AOMA
亚洲眼视光执业管理协会
Asia Optometric Management Academy

Practice Guidelines for Presbyopia Management

Asia Optometric Management Academy (AOMA)
In association with Asia Optometric Congress (AOC)

Article I. Table of Contents

Article II. INTRODUCTION

This project was initiated by the Asia Optometric Management Academy (AOMA), and supported and recognized by the Asia Optometric Congress (AOC). This project involved a group of experts from the international authoritative optometry academic community and eye care practitioners all over the Asia-Pacific region. Taking the latest international professional development and practice directions into consideration, this group of experts have compiled the " **Practice Guidelines for Presbyopia Management** " using a neutral, evidence-based and comprehensive approach, taking into account current technological developments and operability. At the same time, these Guidelines integrates many perspectives from the latest scientific findings and the technological innovations that conform to the developmental concepts of the optometry industry. The promotion target is the Optometric Practice Group and Eye Care Practitioners in the Asia-Pacific region.

Article III. OVERVIEW OF PRESBYOPIA

Presbyopia is a global problem affecting 1.8 billion people worldwide in 2015. The prevalence is expected to skyrocket to 2.1 billion in 2030. The prevalence of uncorrected presbyopia is as high as 50% in those over 50 years of age in developing countries due to lack of awareness and accessibility to affordable treatment. The prevalence of uncorrected presbyopia is also reported to be as high as 34% in developed countries. There is a significant burden from uncorrected presbyopia, with the greatest burden in rural areas of low-resource countries, mainly due to a lack of adequate diagnosis and affordable treatment. Uncorrected presbyopia has a substantial impact on quality of life such as difficulties with reading, threading a needle, using cellphones and other digital devices, and seeing fine details on near objects. In essence, uncorrected presbyopia causes widespread, avoidable vision impairment throughout the world (Fricke et al., 2018; Holden et al., 2008).

Article IV. DEFINITION OF PRESBYOPIA

Definition: Millodot (2018) defined presbyopia as a refractive condition in which the accommodative ability of the eye is insufficient for near vision work due to aging.

A more physiological definition is given by Wolffsohn and Davis (2018). Presbyopia occurs when normal age-related changes in the eye cause a reduction in the eye's ability to focus at near such that the clarity of vision at near is insufficient to satisfy an individual's requirements.

Etymology: "Presbys": Greek means "old"; ops means "sight" (Aggarwal et al., 2021).

Risk factors: There are many risk factors for developing presbyopia. These risk factors include age over 40 years old (Katz et al., 2021), cigarette smoking (Andualem et al., 2017), history of pregnancy (Andualem et al., 2017), female sex (Hickenbotham et al., 2012), hyperopic or astigmatic refractive error (Weale, 2003; Han et al., 2018), ultraviolet radiation (Steven & Bergmanson, 1989), hotter climates (Sliney, 2002) and certain medical conditions such as diabetes (Srinivasan et al., 2021).

Prevalence: In 2015, 25% of the world's population was presbyopic. That is 1.8 billion people out of the world population of 7.3 billion (Fricke et al., 2018).

Age of Onset of Presbyopia: According to domestic and foreign academic and industrial research and survey data, the age of onset of presbyopia is getting younger and younger. A Chinese report showed that nearly 57% of the population over the age of 35 have presbyopia, and the age at which presbyopia first appears clinically is between 38-48 years old (Li L, 2016). This condition generally occurs between the age of 42 and 48 in people living in European and North American countries. People living in hot climates become presbyopic earlier at or before the age of 38 years (Millodot, 2018; Sliney, 2002; Jain et al., 1982).

The binocular accommodation of emmetropic adult eyes start to show signs of gradual decline between age of 40-50 years old (Wu QH, Zhong H,2020). In modern society, reading distance has shortened from 40cm for book reading to 33.8cm for reading mobile devices. It is estimated that this may bring forward the onset of presbyopia to 37 years old (Damien Paille et al., 2015). In accordance with this estimation, the first drug for presbyopia treatment approved recently by the US FDA – Pilocarpine 1.25% – included study participants aged 40 years and over in its clinical trial population (ABBVIE's published information).

Causes of Presbyopia: Age-related changes in the lens as a result of decreased lens elasticity and increased lenticular rigidity due to decreasing levels of α-crystallin (Millodot, 2018; Nandi et al., 2020a; 2020b).

Symptoms of Presbyopia: Presbyopia usually occurs after 40 years of age with a progressive loss of accommodation (Benozzi et al., 2012) The main symptom is blurry vision or difficulty in sustaining clear vision at near. Other symptoms may include eyestrain, a need to hold things further away, double vision at near, drowsiness, tearing, headaches and a need for an increased in lighting (Millodot, 2018; National Eye Institute, 2020).

Pseudophakic: Inability to refocus. If vision is corrected for distance, the patient will experience presbyopia symptoms.

Article V. OVERVIEW OF PRESBYOPIA CORRECTION TECHNOLOGY

The current treatment options available for presbyopia include single vision near spectacle correction, bifocal and progressive spectacle lenses, monovision contact lenses, translating or multifocal contact lenses, extended depth of focus contact lenses, monovision intra- ocular lenses (IOLs), extended depth of focus IOLs, multifocal IOLs, accommodative IOLs, light adjustable IOLs, corneal inlays, scleral expansion, laser refractive surgery, pharmacologic agents, multiple pin-hole glasses, improved lighting and electro-stimulation of the ciliary muscle. While clinicians can ameliorate the symptoms of presbyopia with these choices, none fully overcome all of the symptoms of presbyopia in all patients. The restoration of natural accommodation in a patient remains elusive and challenging (Wolffsohn & Davis, 2018; Charman, 2018).

