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Understanding Presbyopia

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Abstract

Young individuals are able to alter the focal length of their eyes to bring focus or clarity to objects at varying distances, (a process called accommodation). However, with age increase, the accommodative process decreases as a result of gradual hardening and loss of elasticity response of the crystalline lens to the contraction of the ciliary muscle leading to presbyopia. Presbyopia occurs when the near point of accommodation has receded to the point that it is difficult for reading or other close work; without the use of corrective lens. Age is the major risk factor and the clinical signs and symptoms may begin at early forties. Inability to see fine details at the customary near working distance is the hallmark. It is neither a disease condition nor a refractive error; but an anomaly of accommodation. It cannot be prevented, reversed by medication or any exercise. Its prevalence is directly proportional to the proportion of the older persons in the population. It can adversely affect the quality of vision and life of an individual; and those involved in more frequent near visual tasks are mostly affected earlier. The management involves optical, surgical or both interventions.

Keywords

Age, Amplitude of accommodation, Readers, Bifocals, Near addition.

Introduction

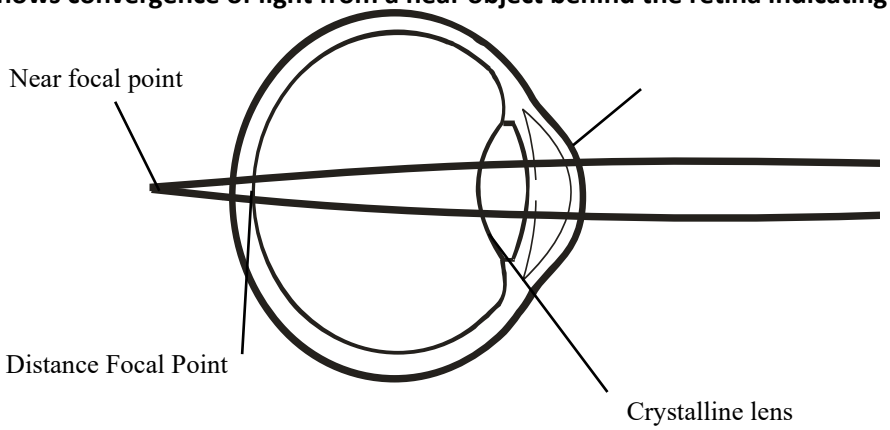
The eye like an optical instrument is able to vary its focal length to bring focus or clarity to objects at varying distances. It achieves this by altering the shape of the crystalline lens through the contraction of the ciliary muscle and relaxation of the suspensory ligament; or the reverse depending on the fixation point. The contraction of the ciliary muscle and relaxation of the suspensory ligament increases the thickness or the power of the lens thereby bringing images of near objects to a sharp focus on the retina. The reverse is also true in changing fixation from near to far objects, causes the lens to flatten (slight decrease in lens power) thereby bringing images of distance objects to a sharp focus on the retina. This physiological ability of the eyes to adjust its focal length to bring focus or clarity to objects at varying distances is known as accommodation (Grosvenor, 1999, Onyeahiri, & Agho, 2024). However, the maximum amount of accommodation the eyes can exert, or a measure of its accommodative ability is called amplitude of accommodation. Clinically, it is calculated as the difference in the dioptric power between near and far point of clear vision of the eyes, expressed in diopters (D) (Khurana, 2015).

Normally, the accommodative process is easily feasible in healthy young individuals, due to the flexibility of their eyes' crystalline lens allowing it to accommodate due to the ciliary muscle's ability to contract and relax. However, with age progression, the accommodative ability decreases; with a corresponding decrease in the range of clear near vision; as a result of gradual hardening of the lens and loss of its elasticity response to the contraction of the ciliary muscle, till a time it becomes almost impossible to accommodate (Grosvenor, 1999). This results in a physiological phenomenon called Presbyopia— a visual impairment associated with age progression (Mancil, et al., 2011). This impairment may also be associate with decreased contrast and glare sensitivity, need for increased lightening, and increased light scattering (Garner, 1983).

Clinically, presbyopia (adult long sightedness or old-age sight) is defined as an irreversible, normal, physiological, and an error of accommodation associated with age, which occurs when the near point of accommodation has moved farther away to the point that reading and other clos work becomes challenging without the use of an aiding lens (Grosvenor, 1999). It's caused by the gradual decline in the amplitude of accommodation due to natural structural aging changes in the crystalline lens of the eye (Mancil, et al., 2011). It is regarded present when the amplitude of accommodation drops to 5.00Diopters (5.00D) or less, since most adults needs about 2.50D of accommodation (100/40cm=2.50D) to read comfortably at the usual reading distance of 40cm (Grosvenor, 1999). The clinical signs and symptoms may begin at mid-to-late 30s or 40s, making common everyday tasks such as reading small-sized prints, using cell phone, threading a needle, sewing, picking stones from rice and other near activities more challenging. Individual may find themselves holding objects at arm's length or farther away for clarity and comfort (Muhammad, et al., 2015). It can significantly impact the quality of life and vision of an individual. However, its effects vary from person to person (Beers, & Van dour Heijde, 1996; Petel, & West, 2007). Those with demanding near-vision tasks like architects, computer operators, and watch repairers are more likely affected early (Mancil, et al., 2011).

