

Disorders of the Lens

Myopia and Hyperopia

Adjustments in vision to be able to see up close and far away are controlled by changes in the ciliary muscles of the eye which control the shape of the lens. When the ciliary muscles of the ciliary body are relaxed, there is tension in the suspensory ligaments. This puts force on the lens to make it more flat for distant vision. For near vision, the ciliary muscles contract, which decreases tension in the suspensory ligaments and the elastic lens recoils to its more round shape. The spherical lens allows for more bending (refraction) of light which is necessary for close-up activities like reading.

The sympathetic nervous system stimulates beta-2 receptors expressed on ciliary smooth muscle cells and induces relaxation. As explained, the suspensory ligaments experience increased tension which flattens the lens and enables the person to focus on more distant objects. The parasympathetic nervous system stimulates muscarinic receptors expressed on ciliary muscle cells that cause smooth muscle contraction, thus relieving tension on the suspensory ligaments and allowing for near vision.

It is common to hear the terms “near-sighted” and “far-sighted.” These terms reference what the eye is best at doing. If a person is near-sighted, they see best up close and have a hard time seeing things far away. **Myopia** is the scientific term for “near-sightedness.” If someone has myopia, they can be fitted with glasses that have a concave, minus, or diverging lens. **Hyperopia** is the term for “far-sightedness.” Someone who is far-sighted can focus on distant objects while close-up objects appear blurry. If someone has hyperopia, they would need a convex, plus, or converging lens. **Presbyopia** is another term you should be familiar with. Presbyopia refers to the loss of lens elasticity that develops as a person ages. This occurs as the composition of elastic fibers within the lens decreases over time. As a result, the lens is less able to recoil to its round shape and the person has difficulty focusing on near objects. People with presbyopia need a convex, plus, or converging lens (often in the form of reading glasses).

An **astigmatism** must sometimes be addressed when a patient is being fitted for glasses. An astigmatism is a condition of blurry vision caused by an irregularly shaped cornea or lens. If these structures are irregular in shape, they bend light differently depending on the location that the light strikes the cornea or lens. This type of vision problem makes it hard to correct vision with a single adjustment to the lens put in a pair of glasses. However, it is possible to manipulate thickness and curvature of different areas on an external lens to compensate for an astigmatism.

Cataracts

Cataracts are clouding of the normally clear lens of the eye that leads to blurry vision. This opacity makes it difficult for light to pass through the lens and stimulate the photoreceptors of the retina. Cataracts usually develop slowly over many years. At first, when clouding is just beginning to develop, a person may have symptoms like seeing faded colors, blurry or double vision, halos around lights, and trouble seeing at night. Eventually, cataracts can lead to blindness, although not total “black out” blindness like damage to the neurological structures of the eye can cause. Cataracts cause half of the cases of blindness worldwide.

Cataracts are mostly due to aging as the lens protein fibers become damaged over time. Other things that can contribute to the development of cataracts are:

- Trauma to the eye may damage the lens and lead to increased opacity.
- Radiation can damage the DNA of lens cells, which can then produce inappropriate forms of lens proteins which add to opacity problems.
- Genetics contribute to the development of cataracts. Individuals can inherit mutated gene alleles that are involved in maintenance of lens fibers. Down syndrome is a genetic condition that also appears to increase the risk of cataracts.
- Smoking has been shown to greatly increase the risk of cataract development.
- Low vitamin C intake has been associated with an increased risk of cataracts.
- Diabetes has been associated with increased risk of cataracts.

The treatment for cataracts usually involves surgery where the damaged lens is removed and a new artificial lens is inserted. Individuals who have severe blindness find almost miraculous recovery of visual function after this surgery. If interest in seeing a cool ocular surgery, google "cataract surgery in real time" and watch a video or two of these surgeries being conducted. Most cataract surgeries can be completed in under 10 minutes!



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