Section 5.01 Current Presbyopia Treatment Options

Tablet 1:Current Presbyopia Treatment Options

Treatment Options	*Available method/technology*
Spectacles Correction	• Reading glasses (Charman, 2014; 2018) • Bifocals (Charman, 2014; 2018) • Trifocals (Charman, 2014; 2018) • Multifocals (Charman 2018; Meister & Fisher, 2008a; 2008b) • Alvarez reading glasses (Alvarez et al., 2017)
Contact Lens Correction	• Monovision • Modified Monovision (Charman, 2018) • Simultaneous design bifocals or multifocals (Kollbaum & Bradley, 2019) • Extended Depth of focus contact lenses (Quinn, 2020; Bakaraju et al., 2018a; 2018b) • Translating bifocals (Gasson & Morris, 2010; Charman, 2018)
Surgical Correction	• Monofocal IOL • Multifocal IOL (Rampat & Gatinel, 2020; Sieburth & Chen, 2019) • Accommodative IOL (Liang & Jia, 2018) • Light Adjustable IOL (Patel et al., 2022) • Extended depth of focus IOL (Kanclerz et al., 2020; Rampat & Gatinel, 2020).

	• Corneal inlays: such as Kamra, Raindrop-stop, Refractive corneal inlays (Hwang et al., 2021; Katz et al., 2021) • Laser refractive surgery: Monovision LASIK, PresbyLASIK, INTRACOR, SUPRACOR, Photorefractive keratectomy (Hwang et al., 2021; Katz et al., 2021) • Scleral implants, • Scleral laser anterior ciliary excision, • Scleral laser micro-excision (Hwang et al., 2021; Katz et al., 2021)
Pharmaceutical	• Pilocarpine 1.25% (Allergen, 2021; ClinicalTrials.gov, 2021; Grzybowski et al., 2020; Grzybowski & Ruamviboosuk, 2022) • Aceclidine and Tropicamide (Grzybowski & Ruamviboosuk, 2022; ClinicalTrials.gov, 2021) • Lens softener UNR844-a lipoic acid choline ester (Richdale, 2020; Korenfeld et al., 2021; Katz et al., 2021; Grzybowski & Ruamviboosuk, 2022) • Lens protein modification ViewPoint Therapeutics, 2019; Katz et al., 2021)
Alternative Treatment	• Ciliary muscle electrostimulation (Gualdi et al., 2017) • Multiple pinhole spectacles (Park et al., 2019) • Improved illumination (Charman, 2018)

Section 5.02 Overview of Advantages and Disadvantages of Treatment Options for Presbyopia (Adapted from Grzybowski & Ruamviboosuk, 2022)

Tablet 2:Overview of Advantages and Disadvantages of Treatment Options for Presbyopia

Treatment Options	Advantages	Disadvantages
Spectacles (Reading glasses, bifocals, trifocals, multifocals/progressive addition lenses)	• Non-invasive • Easy access • Very low risk of ophthalmic and systemic adverse events • Proven for long-term use • Can incorporate may features and designs to improve comfort and adaptability	• Temporary effect • Inconvenience • Lens fogging • Positional instability for sport • Gaze dependent for multifocals/progressive addition lenses

Alvarez Reading Glasses	• Very low risk of ophthalmic and systemic adverse events • Non-invasive	• Induce small amount of astigmatism • Induce some prismatic effect • Right and left eye lenses have to be adjusted separately with a change in task distances • The interpupillary distance isfixed • No provision for a basic sphero-cylinder distance correction for the wearer • Costly and heavy
Contact Lenses	• Convenient for those who regularly wear contact lenses • Good cosmetic appearance	• Temporary effect • Requires daily care of contact lenses • Affected by dry eyes • Affected by pupil diameter • Reduced contrast sensitivity • Straylight and glare problem • Risk of infection • Require good dexterity • Reduced depth perception with monovision
Surgical Multifocal IOL Implant	• Can be permanent • Low risk of systemic adverse events • May restore some accommodation with an accommodating IOL • Tackle cataract at the same time	• No proven standard procedure • The residual refractive error is less predictable • Surgical risks • Higher rate of symptomatic dry eyes • Straylight and glare problem • Reduced contrast sensitivity • Affected by pupil diameter • Halos

Corneal Inlays	• Reversibility • Good repeatability	• Compromise night vision and distance vision • Risk of corneal haze • Straylight and glare problem • Reduced contrast sensitivity • Affected by pupil diameter • Limited to good corneal health candidates
Laser Refractive Surgery	• Can be permanent • Low risk of systemic adverse events	• Some surgical risks • Higher rate of symptomatic dry eyes • Straylight and glare problem • Reduced contrast sensitivity • Refractive error may regress over time • Corneal haze problem • Compromise night vision and distance vision • Affected by pupil diameter • Irreversible
Scleral Implants	• May improve some dynamic accommodation	• High risk of surgical complication • Refractive outcome is less predictable
Pharmacologic	• Easy to use • No spectacles or contact lens needed except for distance correction • No surgical risk	• Temporary effect • Risk of ophthalmic and systemic adverse events such as headaches and redness • Required long-term application • Reduced contrast sensitivity • Reduced retinal illuminance • Affected by pupil diameter

