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Retinometry: a Literature Review

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Abstract

Sharp vision is a major concern in cataract cases. Sharp improvement in vision is the expected outcome of the management of cataract cases, namely by operative measures. Before surgery, there are several ophthalmological examinations that must be performed. Quantitative instruments have been developed to determine the visual potential of eyes that experience turbidity of refractive media. One examination that can be done is a retinometry examination that is the examination of the sharp potential of vision with a retinometer.

Retinometry is a process of measuring sharp eyes using a retinometer to determine the potential for sharp eyesight. Retinometer is one tool that uses the principle of interference fringes to assess the patient's sharp vision through a cloudy lens. On a retinometer, a light source is split into two rays which then enter the least turbid lens area so that interference grating is formed on the retina. The lattice can have a vertical, horizontal or oblique meridian orientation

Keywords: retinometry, vision

Introduction

The function of vision is a very important ability possessed by everyone. Good vision function is very necessary in daily life but several conditions can cause a decrease in vision function. One of the causes of this decreased visual function is cataract. Cataract is the main cause of blindness in the world that can be prevented. Cataracts are any opacities that occur in the lens. To cope with cataracts carried out the cloudy lens removal by surgery[1]

Some checks must be done before undergoing cataract surgery, one of which is a sharp examination of vision. Sharp vision or vision is the minimum threshold that can be read, a point where the patient's visual ability can no longer distinguish letters that are smaller. This threshold determination is generally measured using a Snellen card. In cataract patients there is decreased visual acuity that varies from reduced ability to see the letters on the Snellen card to only seeing light projections.[2]

Sharp vision is a major concern in cataract cases. Sharp improvement in vision is the expected outcome of the management of cataract cases, namely by operative measures. Before surgery, there are several ophthalmological examinations that must be performed. Quantitative instruments have been developed to determine the visual potential of eyes that experience turbidity of refractive media. One examination that can be done is a retinometry examination that is the examination of the sharp potential of vision with a retinometer.[3-5]

Retinometer is one tool that uses the principle of interference fringes to assess the patient's sharp vision through a cloudy lens. On a retinometer, a light source is split into two rays which then enter the least turbid lens area so that interference grating is formed on the retina. The lattice can have a vertical, horizontal or oblique meridian orientation. Spatial frequency can vary according to the sharpness of vision ranging from 6/120 (20/400) to 6/6 (20/20). Therefore, the sharp vision of the patient after cataract surgery can be predicted with this tool.[3-5]

Know the basic principles and uses of the retinometer in determining the visus potential.

Anatomy and Physiology of Vision

The eye is a sensory organ consisting of three layers, namely the outer fibrous layer consisting of connective tissue that forms the cornea and sclera, the vascular layer in the media consisting of iris, the ciliary and choroid bodies, and the inner neural layer, the retina. To get to the retina, a beam of light will travel through the refractive media. Light enters through the cornea, aqueous humor, lens, vitreous, then is focused on the retina. Light that reaches the retina undergoes a complex biochemical process in the form of changes in light energy into signals that are transmitted along neural pathways. Light exits the retina through the optic nerve until it is processed in the visual area of the brain.[6.7]

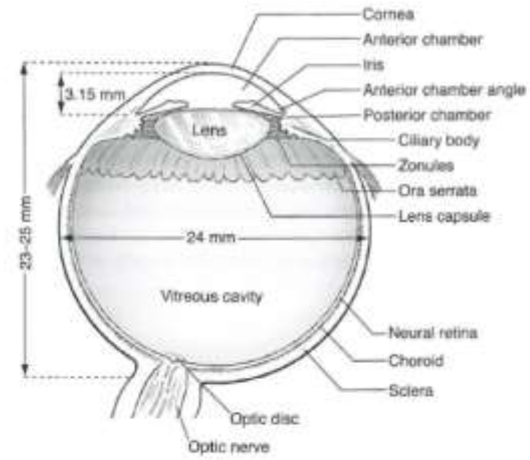

Figure 1. The sagittal cut of the eyeball. Quoted from the American Academy of Ophthalmology: Fundamentals and Principles of Ophthalmology. 2014[6]

The cornea forms the central part of the anterior pole of the eyeball. In adults the cornea is 12 mm in horizontal meridians and 11 mm in vertical meridians. The cornea has a thickness of about 1 mm in the peripheral part and 0.5 mm in the central part. The corneal optical zone is located in the central third which is about 4 mm in diameter. Corneas play a role in ¾ overall optical power of the eye. Corneal transparency is a factor that allows light rays to enter the eyeball, with refraction the light can be focused on the retina.[6-9.]

