Presentation Of The Model

In this model the eye is shown in relationship to adjacent structures: the bones of the orbital and nasal cavity, part of the frontal sinus, nerves and blood vessels, and the extrinsic muscles which move the eyeball. This allows the student to develop an appreciation for how the eye exists in life. Such facts as, "the eyeball is set in a socket of bone" can be illustrated and more easily understood. Also, by viewing the muscles and noting their origins and insertions, it is easy for the student to understand the mechanics of movement of the eyeball.

The blood and nerve supply to the eyeball is also clearly depicted. No tissue can live without this supply and this fact must be reiterated in the specialized study of any organ or tissue. The connections of the eyeball to its adjacent structures should be brought out before going into the study of the eyeball itself.

Upon lifting the upper half of the eyeball in the model, it can be seen that the eye is enclosed by three main coats. By their size and color, their function is almost self-explanatory. It is clearly evident through observation of the model that the outer coat, the sclera **(19)**, is tough for protection. The center layer, the choroid coat **(21)**, is vascular and provides a blood and nerve supply. The inner layer or retina **(30)** is delicate and quite thin by comparison. Light rays are focused by the lens upon the delicate and sensitive retina, and the impulses from this stimulation are transmitted along the optic nerve **(33)** to the brain where they are interpreted as images or pictures.

A yellow spot **(32)** can be seen just lateral to the optic nerve **(33)**. This yellow spot is the area known as the macula lutea and contains the fovea centralis which contains cone cells. The central vision, the only part of our field of vision in which we can see clearly, is used for reading and close study, and is registered at the fovea centralis. The remaining surface of the retina gives us side vision in which we can distinguish movement and color but no detail. A demonstration of this central and side vision is described later.

There is one other "spot" on the retina which we should know about and that is the "blind spot" or optic disc, which is the point where the optic nerve **(33)** leaves the eye. On the eye model this is depicted by a hole in the posterior aspect of the eye. Another demonstration explained later in this manual proves the presence of this blind spot. The blind spot is not noticed because we have two eyes and the blind areas do not overlay each other. The small field of blindness in one eye comes into the field of vision for the other eye.

Even though the retina is delicate and thin, it has a complex histological structure so specialized that its consideration cannot be omitted in any study of the eye. A diagrammatic drawing of the retina in cross section is on the vitreous body **(31)**. The various structures of the retina are lettered from **(a)** through **(t)** and can be identified by the key in this manual. Deficiencies in some of these structures of the retina cause varying degrees of color blindness.

At the anterior aspect of the eyeball it can be seen that the sclera **(19)**, or outer coat, becomes modified to form the cornea **(20)**, the "window" of the eye. The Choroid coat **(21)** becomes modified to form the ciliary muscle **(25)** and the iris **(26** and **27)**. The pigment of the iris determines the color of the eye and the function of the iris is to regulate the amount of light that is permitted to reach the crystalline lens. The crystalline lens is derived from the same source, embryologically, as the sclera and the cornea, i.e. the ectoderm. It is like a magnifying glass and its purpose is to focus the rays of light on the retina. In order to accomplish this, the lens must change its shape, from flatness for distant objects to thickness for objects near at hand. This is accomplished by a delicate balance between the ciliary muscle **(25)** and the suspensory ligament which supports the lens. The suspensory ligament exerts a slight tension on the lens and is inserted into the ciliary process **(24)**. This tension is normal. It is not a strain. No muscular action is involved. This normal tension on the lens (with its flattening effect) is removed by contraction of the ciliary muscle (**25)**, thus allowing the lens to thicken. Notice on the model that the ciliary muscle has its origin at the corneo-scleral junction and is attached by its wide end to the ciliary process **(24)**. Shortening of this muscle draws the ligament towards the lens, thus putting "slack" in the ligament and allowing the lens to thicken from its own internal pressure. The degree of change in the shape of the lens is regulated by the amount of contraction of the ciliary muscle. It can be easily understood how this muscle becomes fatigued after hours of close work with the eyes. Also, students can understand that when the lenses lose their flexibility, as happens around age 45, they will not thicken from their own internal pressure. Thus the person cannot see clearly close at hand, as for reading. That is why many people read with a magnifying glass or hold their reading matter at arms' length. There are two cavities or spaces within the eyeball: one in front of the lens and the other behind it. The one behind the lens is represented by a glass bulb on the model and is called the vitreous body **(31)**. This is a rather thick fluid of about the consistency of thin jelly. It is not replaceable and if any part of this fluid is lost due to injury , its absence will have to be endured throughout the balance of the individual's life. In front of the lens is a thin watery fluid known as the aqueous fluid . This fluid is slightly salty (NaCl), like the fluid from the lacrimal gland which washes the outside of the cornea. Fortunately, this fluid is capable of replacing itself every twenty-four hours. Its loss due to injury is not serious.