Ciliary Muscle Electrostimulation	• Non-invasive treatment • Improves reading speed • Restores some dynamic accommodation	• Regular and Repeatable procedure • Done in the clinical setting • Temporary effect • Only for early presbyopia • Need to optimize the electrostimulation parameters (time, voltage and device)
Multiple Pinhole Glasses	• Do not require a prescription • Easy access • Very low risk of ophthalmic and systemic adverse events • Inexpensive	• Poor reading speed • Low legibility • Increased inter-blink interval • Shortened tear break up time • Uncomfortable and excessive eye fatigue • Poor cosmesis • May cause double/multiple images • Reduced visual field
Improved Illumination	• Inexpensive • Easy access • Does not require a prescription	• Eye fatigue • May not be significant for patients with small pupil • Limited effect for short working distances • Not much improvement for late presbyopia or for more progressed presbyopia

Article VI. PRESBYOPIA MANAGEMENT

Section 6.01 Optometric Presbyopia Management

Optometric presbyopia management mainly focuses on optical correction, spectacles and contact lenses. Both are non-invasive and they are the most viable options for presbyopia correction. Spectacle correction is the most accessible intervention for correcting the symptoms of presbyopia, however no currently available spectacle lens can fully restore the dynamic range of natural accommodation in the aging eye. Single vision reading glasses are commonly used to correct presbyopia. Bifocal, trifocal and progressive addition spectacles correction incorporate zones of various optical powers for viewing objects at various distances. This type of correction provides greater convenience to patients (Charman, 2018; Katz et al., 2021). The Alvarez reading glasses are not commonly used to correct presbyopia due to inherent problems of induced astigmatism and the prismatic effect.

The advantage of spectacle correction for presbyopia is that extra features can be incorporated into the spectacle lenses such as anti-reflection, scratch resistance, anti-fog, anti-virus, anti-bacteria, anti-smudge, photochromic property, impact resistance, blue-light control, high refractive index, tint and so on to improve comfort, cosmetic appearance and satisfaction. In addition, with the advancement in technology in progressive lenses, many unique design features can be incorporated into the lenses to make the wearers more comfortable and adaptable. Some of these design features comprise integrated double surface design, view expansion, auto adjust, lifestyle adaptation, binocular harmonisation and infinite optics (Hoya Vision Care, 2022).

Another advantage of spectacle correction is that prisms or decentered optical center can be incorporated to create prismatic effect for comfortable binocular near vision. Such prismatic correction is not possible with contact lenses or IOL.

Although the wide range of currently available progressive spectacle lenses can provide excellent vision at far, intermediate and near distance, this is only obtained over a limited range of gaze directions for each object distance. The ideal correction should set no

constraints on gaze direction. The holy grail of perfect progressive spectacle lens is yet to be designed (Katz et al., 2021; Charman, 2018; Meister & Fisher, 2008a; 2008b).

Contact lens correction for presbyopia covers single vision distance contact lens correction with reading spectacles, monovision correction, or a bifocal/multifocal correction based on alternating, concentric or aspheric surface principles. The combination of a single vision soft or rigid gas permeable contact lens correction with reading spectacles can provide optimum vision at distance and near with less fitting complications compared to multifocal options. However, patients are still inconvenienced by taking glasses on and off to read (Katz et al., 2021). For patient with significant amount of astigmatism, however, contact lens correction may not be ideal.

Monovision and enhanced monovision correction with contact lenses involves correcting the dominant eye for optimal distance viewing and the non-dominant eye for near with either a single vision contact lens or a bifocal/multifocal contact lens. A major limitation with monovision is the reduction in stereopsis and contrast sensitivity. Both stereopsis and contrast sensitivity are critical for visual tasks such as driving (Katz et al., 2021).

The success of multifocal contact lenses can vary substantially across individuals due to differences to blur tolerance, ocular aberrations and neural adaptation. A variant of concentric multifocal contact lenses known as extended depth of focus contact lenses seem to perform well at intermediate and near distances (Bakaraju et al., 2018a; 2018b). Nevertheless, these lenses suffer from reduced image contrast at all distances (Wolffsohn & Davis, 2018; Katz et al., 2021).

Section 6.02 Spectacle Lenses for Presbyopia

To provide the optimum optometric solution for presbyopia management using spectacle lens, it is essential for eye care practitioners to understand the guidelines and challenges in fitting spectacle lenses for presbyopia. This includes a thorough comprehensive eye examination which includes proper determination of the patient's refractive error and near add. From an optical standpoint, the practitioner must have an extensive knowledge of the

various lens types and designs, accurate horizontal and vertical measurements for lens placement, and a proper understanding of the patient's needs, understanding of the symptoms and problem-solving for progressive lens fitting, practical tips for progressive lens prescription and clinical pearls for patients with moderate to high risk of falls. Training must be given to new wearers for proper use and to prevent fall risk.