In presbyopia, due to the decreased accommodative ability, it is difficult for the lens to change its shape in order to focus sharply on the retina images of close objects; instead they are formed behind the retina, leading to blurry near vision. Figure 1

Fig.1 shows convergence of light from a near object behind the retina indicating presbyopia.



Presbyopia develops gradually overtime, though its symptoms may seem sudden. It's a normal age-related decline in lens flexibility, not a disease, or refractive error as wrongfully assumed by some school of thought; but an anomaly of accommodation. It can't be prevented, reversed, or cured with medication or exercise. Presbyopia is a universal occurrence, as inevitable as 'death' and 'taxes' affecting everyone regardless of their gender. It is not genetically transmitted and it impacts even individuals with no prior vision issues. However, people with mild hyperopia may experience it earlier as a result of manifestation of latent hyperopia with associated decreased accommodative reserve (Grosvenor, 1999).

Though, presbyopia's onset can vary individually, however, there's generally a correlation between age and accommodative amplitude (Garner. 1983; Mancil, et al., 2011). This was first described by Donder in the 19th century and has been confirmed many times since by other authorities (Grosvenor, 1999). As people age, their amplitude of accommodation decreases, eventually reaching zero at age 75. However, after 55 years, any apparent accommodative ability is likely due to the eye's depth of focus or depth of field, not true accommodation (Grosvenor, 1999). The depth

of focus refers to the range behind or in front of the retina where an image remains clear, while the depth of field refers to the range in front of the eye where objects appear clear when moved toward or away from the viewer starting from the point where the optical image is sharply focused on the retina (Grosvenor, 1999). The depth of field varies directly with blur circle sizes. Therefore, in bright light, some presbyopes can read small text without an aiding device due to the pupil constriction and reduction in blur circle sizes. Presbyopia can occur in relation with refractive errors such as myopia (short-sightedness), hyperopia (long-sightedness), or astigmatism (Khurana, 2015; Asbury et al., 2016). It varies with associated visual task, lightening, drugs effect, overall health, and individual's arm length.

Presbyopia should not be confused with hyperopia as they are quite different optical entities. Whereas presbyopia is an accommodative error, hyperopia is a refractive error. In hyperopia, light rays from infinity are focused behind the retina due to the eyeball being shorter or the cornea being too flat than normal, while in presbyopia, light rays form a near object are focused behind the retina due to decreased accommodative power of the eye with age. In presbyopia, near visual tasks become difficult with advance in age (mainly 40 years and above but sometimes mid-thirties) while in hyperopia, near visual tasks are performed with strain in young age. Hyperopia may be hereditary while presbyopia is not but age related. Reading materials are held at normal working distance by hyperopes, while presbyopes hold theirs farther than normal. Besides, hyperopes are able to read in room illumination whereas presbyopes need brighter illumination. Both are related in the way they are managed with convex lenses (Plus lens), contact lenses or surgery (but surgical techniques differ).

Causes And Progression

The exact cause of presbyopia is not clearly understood. However, it is thought to be physiological part of the aging process, likely due to gradual thickening and loss of the elasticity or flexibility of the crystalline lens (Khurana, 2015). Overtime, aging changes in the lens protein causes it to harden and less elastic, thereby reducing its ability to respond to the ciliary muscle's contraction during accommodation (Grosvenor, 1999). Additionally, the ciliary muscle may weaken with age from physiological workload spent on accommodation over the years. It could also be linked to changes in the lens's shape as it grows and thicken overtime (Garner, 1983). These changes result in reduced ability to accommodate at near making near visual tasks more challenging.

Besides aging, other factors can cause early loss of accommodation ability, including certain medications with cycloplegic effect, ciliary muscle palsy, severe uncorrected farsightedness, ocular inflammation such as uveitis, eye alignment issues, injury, or chronic alcoholism. Symptoms may mimic presbyopia, but a thorough examination is needed to determine the underlying cause, especially if the issue affects one eye more than the other since accommodation is usually equal and bilateral (Carlson, & Kurtz; Mancil, et al., 2011).

Presbyopia typically progress slowly over 10-15 years before stabilizing (Beers, et al., 1996; Grosvenor, 1999). However, some people with normal vision (emmetropes) or mild farsightedness may experience an apparent increase in farsightedness after using reading glasses for some months or years, due to decrease of their residual accommodative amplitude reserve and subsequent manifestation of previously hidden farsightedness (latent hyperopia) (Grosvenor, 1999). For instance, a 42-year-old +0.25DS hyperope, requiring a +1.25DS reading glasses may find out that at 45 years, the +1.25DS reading glasses may no longer be effective for close work, rather ideal for distance vision. This is often times referred to as 'hyperopia of presbyopia' (Grosvenor, 1999).

For most presbyopes, near visual tasks becomes challenging when accommodative amplitude drops below 5.00D. One rule of the thumb states that; 'clear and comfortable vision for sustained near work is possible as long as not more than one-half of the amplitude of accommodation is used' (Carlson, et al., 2004; Grosvenor, 1999). This concept works best for emmetropes rather than those with existing refractive errors that can impact their accommodative amplitude. This principle guides the temporary prescription for near vision correction, taking into account the patient's working distance and accommodative amplitude. Thus: Tentative Add = Working Distance (WD) — ½ Amplitude of accommodation (Grosvenor, 1999).

