PRESBYOPIA - the plot behind reading glasses

"My old Grandmother never needed glasses ..... she always drank straight out of the bottle!"

As people age, their ability to focus on near objects gradually declines. It happens to almost everyone: by the middle age reading without glasses becomes increasingly difficult. The “near point” of focus gradually moves towards the “far point”. The eye as an optical system so the nearer an object, the more light must be converged if the eye is to see clearly. Only the lens can alter its front and back curvatures to increase its focusing power.

Helmholtz (1850) described the physiology of accommodation and his work has been confirmed by study of aniridic (no iris tissue) and normal eyes' lenses by means of photography and mathematical modelling

PHYSIOLOGY: lens is supported by 3 rings of filaments projecting from the muscular ciliary body which encircles the lens equator (Circle of Zinn).

- When the eye is focused on infinity (>6 metres), the sphincter-like ciliary body relaxes (i.e. expands) pulling the zonule taut thus flattening the front and rear surfaces and increasing the diameter of the equator of the lens. (Minimum refractive power). i.e. muscle relaxed and lens stretched.
- For near focus, the ciliary body contracts and moves forward relaxing the zonule and allowing elastic recovery of the lens which steepens the anterior and posterior curvatures. i.e. lens relaxed and the muscle contracted.

This process is dynamic and very accurately controlled to produce a clear image.

The Lens comprises concentric layers of long, ribbon-like interlocking cells surrounded by a thin capsule. The Capsule is a stretch-resistant but flexible basement membrane that transforms the discrete zonular stresses into an even perpendicular compressive force exerted on the lens. The curvature change is influenced by the internal structure of the lens.

The vitreous body lends support to the posterior surface of the lens - its natural liquifaction may have a role in the onset of presbyopia.

With age, the size of the lens increases (3.3mm diameter in infant → 5mm at 70yr old) as new fibres are laid down and the nucleus enlarges due to dehydration and compaction of successive layers of deeper cortical cells. i.e. the lens curvature increases and anterior & posterior poles separate, the lens & capsule elasticity wane, the Zonules become slacker, tangential & ciliary muscle progressively fibroses and the index of refraction lessens due to protein change within the lens (the insoluble fraction of alpha-crystalline protein increases also causing glare). The result is a reduced refractive index and change in geometry of the lens-zonule-ciliary muscle complex reducing accommodation ability. These factors are counteracted to some extent by development of new refractive surfaces (Zones of Discontinuity), increasing curvature with growth and further sharpening with accommodation. Exceptions are myopes (short-sighted) and cataract-induced myopia (wherein developing nuclear sclerotic cataract blurs distance vison but improves near focus – for a time)

SUMMARY: it is normal and natural to need Reading Glasses **but always have an eye examination to exclude diseases such as glaucoma if your vision is changing.**

Tithonus is a mythological figure who suffered the burden of "cruel immortality". When his spouse (partner!), Eos, the Goddess of the Morn, asked Jupiter to grant him immortality she forgot to ask for eternal youth to go with it, so Tithonus became completely shrunken and decrepit in this eternity of senescence and ended up as a grass-hopper.