(a) Spectacle Lenses for Presbyopia: Categories and Functions

Tablet 3: Categories and functions of Spectacles Lens for Presbyopia

Category	Sub-Class	Functions
Single Vision	Reading Alvarez lenses	For reading at near only
Bifocals/Trifocals	Round seg, D-seg, Executive	For both distance and near
Occupational Lenses	Office	For Intermediate and near
Progressive Addition lenses (PALs)	Standard/Personalised	For distance, intermediate and near

Tablet 4: The ideal features of progressive lenses and technologies

General Description	The ideal features of progressive lenses include clear vision, short adaptation period, wide field of vision, comfortable wearing (Xu L., et al., 2011)
Clear vision	1. Lens design with minimum optical distortion. 2. High optical quality and design, and lens coating
Short adaptation period	1. One area of the lens corresponds to several clear sight distances 2. Asymmetric design - simultaneous optimization of the far and near areas (Xiang HZ, et al., 2018) • Optimization of the nasotemporal balance of the individual lenses • Optimization of the visual balance of the left and right lenses in the same direction
Wide field of vision	Minimal or no significant blocking of vision at different gazes or different areas of field of vision.
Comfortable wearing	Personalized parameter measurement: monocular pupil distance, monocular mounting height, wrap angle, vertex distance, pantoscopic

	angle, habitual reading distance, reading habits (head-to-eye rotation ratio)
Other elements	Ability to personalise the individual needs based on the habitual use of vision, natural reading habits and ocular parameters.

(b)The Comprehensive Eye Examination

A comprehensive eye examination encompasses a problem-oriented examination approach. This problem-oriented examination approach aligns the eye examination around the problems reported by the patient. This approach uses tests that help solve the patient's problems, and also uses a system-examination approach. The system- examination approach includes an assessment of visual function, refractive error, binocular vision and ocular health (Elliott, 2021). Please see Table 5 (Elliott, 2021). To facilitate a comprehensive eye examination, please check out Appendix 1, 2 and 3 as the references for the examination protocol, its related instruments and selection of the suitable frame for progressive lens.

Tablet 5: Classification of tests/procedures into one of four clinical oculovisual systems

Visual*	**Binocular***	**Refractive**	**Ocular Heath**
Case History	Case History	Case History	Case History
Visual Acuity	Visual Acuity	Visual Acuity	Visual Acuity
Disability Glare	Cover Test	Retinoscopy	Biomicrosopy
Photostress Recovery	Vergence Tests	Autorefraction	Ophthalmoscopy
Contrast Sensitivity	Accommodation Tests	Subjective Refraction	Tonometry
Colour Vision	Suppression Tests	Reading Addition (or ADD)	Gonioscopy
Visual Fields	Stereopsis	Keratometry	Pupil Response
	Motility		Ocular Imaging

*Other classification charts have referenced the sensory and motor systems rather than the visual and binocular systems and place suppression and stereopsis within the sensory system

(i)Determination of Tentative Near Addition Based on Age (Adapted from Elliott, 2021)

One method to determine a patient's tentative near addition is based on patient's age (Please see Tablet 6, 7). The tentative near addition in Asians is slightly higher than Caucasians due to their shorter average working distance and warmer climate in Asia.

Higher addition is needed for working distance shorter than 40 cm. Over the age of 55 years, the patient's working distance appears to determine the near addition as accommodation approaches zero.

The tentative add is required to provide a starting point for the near add examination. There are 4 main ways of obtaining this estimate:

1. Through age estimates
2. With the Hofstetter equation
3. With the formula that accommodation loss 0.25D per year; and with 4D of accommodation at age 44, the accommodation at different ages can be estimated, for example, accommodation would be around 3D at age 50.
4. Measuring the amplitude of accommodation.
   Knowing the amplitude of accommodation, the tentative add could then be estimated.

Tablet 6 shows the tentative near additions for Caucasian and Asian populations based on age

Patient's age (Years)	Tentative Add (D) at 40 cm	Tentative Add (D) at 40 cm
	Caucasians	Asians
45	+1.00	+1.25
50	+1.50	+1.75
55	+2.00	+2.25

Tablet 7: Expert panel's suggested guidelines for average characteristics related to mild, moderate, and advanced presbyopia*. (McDonald MB et al., 2022)

	Mild presbyopia	Moderate presbyopia	Advanced

			presbyopia
Near add required	<+1.25 D	>1.25 to +2.00D	> +2.00D
Typical age	40–47 years	> 47–55 years	> 55 years

*These are averages for the distance-corrected presbyope. Some individuals may fall outside this chart. Near add required is the most significant indicator of severity of presbyopia.

(ii) TheProcedureofDeterminingtheNearAddition(AdaptedfromElliott,2021)

1. Determine the distance refractive error.
2. Add the distance correction to the trial frame using the trial case lenses (oradjusting the lenses if a phoropter is used).
3. Explain the procedure to the patient.
4. Ask the patient if he or she reads in normal room lighting or with additional reading light and use additional lighting if indicated.
5. Determine the near visual tasks the patient would like to perform and relevant working distances (measured with a tape).
6. Ask the patient to hold the near VA chart at the distance with which the patient would like to read/work.
7. Determine a tentative ADD based on the patient's age if patient is 55 years or below (adjust for dioptric working distance if further out than 40cm).
8. Determine a tentative ADD based on the dioptric working distance if patient's age is over 55 years.
9. Determine the range of clear vision with the binocular reading Addition.
10. The range of clear vision with the tentative ADD should encompass all the required near working tasks.
11. If you are unable to obtain a range that encompasses all required near working tasks, consider prescribing a progressive lens or separate near adds for differing visual tasks.
12. Record the final near add power, near visual acuity, and range of clear vision.

Note: In some patients with extremely small pupil (e.g., 2mm or less), the reading add may be lower for the age or near working distance. This is due to increase depth of focus for small pupil.