Demonstrations with the Eye Model

1. Demonstration of the Blind Spot (Optic Disc)

On a clean strip of paper, mark an X to the left hand side. About four inches to the right of the X, mark a solid disc of this size ● Now close the left eye, hold the paper strip horizontally and look at the X with the right eye. Move the paper slowly back and forth about eight inches from the eye . The disc which can be seen in the field of side vision will disappear when the paper is held at a certain distance from the eye and appear again when the distance is varied. This demonstrates the focus of accurate, or central, vision (the X) which is registered by the fovea centralis **(32)**, and the side vision which is registered on all other parts of the retina **(30)**. When the disc figure is thrown on the spot if the retina where the optic nerve **(33)** makes its exit *(the blind spot or the optic disc)* the disc figure disappears in the side vision field.

2. Side Vision

Stand and focus your eyes on some object directly in front of you . Face the object of your attention squarely. This object is now focused in the yellow spot **(32)** of your retina. All else that you can see indistinctly is in the field of side vision, registered on that part of the retina other than the yellow spot. Now raise your arms to the side, level with your shoulders. Wave your hands. Can you see your hands in your side vision while focusing your eye straight ahead? If not, move your waving hands forward until they do come into your field of side vision. Some people have a very narrow range of side vision and this handicap is called "Tunnel vision." It is dangerous for such people to cross a busy street as they cannot notice movement from the sides. As far as is known, no standard has been set for the range of side vision , but 80 degrees from the object focused in the central vision is considered sufficient for people who drive cars.

3. Direct Vision

The crystalline lens bends light rays to a focus on the retina. But a few central rays which run directly from a point in front of the eye to the yellow spot **(32)** do not need to be refracted or bent. People who have difficulty with near or farsightedness can see these straight rays as well as anybody else. The same is not true for people with astigmatism. To prove this, cut out all refracted rays by looking through a hole in a piece of paper made by the end wire of a paper clip or a common pin. This is a small hole and when looking through it only direct or central rays of light are admitted to the eye. In that narrow range, people with near or farsighted deficiencies can see normally. There are usually students in every class who are suitable subjects for this test.

4. Pupil Reaction to Light

Have a student face a window or artificial light. Cup your hand over one of this student's eyes so that the eye is in complete darkness. Remove the hand quickly and note the contraction of the pupil. This shows how the iris **(26** and **27)** does its work of regulating the amount of light entering the eye.

5. The Lacrimal Mechanism

Trace the flow of tears or lacrimal fluid from the lacrimal gland **(55** and **56)** over the cornea **(20)** into the lacrimal duct via the opening in the caruncula lacrimalis **(58)** and thus into the nose.

Explain that the eyes water when the nose becomes inflamed internally , as with the common cold , because the inflammation closes the exit of the lacrimal duct and the normal flow of lacrimal fluid has no way of leaving the eye except to overflow the lids. The tears in weeping are the overflow of lacrimal fluid which cannot be accommodated by the lacrimal duct. The "sniffing" that accompanies weeping is caused by the heavy flow of lacrimal fluid or tears through the lacrimal duct and into the nose.