This idea is that for near work at 40cm, (which is the usual reading distance for most adults), 2.50D of accommodation is needed. This general rule implies that an individual with 5.00D of accommodation wouldn't need reading glasses for his near work as they would use half of the amplitude of accommodation (2.50D) for near work and keep half in reserve.

However, someone with 2.00D of accommodation would need1.50D addition in the form of reading glasses or bifocal (thus, making up 2.50D required for comfortable near work); to comfortably carry out near visual tasks, as he will routinely use 1.00D and keep 1.00D in reserve. Other methods to determine tentative near lens prescription include plus lens to clear vision, balanced range of accommodation (negative relative accommodation/positive relative accommodation), and crossed cylinder test (Carlson, et al., 2004; Mancil, et al., 2011). This result is a starting point that needs refinement to determine the final prescription.

Pathophysiology

The crystalline lens grows throughout life adding new fibres to the outer layer (outer cortex) while compressing older fibres into the inner nucleus, causing it to harden and less elastic. (Beers, et al., 1996; Grosvenor, 1999). This reduces the lens's accommodative response to the contraction of the ciliary muscle (Carlson, et al., 2004). Additionally, the ciliary muscle may weaken with age from physiological workload spent on accommodation over the years (Garner, 1983; Beers, et al., 1996). When performing near visual task, the lens and the ciliary muscle have to be more flexible and work synergistically to bring clarity to near objects. However, as a result of these aging changes, the eyes has challenges executing with ease near visual leading to blurry vision known as presbyopia.

Signs/Symptoms

Presbyopia develops gradually, often becoming noticeable earlier in people who do extensive near visual demanding tasks (Beers, et al., 1996; Mancil, et al., 2011). Blurry near visual tasks or inability to see fine details at the customary near working distance is the hallmark (Mancil, et al., 2011). Working distance is that distance at which an individual would like to do most of his or her near work conveniently (Rènée du, 2006). The symptoms become significant when the patient's accommodative amplitude becomes inadequate for near visual needs (Grosvenor, 1999; Carlson, et al., 2004). Other common symptoms include; difficulty accommodating sufficiently at near, delayed adjustment between near and far vision, headache, diplopia (double vision), squinting (eyestrain), tearing itching, and fatigue or drowsiness (Mancil, et al., 2011). People may also hold reading materials farther away, need for brighter light for reading, and experience focusing problems in dim illumination (Asbury, 2007; Khurana,2008). Symptoms can be worst in the morning due to fatigued eye's accommodative apparatus from lack of good night rest (Asbury, et al., 2016)

Presbyopia symptoms like blurry near vision, difficulty changing focus, and eye strain are due to decreased accommodative amplitude (Beers, et al., 1996; Mancil, et al., 2011). Need for brighter light for reading helps by increasing depth of focus through pupillary constriction (Grovenor, 1999). Headaches and fatigue are linked to tension of the orbicularis muscle or part of the occipitofrontalis muscle and frustration from struggling to focus at near (Mancil, et al., 2011). Drowsiness occurs due to prolonged strain on accommodative apparatus over extended time. Diplopia occur as a result of exotropia along with increased exophoria and decreased positive fusion vergence amplitude, both of which are prevalent in presbyopia (Grosvenor, 1999); Mancil, et al., 2011). Presbyopes tend to be more exophoric at near even while putting on their reading prescriptions (Mancil, et al., 2011). This is because no interplay of accommodative convergence and accommodation while wearing their near correction (Grosvenor, 1999). However, they can maintain single binocular vision using proximal convergence or positive fusional vergence, even without accommodative convergence (Mancil, et al., 2011). Despite reduced or loss of accommodation in presbyopes, the innervation to accommodative mechanism remains unbroken. However, they utilize accommodative convergence to sustain single binocular vision, though their accommodation response is insufficient (Grosvenor, 1999; Mancil, et al., 2011).

Types of Presbyopia

PREMATURE PRESBYOPIA: This condition involves insufficient accommodative amplitude for near visual tasks at a younger age than typical, potentially caused by factors like environment, nutrition, disease, medication, or conditions such as uncorrected farsightedness, premature lens sclerosis, eye trauma, or chronic simple glaucoma. (Mancil, et al., 2011)

INCIPIENT PRESBYOPIA: This is also known as borderline; beginning; earlier or pre-presbyopia. It is a stage where reading small prints requires extra effort. Patients may need reading correction as suggested by patient's history, but

often performs well on visual test and might prefer not to be corrected if given the choice (Mancil, et al., 2011). Some may experience blurry distance vision due to undiagnosed latent hyperopia or slowed lens-ciliary body complex during relaxation from near focus to distance. (Mancil, et al., 2011). If left unaddressed, patients may develop a dislike for reading or near visual tasks due to the extra efforts require to maintain comfortable near vision.