(c) Progressive Spectacle Lenses

(i) The Accurate Measurement of Fitting Heights for Spectacle Progressive Lenses (Adapted from Essilor Academy Europe, 2015)

With Traditional Instruments such as Pupillometer and Ruler

1. Position the pupillometer accurately at eye level between examiner and patient.
2. Set the pupillometer measuring distance at infinity.
3. Move the right and left reticles to bring them into line with corneal reflexes.
4. Take the measurement with both eyes open and then each eye in turn, using the pupillometer's eye occlude.
5. Read the right and left monocular interpupillary distances.
6. Now position the ruler on the patient's frame.
7. Get the patient to adopt a natural position and look into the distance at eye height.
8. Stand facing the patient at the same height with one eye open to avoid parallax error.
9. If the centre of the pupil is difficult to see, create a corneal reflex using a pen-torch.
10. The fitting height is the distance from the pupil centre to the frame bottom.
11. Note the pupillary height of right eye and left eye.

With an Electronic Measuring Column or Tablet

1. Centre the clip on the bridge of the frame.
2. Press the clip's rear hooks against the frame.
3. Make sure the hooks plane is parallel to the lens plane.
4. Ask the patient to position the frame with clip on his/her face, about 1 m from the column.
5. Ensure the patient adopts a natural posture.
6. Take a static front view with a video capture.
7. Check the positioning of corneal reflexes (cross on corneal reflection).
8. Accurate measurement of fitting heights can now be taken.

(ii) Troubleshooting Progressive Lenses (Adapted from Essilor Academy Europe, 2015)

Tablet 8: Troubleshooting Progressive Lenses

Wearers' Complaints	Indication	Possible Solutions
Tilts head upwards or lifts lenses to read	The reading portion is too low and it is difficult for the patient to reach the full add power	• Narrow the nose pads to lift the frame • Decrease the pantoscopic tilt • Mount the lens higher up • Adjust frame to sit higher
Tilts head downwards or lowers glasses to see distance vision	The distance portion is set too high and the patient is looking through the add portion when looking straight ahead	• Widen the nose pads to lower the frame • Increase the pantoscopic tilt • Mount the lens lower • Adjust frame to sit lower
Tilts head to the side to see clearly	The image is distorted due to lens decentration or incorrect refractive error	• Check the astigmatism • Modify lens centration • Check PD measurements
Reduced field of vision at near. Fatigue after prolonged near work	Patient is not reaching the full progressive add at the bottom and may be using the narrow corridor.	• Narrow the nose pads to lift the frame • Adjust the frame to sit higher • Add pantoscopic tilt and decrease vertex distance • Verify fitting height, PD measurements and add power are correct
Sees out of focus in lateral		• Adjust the pantoscopic angle

vision when moves head Peripheral visual distortion.		• Decrease vertex distance and increase wrap angle • Verify the balance between right and left lenses • Reduce distance power • Reduce the addition • Check the centring (consider changing lens design)
Moves reading material to the side for better focus	Lenses are not properly centered	• Verify the PD again • Mount the lenses according to monocular PD
See double vision at distance or near or both	Induced prism from lenses	• Check the monocular PD and heights to confirm centring • Check again the distance and near powers between right eye and left eye • Check the pantoscopic angle • Always compare with previous glasses
See light sources as double or specifies glare	Uncorrected astigmatism or higher order aberrations due to lens design	• Make new lenses with anti-reflective coating • Verify the astigmatism • Consider different progressive design
See lines deformed Peripheral visual distortion		• Check the astigmatism • May need to modify the axis of cylinder • Reduce the addition

		• Check for monocular PD and centring • Narrow the nose pads by lifting the frame (consider changing lens design, or may need adaptation if first time progressive lens wearers)

(iii) Practical Tips for Prescribing Progressive Lenses (Adapted from Elliott, 2021)

1. Use the lowest addition needed to provide comfort and clarity. It is prudent to keep the addition as low as possible to keep the range of clear vision as long as possible.
2. Monitor symptoms after presbyopic correction. Follow-up with patients regularly; explain and communicate clearly with the patients.
3. Pick the most appropriate design based on lifestyle and visual requirements.
4. Consider also any occupational or avocational visual needs at other distances.
5. Do not prescribe unequal add powers between the two eyes.
6. Clinicians rarely add powers greater than +3.00D in patients with normal visual acuity.
7. If patients are over 55 years of age, estimate the tentative addition based on working distance rather than age.
8. Be sure to determine the patient's near vision needs.
9. Be sure to determine the correct working distances.
10. Near add powers may need to be adjusted for cases with binocular vision abnormalities or accommodative insufficiency.
11. Any changes in correction of over 0.75 D can increase fall risk and non-adaptation.
12. Before giving progressive lenses, clinicians need to recognise patients who are at moderate to high fall risk.
13. Progressive glasses can increase fall risk because of blur in the lower visual field and peripheral distortion.
14. Always demo lenses if making a significant change from previous spectacles.