6. Mechanism of Sight

Trace the rays of light through the cornea **(20)** , aqueous fluid , through the opening in the iris (the pupil), the crystalline lens, vitreous body **(31)**, onto the retina where the impulses are picked up and transmitted to the brain by way of the optic nerve.

Bones of the Orbital and Nasal Cavity

1. Frontal bone, with frontal sinus
2. Nasal bone
3. Zygomatic bone
4. Maxilla
5. Fossa sacci lacrimalis
6. Lacrimal bone
7. Lamina papyracea of ethmoid bone
8. Sphenoid bone
9. Foramen opticum *(optic foramen)*
10. Lamina cribrosa of ethmoid bone

Extrinsic Muscles of the Eyeball

11. Superior rectus muscle
12. External *(lateral)* rectus muscle
13. Internal *(medial)* rectus muscle
14. Inferior rectus muscle
15. Inferior oblique muscle
16. Superior oblique muscle
17. Tendon of superior oblique
18. Trochlea of superior oblique

Structures of the Eyeball

19. Sclerotic coat *(sclera)*
20. Cornea
21. Choroid coat
22. Ciliary disc
23. Anterior margin of retina
24. Ciliary ligament with ciliary processes
25. Ciliary muscle
26. Posterior epithelial layer of iris*
27. Posterior basal membrane *(Bruch's or Renie's layer)**
28. Circular muscle fibers*
29. Radiating muscle fibers*

30. Retina

Layers:

a. Pigmented layer
b. Layer of rods and cones
c. External limiting membranes
d. Outer nuclear layer
e. Outer plexiform layer
f. Inner nuclear layer
g. Inner plexiform layer
h. Ganglionic layer or layer of nerve cells
i. Stratum opticum or layer of nerve fibers

Features:

k. Internal limiting membrane
1. Rods
m. Rod granules
n. Cones
o. Cone granules
p . Horizontal cells
q. Bipolar cells
r. Amacrine cells
s. Sustentacular fibers of Müller
t. Ganglionic cells

31. Vitreous Body*
32. Macula lutea *(yellow spot)* with fovea centralis

Nerves and Blood Vessels

33. Optic nerve *(Cranial Nerve II)*
34. Maxillary nerve
35. Ophthalmic nerve
36. Frontal nerve
37. Lacrimal nerve
38. Oculomotor nerve *(Cranial Nerve III)*
39. Abducens nerve *(Cranial Nerve VI)*
40. Infraorbital branch of maxillary nerve
41. Zygomatic nerve
42. Zygomatico-facial branch
43. Ophthalmic artery
44. Lacrimal artery
45. Frontal artery
46. Supraorbital artery
47. Posterior ciliary arteries
48. Episcleral arteries
49. Ciliary arteries and nerves passing through sclera to supply choroid coat
50. Vasa sanguinales of retina
51. Vorticose veins
53. Nasociliary nerve
54. Ciliary ganglion
55. Superior lacrimal gland
56. Inferior lacrimal gland
57 Saccus lacrimalis
58. Caruncula lacrimalis

*Not labeled on the model.

Autographed Anatomy

Molded and hand-painted in the United States by experienced artisans. Proudly autographed and dated to show that we stand by our products. The Autographed Anatomy™ product line carries a Lifetime Guarantee against manufacturing defects.

Care of Denoyer-Geppert Models

Your Denoyer-Geppert model was designed and manufactured to provide years of satisfactory service. Our models are molded of durable vinyl plastic. The finest lacquers and inks are used in the hand-painting and numbering of all our models.

In order to clean the model, you should wipe it with a damp cloth, or a cloth wet with mild soap solution, and wipe dry.

Avoid placing the model in direct sunlight for extended periods. A cloth cover or case will help keep the model clean.

Plastic covers not recommended