FUNCTIONAL PRESBYOPIA: This occurs when the amplitude of accommodation is significantly reduced, making reading additions necessary for near visual tasks. (Asbury, et al., 2016; Mancil, et al., 2011). It can also be called Manifest presbyopia. The age of onset varies depending on factors like distance vision status, environmental demands, nutrition, and overall health of the individual (Mancil, et al., 2011).

ABSOLUTE PRESBYOPIA: This is the stage where accommodative amplitude is virtually lost. This means that the amplitude of accommodation is zero (Grosvenor, 1999; Mancil, et al., 2011). Any apparent accommodative mechanism is due to the eye's depth of focus or depth of field, typically occurring around age 75 (Grosvenor, 1999).

NOCTURNAL PRESBYOPIA: This is a condition where near visual task is challenging in low or dim illumination due to decreased amplitude of accommodation (Beers, et al., 1996; Mancil, et al., 2011). This is often caused by increased pupil size, leading to larger blur circles and reduced depth of field as a result of dim illumination (Grosvenor, 1999).

Prevalence

Presbyopia is more common in societies with higher life expectancy, where more people live into older age (Mancil, et al., 2011). Since presbyopia is age related, its prevalence increases with the proportion of older individuals in a population. However, researching presbyopia can be challenging due to the lack of a universally accepted definition and standardized measurement techniques (Petel, et al., 2007). Hence, the prevalence of presbyopia varies depending on its definition, such as the near vision testing distance and the chosen endpoint (Petel, et al., 2007). According to World Health Organisation, in 2005, it estimated that over 1 billion people globally had presbyopia, with approximately 517 million lacking proper corrective lenses, representing about 49.7% of those affected (Holden, et al., 2008; Obajolowo, et al., 2016). Of those without adequate correction, an estimated 410 million had some level of disability in performing near visual tasks (Holden, et al., 2008). More recent estimates suggest the number of people with presbyopia could be around 1.8 billion, with 826 million experiencing near visual impairment due to inadequate correction (Fricke, et al., 2018). The vast majority of this number lived in developing countries. The global prevalence of presbyopia was projected to increase from 1.04 billion in 2005 to 1.37 billion by 2020 and 1.78 billion by 2050 (Holden, et al., 2008). According to the Bureau of Census, more than 76 million people in the Unites States (28% of the population) were older than 50 in 2000. This number is expected to increase to 121 million (36% of the population) in 2025 and to more than 148 million (37% of the population) by 2050 (Holden, et al., 2008). Based on arbitrary definition of presbyopia, U.S Census Bureau figures suggest that in everyone over 40, approximately 112million Americans had presbyopia in 2006, with expectations of continued growth in the following decade (Mancil, et al., 2011). Also, studies show that up to 94% of people with presbyopia in some African and Asian countries lack corrective lenses. This translates to potentially over 500 million people without access to necessary eye care and spectacles (Holden, 2007). A survey of ocular morbidity in rural Uganda adults, presbyopia was the leading cause of visual impairment for which treatment was sought, accounting for 48% of cases (Petel, et al., 2007). Morny, using hospital chart reviews, found a prevalence of presbyopia of 65% in Ghanaian women. Also, Pointer, and Muhammad, et al., in his clinic based study, and a population-based cross-sectional study respectively observed that presbyopia affected women earlier than men (Petel, et al., 2007; Muhammad, et al., 2015). This may be attributed to hormonal changes as a result of onset of menopause. Furthermore, a population-based cross-sectional study to determine the prevalence of presbyopia in rural Gwagwalada, Abuja, Nigeria; found a 53.4% prevalence of presbyopia in the sample population of aged 40years and above (Muhammad, et al., 2015). The study revealed a high magnitude of presbyopia among communities where reading is uncommon in rural Nigeria. The study further emphasized the need for provision of near vision spectacles even in the communities with limited reading habits, as everyday tasks like threading needles, cutting finger nails, weeding, cooking, dressing children, adjusting lamps, and sorting grains require adequate near vision (Muhammad, et al., 2015). It will be a misconception to assume presbyopia doesn't affect quality of life in communities where reading and writing are less common, such as rural areas and middle-income countries (Petel, et al., 2007). Besides, increasing trained eye car personnel and establishing affordable spectacle delivery system in developing countries can help

address the challenge of presbyopia (Muhammad, et al., 2015). Research have shown that age of presbyopia onset varies geographically, with hotter climates linked to earlier onset (Petel, et al., 2007; Mancil, et al., 2011). This may be related to increased exposure of the crystalline lens to ultraviolet radiation and higher temperatures, particularly near the equator (Mancil, et al., 2011).

Risk Factors

AGE: This is the primary factor for presbyopia, typically affecting people in their late-30s to 40s due to reduced accommodative amplitude. However, it can occur prematurely due to factors like nutrition (lack of essential macro and micro nutrients to the eyes) (Mancil, et al., 2011).

GENDER: Studies had shown that women tend to develop presbyopia earlier than men, possibly due to hormonal changes and menopause onset (Petel, et al., 2007).

OCCUPATION: The impact of presbyopia varies by person, with those engaged on near visual demanding tasks such as typists, architects, and computer operators likely to be affected earlier. (Beers, et al., 1996).