(iv) Clinical Pearls for Patients with Moderate to High Risk of Falls (Adapted from Elliott, 2021)

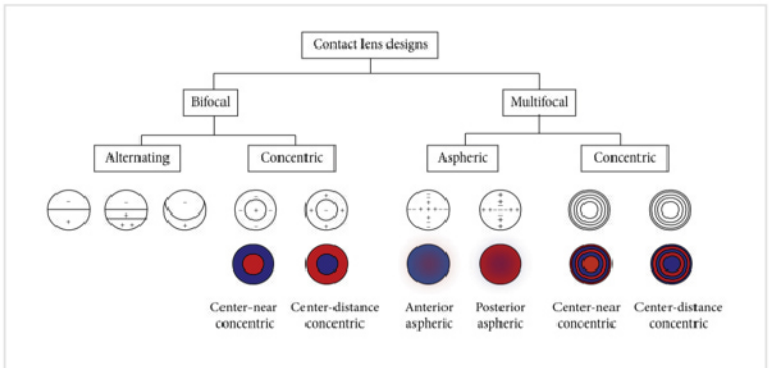
1. Ask the patient if they have fallen previously, or are prone to vertigo. Warn all patients of the risks of falling with a new pair of glasses, and hence the need to adapt prior to walking around.
2. Ask the patient if they wear their glasses when walking outdoors and if they take off their multifocals/progressive addition lens (PALs) when ascending /descending stairs.
3. Do not make large changes in refractive correction, preferably 0.50 D or below.
4. Carry out more frequent eye examination and make regular, small changes as needed.
5. Do not prescribe PALs or bifocals unless the patient has successfully worn them previously.
6. For patients wearing PALs, always keep changes as minimal as possible including the lens type and refractive correction.
7. For active and fit patients, prescribe an additional pair of single vision distance lenses for walking outside the home.
8. For patients who do not want to forego PALs when walking outside the home, suggest a low add multifocals (~+1.25 D) that provides reasonable spot reading.
9. Be cautious of a monovision approach due to the loss of stereoacuity.

Section 6.03 Contact Lenses for Presbyopia

To provide the optimum solution to presbyopes with contact lenses, it is essential to understand the functions and categories of presbyopic contact lens correction: monovision, multifocal lenses / depth of focus and modified monovision, and problem-solving for contact lens fitting for presbyopia.

(a) Categories of Presbyopic Contact Lens Correction

Figure 1: Categories of presbyopic contact lens correction (Remon et al., 2020).



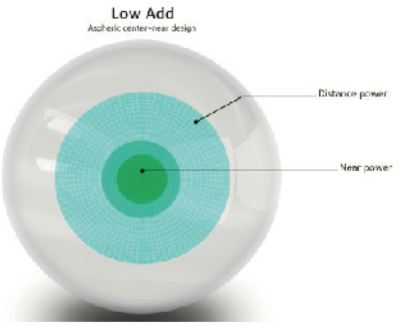
— Figure 1

Illustration of different contact lens designs. In red: areas for near vision; in blue: areas for distance vision.

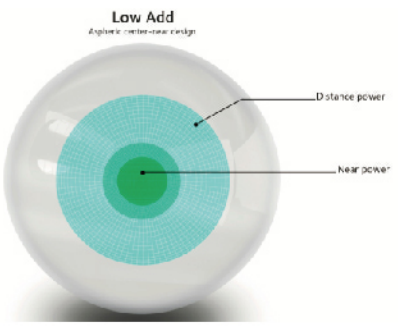
Figure 2: Multifocal contact lens solutions for optimizing vision for all levels of presbyopia

1. For early presbyopes: Combines two low add aspheric center-near designs with a wide distance area and optical progression into the reading area, ideal for maintaining clear distance vision when transitioning into multifocal contact lenses.

Dominant Eye

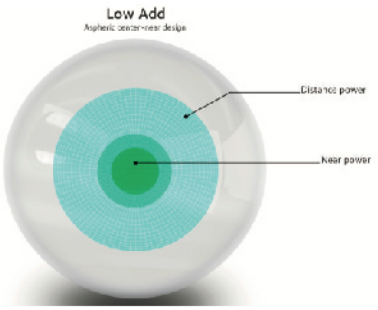


Non-dominant Eye

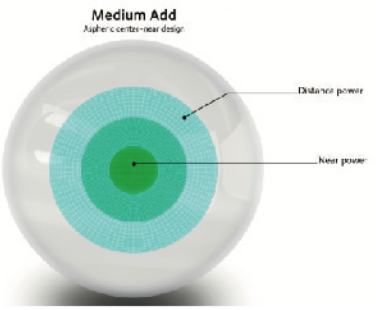


2. For advancing presbyopes : Combines the wide clear distance vision of the low add with increasing near support. In the aspheric medium- add design, the central reading area is strengthened and widened.

Dominant Eye

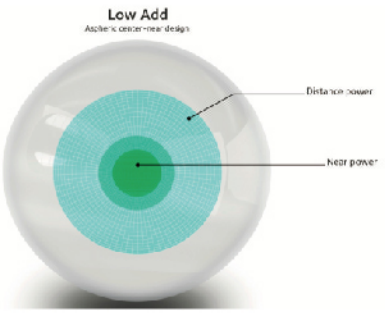


Non-dominant Eye

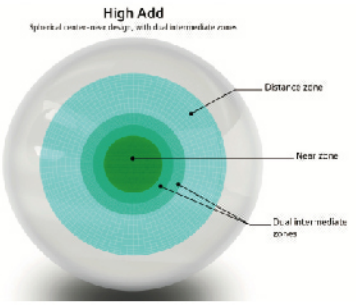


3. For later stage presbyopes: Combines the wide, clear distance vision of the low add with a high add lens designed with a single powered, spherical center-near zone and dual intermediate power zones for wearers who need the most help with their near vision.

