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AGE-RELATED ANATOMICAL CHANGES IN THE HUMAN CRYSTALLINE LENS AND THEIR ROLE IN PRESBYOPIA: A CRITICAL REVIEW

***Dr. Anil Deshmukh**

HOD & Professor, Department of Rachana Sharir, Antyoday institute of Ayurvedic medical science and research centre and Hospital, Devgram, tah. Narkhed, Dist. Nagpur,(Mah.)

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***Corresponding Author: Dr. Anil Deshmukh**
HOD & Professor, Department of Rachana Sharir, Antyoday institute of Ayurvedic medical science and research centre and Hospital, Devgram, tah. Narkhed, Dist. Nagpur,(Mah.)
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ABSTRACT:-

Eyes are one of the most susceptible organs which are affected as an aging process and Presbyopia is one such disease. Presbyopia, or age-related farsightedness, has been linked to alterations in the lenticular (lens and capsule) and extra-lenticular (ciliary body and muscle) accommodative apparatuses. The crystalline lens undergoes significant age changes that contribute to the progression of presbyopia. After 60 years of age, the human crystalline lens gradually loses its ability to undergo accommodative changes with mechanical stretching and fails to undergo accommodative changes in focal length. In Ayurveda, these visual disturbances are described under *Drishtigata roga* of eyes and more importantly *Timira-Kacha-Lingnasha* complex. The concept of herbal *Chakshushya dravya* (Food beneficial for eyes), *Rasayana* and *Kriyakalpa* (local therapeutic procedures) can prevent the progression of Presbyopia and delay the aging process.

KEYWORDS:– Presbyopia, Lens, *Timira, Kriyakalpa.*

INTRODUCTION

Presbyopia is an accommodative error of eyes which develops with growing age and is more common in societies having larger proportion of older population. With growing age, the human crystalline lens losses its elasticity, becomes harder and the ciliary muscles and suspensory ligaments weakens. This leads to poor accommodation resulting in difficulty in

viewing near objects clearly. In Ayurveda, these visual disturbances are described under *Drishtigata roga* of eyes and more importantly *Timira-Kacha-Lingnasha* complex. The symptoms of *Prathama patalagata Timira (Avyakta Darshana* i.e. blurring of vision) and *Dwitiya patalagata Timira (Suchipasham na Pashyate* i.e. unable to see small objects) resemble to the clinical features of Presbyopia.

AIMS & OBJECTIVES

1. To review the anatomical changes occurring in human crystalline lens with growing age.
2. To review the anti-aging effect of *Chakshushya dravyas, Rasayana and Kriyakalpa* on Human crystalline lens.

MATERIAL AND METHODS 3.1. Healthy human crystalline lens structure and suspensory ligaments,

The Human lens is a clear, biconvex, crystalline structure positioned between the iris and the vitreous in the patellar fossa, a saucer-shaped depression. It has a diameter of 9-10 mm and a thickness that fluctuates with age, ranging from 3.5 mm at birth to 5 mm as an adult (at extreme of age). Its weight ranges from 135 milli-grammes (0-9 years) to 255 milli-grammes (10+ years) (40-80 years of age). It has two surfaces: the anterior is less convex than the posterior (radius of curvature 10 mm) (radius of curvature 6 mm). At the equator, these two surfaces meet. It has a 1.39 refractive index and a total power of 15-16 D. The lens has accommodative power varying with age, ranging from 14-16 D (at birth) to 7-8 D (at 25 years of age) to 1-2 D (at 50 years of age) (at 50 years of age). The lens's architecture and cellular contents are critical to its transparency. The transparency and high refractive index of cells in the lens are induced by the tight packing of their proteins, which provides a constant refractive index over distances close to the wavelength of the transmitted light.

Lens suspensory ligaments (Zonules of Zinn) also known as ciliary zonules, are made up of a series of fibres that run from the ciliary body to the lens. These keep the lens in place while allowing the ciliary muscle to work on it.

Aging effect on human crystalline lens

There are three stages of age related changed in the crystalline lens development growth and aging.

Physical changes-

- Lens weight and thickness increases steadily with age. It results due to continued growth of the crystalline lens throughout life building up layers of new cells from the equator.
- The inability of cells in the encapsulated lens to be replaced, combined with the inability of lens cell proteins in nonnucleated fibre cells to turn over, makes the lens particularly vulnerable to damage from ageing and environmental insults such as UV light and other oxidative stresses. This causes a decrease in light transmission and focusing even in normal aged lenses, so that the intensity of light reaching the retina is reduced by about 10-fold by the age of 80 years.
- Although the human lens is colourless at birth, it gradually becomes yellowish with age, most likely due to the production of 3hydroxykynurenine and other tryptophan metabolites that filter UV light.
- With growing age, vacuoles and multilamellar bodies form between lens fibre cells, occasionally disrupting the fibre plasma membrane. Furthermore, the majority of the elaborate cytoskeletal structure found in lens cells disappears with age, resulting in presbyopia by the fifth decade, with loss of the ability to accommodate.
- Light Scattering is increased with the age. It has been reported to be caused by aggregation and formation of a gel- like state.

Metabolic changes -

Most of the metabolic activities of the lens decreases with age. The proliferative capacity of human lens epithelial cells declines during adult life. Many enzyme activities decline in the whole lens with age. There occurs an increase in the urea- soluble protein at the expense of soluble proteins, ongoing from cortex to nucleus.

Changes in Crystallines –

There occurs an age- related loss of γ- crystallines. The γ- crystallines fraction in particular shows an increase in disulphide bonds age. These occurs a limited unfolding of bovine γ- crystallines with age.

Changes of Plasma membrane And Cytoskeleton –

There occur age-related losses of membrane proteins and lipids and of cytoskeletal proteins. A loss of membrane potential and an increase in lens sodium and calcium occurs with age. Changes in membrane rigidity- also occur with aging.

Management

- Intake of *Chakshushya ahara* i.e. *Shali, Godhuma, Mugda, Saindhava, Go-ghrita, Go-dugdha, and Kshodra.*
- Intake of *Chakshushya aushadha dravya* and *Chakshushya Vargai.e. Triphala, Shatavari, Yava, Patola, Karpura, Rakta Chandana, Kasturi, Lavanga, Prapondarika, Yashtimadhu, Kokilaksha, Gambhari* etc.
- *Kriyakalpa* i.e. *Ashchyotana, Seka, Anjana, Tarpana, Putapaka, Pindi, Vidalaka,*
- *Nasya karma*
- *Chakshushya Basti*
- *Trataka Yoga Kriya* and Eye exercises

RESULT AND DISCUSSION

Presbyopia is an eyesight of old-age occurring after 40 years of age in which the lens becomes less elastic, more thickened and suspensory ligaments become weak resulting in poor accommodation.

In Presbyopia, the subject faces difficulty in near vision while having normal far vison and asthenopia symptoms like eyestrain, headache, intermittent diplopia etc. The symptoms of Presbyopia resemble with the clinical features of *Prathama patalagata Timira and Dwitiya patalagata Timira*. Ayurveda plays a very important role while dealing with age related disorders.

Presbyopia can be prevented by regular use of *Chakshushya dravas, Chakshushya Ahara* and by following *Vihara* beneficial for eyes. It can also be cured by using *Kriyakalpa* (local therapeutic procedures), *Nasya, Chakshushya Basti* etc. *Trataka Yoga Kriya* and Eye exercises are also very beneficial in relieving the asthenia symptoms. These treatment modalities provide better nutrition to the eyes and strengthens the lenticular and extra-lenticular structures such as suspensory ligaments, ciliary muscles etc.

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