HYPEROPIA: Individuals with high uncorrected or latent hyperopia may develop presbyopia earlier due to increased accommodative demand on near visual tasks without corresponding accommodative reserve (Mancil, et al., 2011).

SYSTEMIC DISEASES: The alternate fluctuation in the blood sugar level in management of diabetes mellitus as well as oxidative damage from free radical reaction as a result of metabolic activities in the body can results in the swelling, opacification and fluctuation in the refractive error of the crystalline lens of the eye due to osmotic stress (Garner,1983). This lens changes occur in the form of senile nuclear sclerosis, posterior subcapsular changes and cortical opacities (Asbury, et al., 2007; Khurana, 2015). The lens sclerosis in diabetic patient usually cause early onset of presbyopia. In addition, cardiovascular accident can also dispose one to developing presbyopia due to impaired accommodative innervation (Mancil, et al., 2011). Other systemic diseases that can lead to early development of early presbyopia include vascular insufficiency, multiple sclerosis as a result of impaired innervation, myasthenia gravis, measles, and influenza (Mancil, et al., 2011).

OCULAR TRAUMA/ IATROGENIC FACTORS: Eye trauma or certain ocular procedures like scatter (pan-retinal) laser photocoagulation or intraocular surgery, can cause premature presbyopia by damaging the lens (cataract), zonules or ciliary muscles through lack of accommodative innervation (Beers, et al., 1996; Khurana, 2015).

DRUGS: Long-term use of certain medications such as antianxiety agents, antidepressants, antipsychotics, hydrochorothiazides, antihistamines, and cycloplegics as well as chronic alcohol consumption can impair accommodation mechanism, potentially leading to premature presbyopia (Mancil, et al., 2011).

GEOGRAPHIC FACTORS: Research links presbyopia onset to hotter climates near the equator, possibly due to increased ultraviolet radiation and temperature on the crystalline lens (Petel, et al., 2007; Mancil, et al., 2011). People with higher melanin levels in these regions also tend to develop presbyopia earlier (Holden, et al., 2008).

Management

Presbyopia has no absolute cure, but can be managed with corrective lenses (convex or plus lenses), plus contact lenses, or surgery, which compensates for the loss of accommodative amplitude rather than restoring it (Mancil, et al., 2011). Patients' age is a key factor in diagnosis and management of presbyopia, helping determine if the they are within the typical presbyopic age range or not (Beers, et al., 1996; Mancil, et al., 2011). However, understanding a patient's vocational and avocational activities is crucial in determining the most suitable management option for presbyopia (Carlson, et al., 2004). Effective patient education by the practitioner is a key to successful presbyopia management, helping patients make informed decision about their treatment. Besides, a patient's medical history is key in premature presbyopia diagnosis, as conditions like diabetes mellitus, glaucoma, hypertension, neurological disorder, ocular trauma, and certain medications like antianxiety, antipsychotics, antidepressant agents, and antihistamines can increase the risk of early onset (Garner,1983; Mancil, et al., 2011).

Accurate distance vision correction is essential for effective presbyopia management (Rènée du, 2006). The effective power of presbyopia correction is the sum of the distance correction and the near correction powers. As the near visual acuity decreases, the near correction power (Near Addition) increases. The patient should try out the near vision correction to ensure the range of clear near vision is comfortable and acceptable (Rènée du, 2006). The range of clear near vision refers to the distance between the closest and the farthest points where a person can see clearly and comfortably with their near prescription (Rènée du, 2006). A myopic person might notice that removing their distance glasses helps them read, illustrating how uncorrected refractive error affects presbyopia (Grosvenor, 1999). However, the amount of myopia may be uneven, and astigmatism may also be present, affecting the ability to use distance glasses for near work due to the amount of myopia being either insufficient or excessive for it. In addition, taking off glasses to read is often less convenient than wearing reading glasses. In contrast, uncorrected hyperopes often need reading correction earlier than those with normal vision (emmetropes) due to underlying latent hyperopia. Due to lens effectivity (Base-in for the myope and Base-out for the hyperope), low to moderate hyperopic spectacle wearers usually need their first near addition at an earlier age or need a stronger addition than their spectacle wearing myopic counterparts (Garner, 1983). In addition, myopic patients typically need weaker bifocal prescription than same-aged hyperope wearing spectacle for his hyperopia correction (Garner, 1983). However, in contact lens corrected ametropes, this difference does not apply due to dioptric effectivity at the cornea. Hence, a pre-presbyopic myope who wears contact lenses may require reading addition earlier than if he had been putting on glasses. Contrarily, for hyperopic individual who wear contact lenses for distance vision, the need for reading glasses may be delayed (Garner,1983; Beers, et al., 1996). This is due to the optical difference between the spectacles and contact lenses as a result of the dioptric effectivity at the cornea. During eye exams, controlling accommodation is crucial, especially for patients developing presbyopia, to avoid underestimating the needed lens power (Mancil, et al., 2011). This issue is more significant for people with undiagnosed latent hyperopia or uncorrected hyperopia who are also developing presbyopia. Not everyone needs reading correction, especially if they don't do much close work or don't experience discomfort. These patients should be informed about potential visual changes and schedule for follow-ups (Carlson, et al., 2004). Patients can as well compensate for reduced accommodative amplitude by using good lightening or adjusting reading distance further away. They may also benefit from use of reading glasses. (Carlson, et al., 2004; (Mancil, et al., 2011).

