EHIE-BISHOP GINA

NURSING SCIENCE

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EYE DEFECTS

Presbyopia—Loss of Accommodation by the Lens. As a person grows older, the lens grows larger and thicker and becomes far less elastic, partly because of pro gressive denaturation of the lens proteins. The ability of the lens to change shape decreases with age.

- The power of accommodation decreases from about 14 diopters in a child to less than 2 diopters by the time a person reaches 45 to 50 years; it then decreases to essentially 0 diopters at age 70 years. Thereafter, the lens remains almost totally nonaccommodating, a condition known as “presbyopia.”Once a person has reached the state of presbyopia, each eye remains focused permanently at an almost constant distance; this distance depends on the physical characteristics of each person’s eyes.
- The eyes can no longer accommodate for both near and far vision. To see clearly both in the distance and nearby, an older person must wear bifocal glasses with the upper segment focused for far-seeing and the lower segment focused for near-seeing (e.g., for reading).

- **Hyperopia (Farsightedness)**
- Hyperopia, which is also known as “farsightedness,” is usually due to either an eye ball that is too short or, occasionally, a lens system that is too weak. In this condition,parallel light rays are not bent sufficiently by the relaxed lens system to come to focus by the time they reach the retina. To overcome this abnormality, the ciliary muscle must contract to increase the strength of the lens. By using the mechanism of accommodation, a farsighted person is capable of focusing distant objects on the retina. If the person has used only a small amount of strength in the cili ary muscle to accommodate for the distant objects, he or she still has much accommodative power left, and objects closer and closer to the eye can also be focused sharply until the ciliary muscle has contracted to its limit. In old age, when the lens becomes “presbyopic,” a farsighted person is often unable to accommodate the lens sufficiently to focus even distant objects, much less near objects.
- **Myopia (Nearsightedness).** In myopia, or “nearsighted ness,” when the ciliary muscle is completely relaxed, the light rays coming from distant objects are focused in front of the retina. This is usually due to too long an eyeball, but it can result from too much refractive power in the lens system of the eye.
- No mechanism exists by which the eye can decrease the strength of its lens to less than that which exists when the ciliary muscle is completely relaxed. A myopic person has no

mechanism by which to focus distant objects sharply on the retina. However, as an object moves nearer to the person's eye, it finally gets close enough that its image can be focused. Then, when the object comes still closer to the eye,the person can use the mechanism of accommodation to keep the image focused clearly. A myopic person has a definite limiting "far point" for clear vision.

- **Correction of Myopia and Hyperopia by Use of Lenses. It** will be recalled that light rays passing through a concave lens diverge. If the refractive surfaces of the eye have too much refractive power, as in myopia, this excessive refractive power can be neutralized by placing in front of the eye a concave spherical lens, which will diverge rays.

  Such correction is demonstrated in the upper diagram of Conversely, in a person who has hyperopia—that is, someone who has too weak a lens system—the abnormal vision can be corrected by adding refractive power using a convex lens in front of the eye. This correction is demonstrated in the lower diagram of One usually determines the strength of the concave or convex lens needed for clear vision by "trial and error"—that is, by trying first a strong lens and then a stronger or weaker lens until the one that gives the best visual acuity is found.

- **Astigmatism**

  - Astigmatism is a refractive error of the eye that causes the visual image in one plane to focus at a differ ent distance from that of the plane at right angles. This most

often results from too great a curvature of the cornea in one plane of the eye. An example of an astigmatic lens would be a lens surface like that of an egg lying sidewise to the incoming light. The degree of curvature in the plane through the long axis of the egg is not nearly as great as the degree of curva ture in the plane through the short axis.

Because the curvature of the astigmatic lens along one plane is less than the curvature along the other plane, light rays striking the peripheral portions of the lens in one plane are not bent nearly as much as the rays striking the peripheral portions of the other planeThe accommodative power of the eye can never compensate for astigmatism because, during accommodation, the curvature of the eye lens changes approximately equally in both planes; therefore, in astigmatism, each of the two planes requires a different degree of accommodation. Thus, without the aid of glasses, a person with astigmatism never sees in sharp focus.

Correction of Astigmatism with a Cylindrical Lens.

- One may consider an astigmatic eye as having a lens system made up of two cylindrical lenses of different strengths and placed at right angles to each other. To correct for astigmatism, the usual procedure is to find a spherical lens by trial and error that corrects the focus in one of the two planes of the astigmatic lens. Then an additional cylindrical lens is used to cor rect the

remaining error in the remaining plane. To do this, both the axis and the strength of the required cylindrical lens must be determined