The cornea consists of five layers, namely the epithelium, bowman's membrane, stroma, Descemet membrane and endothelium. There are several factors that can affect the transparency of the cornea in various layers. Disorders of the epithelium or endothelium can cause corneal edema, causing sharp visual disturbances. In the epithelial layer erosion can occur but usually this condition is temporary and can be re-improved. In the stromal layer there are spatial regulations between stromal collagen fibrils which are the result of the interaction of proteoglycans and collagen fibrils. If this interaction is disrupted, the ability of the cornea to maintain transparency is impaired. In the endothelial layer, destruction of endothelial cells causes corneal edema and loss of corneal transparency which is usually persistent because of the limited potential for improvement of endothelial function.[5-7]

Epithelial cells near the lens equator continue to divide throughout life and differentiate into new lens fibers. The formation of this new lens fiber causes the old lens fibers to gather in the central nucleus while the younger lens fibers gather around the nucleus to form the cortex. The lens is an avascular structure and has no innervation so the lens gets a supply of nutrients from the humor aquos.[1,5]

The lens provides additional refractive power to focus the image accurately on the retina. The lens must change its shape to see objects at close range through the mechanism of accommodation. Along with increasing age, the power of accommodation will disappear.[6,7]

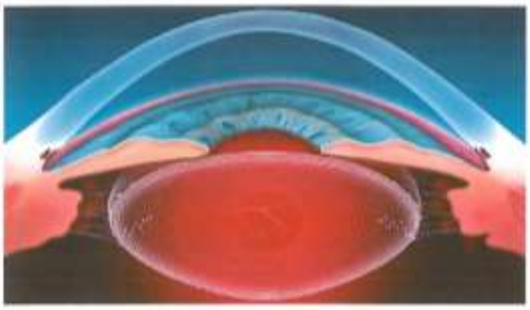

Figure 2. Lenses and surrounding structures. Quoted from Skuta GL, et al. Lens and Cataract. American Academy of Ophthalmology. 2014[1]

One important factor for focusing light properly on the retina is lens transparency. Circumstances that can cause cloudiness in the lens are cataracts. Cataracts can occur from birth (congenital cataracts), can be caused by other diseases (secondary cataracts), by trauma, and most often found is senile cataracts.[1,10]

The retina is located on the inner surface of the eyeball between the vitreous and the choroid. The retina is a layered structure with neurons and synapses that are interconnected with cells that are sensitive to light in their outer aspects in the photoreceptor layer containing rod and cone cells. There are about 6 million of the most-dense cone cells in the fovea and 125 million of stem cells scattered in the peripheral retina.[7-12]

The central area of the retina, the macula, has a diameter of 5.5 mm and is located between the disc and temporal vascular tissue. The macula is histologically composed of 2 or more layers of ganglion cells which are half of the entire ganglion cells in the retina. In the central part of the macula there is an area with a diameter of about 1.5 mm called the fovea (central fovea) which is very instrumental in the sharpness of vision and color vision. In the fovea there is a foveola of 0.35 mm in diameter where in this area the cone cells are slim, long and dense. The most central part of the foveola is a slightly depressive area, with a diameter of 150 flm, known as *umbo.*[5-12].

The visual system processes information from the environment in the form of light to be analyzed and interpreted. The retinal neural network undergoes a complex biochemical process by converting light energy into signals that are transmitted along the neural pathway.

Signals travel through the retina and then exit the eye through the optic nerve and are transmitted to various parts of the brain for processing[7]

Light is absorbed by rhodopsin which is concentrated in the outer membrane segment of the stem cell. Rodopsin is a membrane protein that can diffuse freely. When rhodopsin absorbs light, the 11-cis double bond on the retina is broken (forming all-trans-retina) and the opsin molecule undergoes several series of rapid configuration changes that cause the activation phase of metarodopsin II. Activated rhodopsin initiates a reaction that controls cation inflow to the outer segment of the stem cell. The target of this reaction is the cGMP (cyclic guanosine monophosphate) cation channel located on the outer membrane of the outer segment. This channel controls the flow of Na^+ and Ca^{2+} ions into the stem cells.[5-7.11]

Sharp vision can be measured by various methods. The most common way to measure vision is to use a Snellen card. In America generally used equivalent notation that explains the sharpness of vision against the measurement distance. This is usually indicated by the measurement distance notation to the distance that can be read on a Snellen card with the number 20 (a distance of 20 *feet*). Decimal notation is generally used in Europe, while in the UK it uses 6metre spacing. [2,13,14]

Conclusion

Retinometry is a process of measuring sharp eyes using a retinometer to determine the potential for sharp eyesight. This measurement is done by assessing the light entering through the gap or grating of the retinometer tool. Retinometers use the principle of interference fringes to assess the patient's sharp vision through a cloudy lens. On a retinometer, a light source is split into two rays which then enter the least turbid lens area so that interference grating is formed on the retina.

The results of retinometry examination are very dependent on the function of the retina and not so much on the refractive media because the pattern of light on the retina is not formed through imaging. Interference occurs when the two light sources meet and appear as a moving wave when the macula is still functioning. This effect occurs even though there are cataracts or refractive abnormalities.

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