Eye glasses in the form of Readers (Reading glasses or Single vision convex lens), Bifocals, Multifocals (e.g. Progressive addition lenses (PAL) or Varifocals or Varilux), or plus contact lenses are the most common, cheapest and effective solution or means of "correction" for presbyopia. Fig. 2. (The word correction appears in quotation mark because the lens does not actually correct anything. It only compensates or acts as temporary aid for clear near vision when worn; when remove, the vision returns to its original state) (Grosvenor, 1999). The same principle applies to lenses for hyperopia, myopia, and astigmatism correction.

Readers are a cost-effective option for presbyopia, providing a wide field of view compared to any form of spectacle correction, and are worn only for near visual tasks. Research shows that reading glasses or glasses in general doesn't slow or speed up presbyopia progression, which is a common concern of many patients. However, two method based on sound optical principles can potentially delay the need for reading glasses early: correcting undiagnosed hyperopia and reading in bright light. Bright light helps by reducing pupil size, increasing depth of filed, and allowing some people to read without glasses. (Asbury, et al., 2016; Grosvenor, 1999). Some people find readers inconvenient because they have to constantly put them on and take them off, and it can cause blurry distance vision when looking at far objects. This potential issue should be shown to patients before prescribing readers (Mancil, et al., 2011). Also, many people dislike reading glasses due to their association with aging. However, one solution to the distance blur issue is to wear readers lower on the nose (a little below eye level like the traditional half eye spectacle), allowing the wearer to look over the lenses for distance vision (Mancil, et al., 2011). It's best to get a proper eye examination before purchasing readers (mainly from over-the-counter at a retailer's store), as buying readers without a prescription can lead to incorrect lens power and can cause visual discomfort.

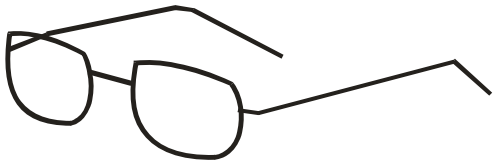
Bifocals, or progressive addition lenses (PAL) can be more convenient than readers, as they combine distance and near vision in one lens, eliminating the need to switch between glasses. Typically, bifocals have a larger area for distance vision and a smaller area at the bottom for near vision, allowing the wearer to easily switch between the two depending

on the task at hand. It comes in various designs and sizes like: executive, round, flat-top, curved-top, blended, and ultrex (Mancil, et al., 2011). The right glasses are chosen based on a patient's needs. An advantage of using bifocals for near visual tasks is that a correction for residual astigmatism, or even a prism correction, in the case of a binocular vision problem, can be incorporated into the lens (Grosvenor, 1999). However, some bifocal wearers may experience issues like blurry distance vision when the eyes suddenly look through the near portion, near object magnification, limited field of view, reduced range of vision, diplopia, object displacement, image jump, and that segment line can also be a cosmetic concern as it is thought to betrays one's age. Additionally, bifocals can be impractical for certain profession (e.g. a grocery clerk, violinist) that requires looking up frequently (Carlson, et al., 2004).

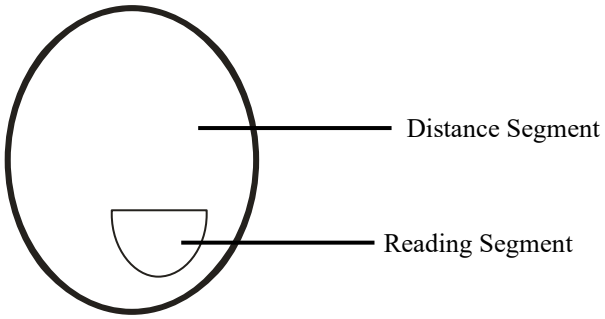
Progressive addition lenses (PAL) provide a seamless transition between distances, intermediate, and near vision without a visible line of demarcation, offering clear vision at all distances, though with some limitations on peripheral vision (narrower field of view towards the bottom). The top portion of the lens is for distance vision; the central part is for middle vision while the lower portion is for close task. Unlike Readers, Bifocals and PAL can be worn all day. Some people need time to adjust to progressives due to their narrow field of view. Many presbyopes prefer PAL over bifocals because they look like single-vision lenses (demarcation line not visible), making them more cosmetically appealing and invariably does not betray one's age as Bifocals.

Fig.2. showing readers, bifocals and progressive addition lenses for presbyopia correction.

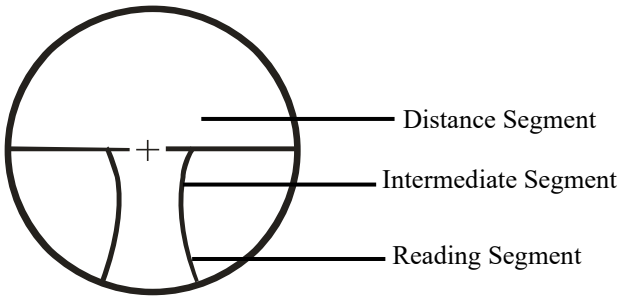
2(i) Reader.