Dominant Eye



Non-dominant Eye



Each multifocal contact lens design has their own fitting guide with their recommendation. To optimize multifocal fitting:

1. Careful refraction where you push the most (+) prescription possible for clear distance vision.
2. Determine minimum necessary near add for patient to see clearly and comfortably at their desired distance.
3. Determine patient's dominant and non-dominant eye.
4. Pick starting lens based on fitting guide of chosen multifocal lens.
5. Follow fitting guide steps to adjust for improved distance or near as needed.

Attention needs to be taken on multifocal lenses that may have distance-center adds while others have only low and high add powers.

(b) Contact Lens Fitting

1、Fitting Contact Lenses for Presbyopia: Monovision (Elliott, 2021)

1) Trial lens fitting is important. This modality is available in single vision soft lenses, hybrid lenses, and rigid gas-permeable lenses.
2) Determine the dominancy using both sensory and sighting methods. Monovision may not work if patient does not have a clear eye dominance.
3) A reading addition should be determined with the appropriate distance contact lenses in place.
4) Determine the dominancy using hole in the card technique.
5) The dominant eye should wear the distance powered contact lens while the non-dominant eye should wear the near powered contact lens.
6) Demonstrate the reading add over the non-dominant eye using a trial lens. Instruct patient to keep both eyes open for distance and near.
7) Measure acuity binocularly, both for distance and near
8) Counsel the patient on reduced stereopsis and adjustment period. Let the patient try monovision for at least 3 days before a decision is made.

2、Fitting Contact Lenses for Presbyopia: Multifocal lenses / Depth of focus contact lenses (Elliott, 2021)

1) As there are a variety of designs available, warn the patient that they may need to trial a few different pairs in order to identify what works best for them and their vision.
2) Precise centration is important.
3) The lenses are generally aspheric in nature, a decentred lens may induce visually compromising aberrations.
4) A decentred lens may result in poor distance visual acuity that cannot be improved.
5) Follow the fitting guide developed by manufacturer.
6) For a trial lens fitting, do not use a current contact lens prescription as a starting point.
7) Perform a refraction and push as much plus as possible while maintaining clear and comfortable distance vision. Consider performing a fogging test or binocular balance.
8) Perform a binocular refraction with reading addition determined at the patient's habitual working distance as a starting point.

9) The initial trial multifocal lenses should be selected based on lens power on the new ocular refraction, adjusting for any cylinder and axis; select the reading addition using the manufacturer's guidelines.
10) Allow at least 15 minutes of settling time before assessment.
11) Assess distance and near visual acuity binocularly. Perform an over-refraction if needed.
12) Use full aperture lenses in a trial frame with the monocular fogging technique to keep the binocularity, pupil size and gaze position.
13) If the initial over-refraction is greater than 0.50 D, do not order the lenses. Try a different diagnostic lens and repeat the over-refraction.
14) Always assess vision binocularly.
15) Once the final trial lenses are selected, allow the trial wearing period up to 4 days.

3、Fitting Contact Lenses for Presbyopia: Modified Monovision (Elliott, 2021)

Tablet 9: Fitting Contact Lenses for Presbyopia: Modified Monovision

Reading addition	**Dominant eye**	**Non-dominant eye**
Pre-presbyopia to +1.00 D	Distance contact lens	Low add multifocal
+1.25 D to +1.75 D	Low add multifocal	Mid add multifocal
+2.00 D or greater	Mid add multifocal	High add multifocal

Note: Modified Monovision is generally not a recommended modality by any manufacturer and usually does not work well.

(c) Troubleshooting Contact Lens Fitting for Presbyopia

Tablet 10： Troubleshooting for Contact Lens Fitting for Presbyopia (Elliott, 2021; Gasson & Morris, 2010)

Complaint	Possible solutions
Fluctuating vision	Assess tear film stability and lens fit
Poor near vision over-readers	• Check the distance vision is correct • Assess whether the reading addition power is appropriate for the patient's habitual working distance
Poor distance vision in monovision	• Make sure the distance vision is optimised • Consider an increase in the distance power (-0.25 D) in the dominant eye
Poor near vision in the monovision	• Make sure the distance vision is optimised • Consider an increase in +0.25 D in the non-dominant eye
Distance ghosting	• Check for any uncorrected astigmatism in the dominant eye
Increased or high reading addition	• Refit with modified monovision • *Refit with distance contact lenses and over-readers

Note: These are very generalized recommendations. Troubleshooting for each modality (single vision + Readers, Monovision, and Multifocal / extended depth of focus soft contact lenses) is different and should be addressed depending on the type or design of the lenses.

Section 6.04 Surgical and Pharmaceutical Management for Presbyopia

The widespread use of digital devices, coupled with an increase in patients continuing to work past retirement age, has resulted in permanent vision correction options becoming particularly attractive to the aging population. Surgical interventions that modify the optics of the cornea, replace the crystalline lens, or attempt to restore active accommodation using accommodating IOLs have become important options. While patients undergoing

surgery for presbyopia report satisfactory outcomes post-operatively, many of them eventually require reading glasses (Katz et al., 2021).

Refractive Lens Exchange is when the natural crystalline lens in a patient is replaced with an intra-ocular lens (IOL) such as a monovision IOL, multifocal IOL, extended depth of focus IOL, accommodating IOL and light adjustable IOL. Current multifocal IOLs can provide good intermediate and near vision. Although accommodating IOLs can induce some limited accommodation, they are associated with high rate of posterior capsular opacification. Light adjustable IOL permits post-operative titrations in IOL power after the eye has healed, facilitating optimization of the desired lens power (Katz et al., 2021; Hwang et al., 2021; Patel et al., 2022).

