Commentary Article

Refraction Error, Problem with Focusing Light

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INTRODUCTION

Light focuses accurately on the retina due to the shape of the eye and or cornea. The most common types of refractive error are near-sightedness, far-sightedness, astigmatism, and presbyopia. Near-sightedness results in faraway objects being blurry, far-sightedness and presbyopia result in close objects being blurry, and astigmatism causes objects to appear stretched out or blurry. Other symptoms may include double vision, headaches, and eye strain. Near-sightedness is due to the length of the eyeball being too long, far-sightedness the eyeball too short, astigmatism the cornea being the wrong shape, and presbyopia aging of the lens of the eye such that it cannot change shape sufficiently. Some refractive errors occur more often among those whose parents are affected. Diagnosis is by eye examination. Refractive errors are corrected with eyeglasses, contact lenses, or surgery. Eyeglasses are the easiest and safest method of correction. Contact lenses can provide a wider field of vision; however they are associated with a risk of infection. Refractive surgery permanently changes the shape of the cornea.

The number of people globally with refractive errors has been estimated at one to two billion. Rates vary between regions of the world with about twenty five Percentage of Europeans and eighty Percentage of Asians affected. Near-sightedness is the most common disorder. Rates among adults are between fifteen to fourth nine Percentages while rates among children are between one point to forty two Percentage. Far-sightedness more commonly affects young children and the elderly. Presbyopia affects most people over the age of thirty five. The number of people with refractive errors that have not been corrected was estimated at six hundred and sixty million (ten to hundred people) in 2013. Of these nine point five million were blind due to the refractive error. It is one of the most common causes of vision loss along with cataracts, macular degeneration, and vitamin A deficiency.

An eye that has no refractive error when viewing distant objects is said to have emmetropia or be hemitropic meaning the eye is in a state in which it can focus parallel rays of light (light from distant objects) on the retina, without using any accommodation. A distant object, in this case, is defined as an object located beyond six meters, or twenty feet, from the eye, since the light from those objects arrives as essentially parallel rays when considering the limitations of human perception.

METHOD

The word "ametropia" can be used interchangeably with "refractive error". Types of ametropia include myopia, hyperopia and astigmatism. They are frequently categorized as spherical errors and cylindrical errors:

Spherical errors occur when the **optical power** of the eye is either too large or too small to focus light on the **retina**. People with refractive error frequently have blurry vision.

Near-sightedness: When the optics is too powerful for the length of the eyeball one has **myopia** or near-sightedness. This can arise from a **cornea** or **crystalline lens** with too much curvature (refractive myopia) or an eyeball that is too long (axial myopia). Myopia can be corrected with a concave lens, which causes the divergence of light rays before they reach the cornea.

Farsightedness: When the optics is too weak for the length of the eyeball, one has hyperopia or farsightedness. This can arise from a cornea or crystalline lens with not enough curvature (refractive hyperopia) or an eyeball that is too short (axial hyperopia). This can be corrected with convex lenses, which cause light rays to converge prior to hitting the cornea.

Presbyopia: When the flexibility of the lens declines, typically due to age. The individual would experience difficulty in near vision, often relieved by reading glasses, bifocal, or progressive lenses.

Cylindrical errors cause astigmatism, when the optical power of the eye is too powerful or too weak across one meridian, such as if the corneal curvature tends towards a cylindrical shape. The angle between that meridian and the horizontal is known as the axis of the cylinder.

Astigmatism: A person with astigmatic refractive error sees lines of a particular orientation less clearly than lines at right angles to them. This defect can be corrected by refracting light more in one meridian than the other. Cylindrical lenses serve this purpose.

CONCLUSION

Refractive error may be quantified as the error of a wave front arising from a person's far point, compared with a plane, or zero mergence, wave front compared at an appropriate reference plane. The reference plane may be a real plane such as the spectacle plane or the corneal plane, or an imaginary plane such as the first principal plane or the entrance pupil plane. In dioptres, , where k is the distance in meters from the reference plane to an eye's far point, and K is the refractive error in dioptres. Thus, a person with myopia would have a negative refractive error, a person with emmetropia would have zero refractive error and a person with hyperopia would have a positive refractive error. In the case of regular astigmatism, refractive error needs to be expressed as 3 values: classically as sphere, cylinder and axis. However, it can also be expressed in vector terms, for example, M (mean sphere), J0 (With the rule/against the rule astigmatism), and J45 (oblique astigmatism). Refractive errors containing higher order aberrations (sometimes referred to as irregular astigmatism) can be expressed for a given pupil size using wave front errors or optical path differences, often as coefficients for Zernike polynomials. A more subjective quantity **visual acuity** (expressed as a fraction) may be used, but there is no direct or exact conversion between the two.

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