2(ii) Bifocal lens



2(iii) Progressive lens



Near vision glasses typically need to be updated every 2-3 years due to age-related changes in the crystalline lens. This is usually necessary when the old glasses become uncomfortable or when a stronger prescription (at least +50.0DS more) improves vision (Rènée du, 2006). Besides, if a person starts holding reading material farther away to see it clearly, it's a sign that the reading glasses needs update. When a significant prescription change is required, it's often better to adjust the power gradually over 6-12 months to help the patient adapt comfortably (Carlson, et al., 2004; Mancil, et al., 2011).

The right solution for presbyopia correction – whether reading glasses, bifocals, or contact lenses depends on individual factors like lifestyle, age, occupation, hobbies, arm's length and personal preferences (Mancil, et al., 2011). Where there is a distance refractive error such as hyperopia, myopia, or astigmatism; it should be corrected as well. The

maximum comfortable convex lens with which the patient can see clearly and comfortably at near should be prescribed, since over correction or under-correction will also result in asthenopic symptoms (Khurana, 2008). In the same vein, where there is a need for distance vision such as driving, watching television or other daily activities, coupled with the need for reading, or those who experience significant difficulty using multifocal lenses, options are available. Two separate pairs of glasses can be made —reading and distance glasses. This means that one need to keep changing glasses depending on what one is doing. Also, moving about with two separate pairs of glasses is a great inconvenience to some people. However, to avoid this discomfort, the glasses can be made as bifocal or multifocal (PAL).

As stated earlier, where there is distance refractive error, and the patient requires only reading glasses, the effective power of the reader is the power of the distance power and the addition. Thus a + 2.00 DS (distance error in both eyes) hyperope; aged 52 with an ADD of +2.00 will require + 4.00 DS as his reading glass only. Also, a 50-year-old +1.50—1.00 x 145 (distance error) astigmat, with Add of +2.00 will need +3.50—1.00 x145 as his reading glass only. Besides, a 52-year-old −3.00 DS (distance error) myope, with an ADD of +2.00 will need −1.00 DS as his reading glasses, but could read at 33 cm without glasses. However, a 40-year-old −1.00 DS myope with an ADD of + 1.00 DS will read without glasses because his reading power would be zero or Plano.

On the other hand, if the distance refractive powers of both eyes differ, then the reading power in both eyes will as well differ. For instance, distance refractive error: RE: +1.00DS; LE: +1.50DS; with ADD+2.00 in both eyes; then the reading glasses power alone will be RE: +3.00DS and LE: +3.50DS. This also applies to both myopes and astigmats. However, it should be noted that for a myopic eye, both the far point and near point of accommodation are located at a finite distance in front of the eyes, rather than at infinity for far point as in normal vision (Grosvenor, 1999; Asbury, et al., 2016). Hence, a myopic person has the advantage of being able to read at the far point, near point or at any point between the two without glasses even at the beginning of presbyopic age (Asbury, et al., 2016). The above is the reason for the phobia some has towards the use of glasses for reading; because they compare themselves to grandparents who didn't need them, but this is a misconception since refractive errors vary between individuals, and proper education can help correct this misunderstanding. However, some myopic presbyopes (mostly absolute myopic presbyopes) may experience blurry near vision when wearing their distance correction glasses or contact lenses, and might need to remove them to read or consider bifocals (Asbury, et al., 2007; Mancil, et al., 2011). This is because, as the far and near point of clear vision for myopes are located in front of the eye, correcting myopes for distance vision displaces the near point of clear vision to a point behind the retina (myopic lens correction is a diverging lens), and to bring it back to the retina for clear vision at near, requires a near addition lens (plus lens). This means a presbyopic myope who desired to read at far and near without removing the glasses requires a bifocal or varifocal glasses. On the other hand, the far point of accommodation for hyperopes is an imaginary line located behind the retina, hence hyperopes require constant accommodation for clear vision. However, the near point of accommodation varies based on the balance between their amplitude of accommodation and the severity of their hyperopia. If the amplitude of accommodation cannot overcome their degree of hyperopia, both the near and far of clear vision will be located behind the eye with the result that clear vision may be unattainable, even with maximum accommodation resulting in blurred vision (Grosvenor,1999). Hence, presbyopic hyperopes always require reading addition lenses for their near visual tasks.

When presbyopia starts, emmetropes typically needs a reading correction of around +1.00DS (Rènée du, 2006). A rough guide for prescribing reading glasses in an emmetrope can be based on patient's age as shown in table 1 below.

Table 1 showing suggested lens power for different ages in an emmetrope

PERSON'S AGE (YEARS)	LENS POWER (DIOPTER SPHERES DS)
40-45	+1.00 to +1.50
45-50	+1.50 to +2.00
50-55	+2.00 to +2.50
Over 55	+2.50 or higher

It is important to note that the weakest Addition power for presbyopia correction is +1.00DS and the maximum or strongest power is +4.00DS (Rènée du, 2006). Any Addition correction above +4.00DS are categorised as low vision aids and the patient; a low vision patient (Grosvenor, 1999).

Presbyopes can also use Contact lenses (either in Bifocal or Multifocal form); available in gas permeable rigid or soft lens material, giving the practitioner several options to provide clear and comfortable near vision. (Grosvenor, 1999). Other options include the monovision system (distance contact lens in fitted in one eye, and near vision contact lens on the other eye), and finally, bifocal or multifocal contact lenses can be fitted in both eyes (Grosvenor, 1999). Multifocal contact lenses allow both eyes to work together for distance and near vision. When prescribing contact lenses for presbyopes, factors like patients' refraction status, ocular health, and lens design needed to be considered (Mancil, et al., 2011). A patient's refractive error and ocular health can affect contact lens options and suitability. evaluating ocular physiology helps determine if someone is a good candidate for contact lens wear (Grosvenor, 1999). For instance, patients with dry eye syndrome, corneal dystrophy, and giant papillary conjunctivitis are not good candidates for contact lens wear due to their compromised corneal surface (Mancil, et al., 2011). Other factors to be considered include; patient's vocational and avocational activities, motivation and understanding, manual dexterity, personal hygiene and financial status (Grosvenor, 1999; Mancil, et al., 2011). If a patient doesn't want to wear reading glasses with contact lenses, monovision system, or bifocal contact lenses presents an alternative (Khurana, 2015). In monovision system, only one contact lens may be needed for these categories of patients: the low myopes (≤ 2.00 to 3.00D) may be fitted with a distance lens for one eye and no lens for the other eye for near vision, and an emmetropes or very low hyperopes may require lens for one eye used for near vision and no lens for the eye used for distance vision. Normally, one eye (dominant eye or stronger eye) wears a distance prescription and the other eye (weaker eye) wears a prescription for near vision (Grosvenor, 1999; Mancil, et al., 2011). The brain adapts to monovision by prioritizing one eye for distance and the other for near tasks. For monovision fitting to work effectively, the patient needs to have good visual acuity in both eyes (Grovenor, 1999). However, while some people appreciates monovision, others experience reduced visual acuity and depth perception issues. With monovision, reading glasses might still be needed for very small prints or prolonged reading, but the individual can often go without glasses for most of the day (Grosvenor, 1999; Mancil, et al., 2011). Bifocal contact lenses have not achieved the same level of success as bifocal glasses, partly because the segment on contact lens is small, requiring precise alignment for optimal vision (Grosvenor, 1999). With bifocal glasses, eye movements do not affect lens position but bifocal contact lens, move with the eyes, which can impact vision since the lens position shifts. When the contact lens wearer looks downwards, the lens tends to move upwards and when looked upwards for distance vision, the lens tends to move downwards. This problem of lens rotation in bifocal contact lens can be reduced by adding features like prism blast or truncation to stabilize the lens (Grosvenor,1999). Despite these limitations, bifocal contact lenses remain a viable option for prebyopes, offering quality and comfortable vision, thanks to advancements in the design and materials (Grosvenor, 1999). The disadvantage with contact lens is its high cost together with its accessories and require strict hygienic practices to prevent damage and infections.

Surgery is another option for presbyopia correction. These include: Monovision conductive keratoplasty (near vision CK), Laser in-situ keratomileusis monovision (Lasik monovision), Implantable bifocal or multifocal intraocular lens, Accommodating intraocular lens, Multifocal Lasik (Presbylasik), Laser presbyopia reversal, scleral expansion band, and corneal inlays (Grosvenor, 1999; Khurana, 2015). However, while surgical options show promise, none have proven safe and effective enough to become a standard treatment. (Mancil, et al., 2011). Surgery for presbyopia has disadvantages including high cost and potential need for additional surgeries every two to three years as it is age related in progression. Even after surgery, need for reading glasses may still be necessary for clear near vision. Besides, it can also lead to complications such as overcorrection, under-correction, astigmatism, vision regression, delayed epithelial healing, stromal haze, double vision, and ocular tenderness, potentially resulting in loss of binocular vision (Mancil, et al., 2011). Refractive surgery is irreversible and carriers potential side effects that the patients should fully understand before consenting. Its main benefit is reducing or eliminating the dependency on glasses.

When presbyopia is not properly corrected, it can lead to significant vision problems and negatively affect quality of life (Petel, et al.,2007; Mancil, et al., 2011). Uncorrected presbyopia can prevent adults from working effectively, leading to economic hardship, social exclusion, and a cycle of poverty that affects individuals' and their families

(Holden. 2007). Since it cannot be prevented, reversed by any exercise or medication, the focus should be on early detection and managing its effects. Public awareness campaigns through media, seminars, and workshops are essential to educate people about presbyopia and its implications (Mancil, et al., 2011). Some people view presbyopia as a spiritual issue, seeking helps from religious leaders or prayer houses. Educating people in their early 30s or 40s about presbyopia's symptoms and treatment options can lead to early diagnosis and better management. The world health organisation (WHO) stresses adult literacy for development, but good near vision is crucial for benefitting from literacy programs. Uncorrected presbyopia can hinder this and limit development progress, affecting not only reading and writing, but various daily tasks (Holden, 2007). Hence, good near vision is essential for many daily tasks beyond just reading and writing. As presbyopia progresses with age, regular eye exams and updates to eyewear are necessary to ensure clear and comfortable vision.

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