Other surgical options for presbyopia involve procedures such as corneal inlays and laser refractive surgery. Corneal inlays consist of an invasive surgical implantation of an inlay into the corneal stroma of one eye. Corneal inlays implantation has the advantages of being reversible and repeatable while providing excellent near vision. The disadvantage of corneal inlays is the potential for corneal haze with poor night vision and poor distance vision. As for laser refractive surgery, monovision or multifocal LASIK/PRK (not FDA approved) can be used to reshape the cornea to provide some useful near vision. Scleral correction procedures for presbyopia attempt to restore the accommodative ability of the eye by expanding the equatorial scleral diameter overlying the ciliary body and restoring zonular tension. However, this type of scleral procedure remains controversial with high complication rate (Katz et al., 2021; Hwang et al., 2021).

Pupillary miotics such as pilocarpine can increase the depth of focus by creating a pinhole effect. Pilocarpine 1.25%, marketed as Vuity from ABBVIE company has recently received US FDA approval to treat presbyopia as the first drug for presbyopia worldwide. However, there are some disadvantages of instilling pilocarpine into the eye. The parasympathetic treatment can result in a small pupil diameter with limited field of vision and myopic shift, compromising distance vision. Further side effects include but not limited to: ocular redness, retinal detachments, headaches, eye pain, eye irritation, redness, visual impairment and excessive tearing (Grzybowski et al., 2020; Grzybowski & Ruamviboosuk, 2022).

Section 6.05 Alternative Management for Presbyopia

Electrostimulation of ciliary muscle contraction to restore accommodation was reported to be safe and to improve the short-term accommodative ability of patients with early emmetropic presbyopia (Gualdi et al., 2017).

Multiple pinhole glasses improve visual acuity at all distances via pinhole effect. However, the small field of vision, the low legibility, increased inter-blink interval, and shortened break-up time of pinhole glasses can result in an uncomfortable feeling and excessive eye fatigue (Park et al., 2019).

Improved background illumination may be helpful to improve near vision in early presbyopic patients through the increase in depth of focus associated with smaller pupil and increased retinal illuminance (Charman, 2018).

Article VII. PATIENT EDUCATION

Patient education is an important step to help improve the success rate of spectacle and contact lens correction for presbyopia (Pal, 2016).

After a pair of spectacles or contact lenses has been prescribed, it is important to monitor the patient closely. The first follow-up particularly for contact lenses can be carried out at Day 1, Day 7, 1-2 weeks or 1-month, then subsequently 3 to 6 months thereafter. Most of the follow-ups can be done effectively through telephone or through an APP like WhatsApp or WeChat. In cases of non-tolerance to the spectacle or contact lens correction, an appointment can be scheduled to consult the eye care practitioners. Frequently, the success of presbyopic correction is very much dependent on the patient's education especially the value of patient's understanding. The primary goal of maintenance and education is to improve the patient's knowledge, to reduce patient frustration and to increase patient satisfaction and loyalty (Pal, 2016). Please see Appendix 1 for the Follow-up Schedule as a reference.

Article VIII. FUTURE OUTLOOK OF PRESBYOPIA MANAGEMENT

Ideally it would be desirable to delay or reverse the physiological changes which lead to presbyopia. The prodrug UNR 844 and ViewPoint Therapeutic seem to show some very promising signs. The prodrug UNR 844 has been demonstrated to be a well-tolerated, effective pharmacological intervention for improving near visual acuity through lens softening. ViewPoint Therapeutic targets lens protein misfolding and aggregation to treat and prevent presbyopia. Notwithstanding, much work is needed to obtain the holy grail solution that restores true accommodation in future (Katz et al., 2021).

Article IX. REFERENCES:

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Article X. APPENDIX

The following appendix is for reference only. Eyecare Practitioners should practice according to the professional-based, patient actual situation and local regulations.

Section 10.01 Appendix 1 : Essential Protocol of the Examination and Refraction for Presbyopia Progressive Lens

Workflow	Objectives	Key focus areas of professional care
Screening	➢ Enquire about patients' current near vision performances ➢ Enquire about patients' individual visual requirements	• History taking: understanding patient's baseline performances and chief complaint • Requirements: understanding patient's near vision needs • Corresponding follow-ups • Record keeping
Refraction	➢ Conduct visual examination ➢ Confirming presbyopia	• Necessity of distance and near vision examination for patients over 40 years old • Distance vision test • Near vision test • Standard binocular refraction • Near ADD examination • Trial frame to confirm near ADD • Confirmation of presbyopia • Finalise prescription and record keeping
Recommendation	➢ Prescribing based on the results of the visual examination ➢ Trialing progressive lenses for first time users	• Recommending the necessity tool to use progressive lenses • Optometrist to recommend type of products best suited • Dispensing optician to recommend products based on requirements
Measurement	Accurate measurements of parameters	• Frame fitting and adjustment • Measurements of spectacle lens parameters (e.g., mounting height, monocular pupillary distance, etc.)

Dispensing	➢ Confirming all parameters and adjust accordingly to the patient ➢ Educate first time users correct use of the product	• On spectacle collection: rechecking all lens parameters • Patient guidance for adaptation
CRM （Customer Relationship Management）	➢ Follow up and maintenance ➢ Follow up on utilization	• Educating the patients on presbyopia • Follow up and return visit plan: ✧ Usually after 1 day, 7 days, every 3-6 months, or according to company regulations ✧ Follow up after 1 day to ensure patients are using spectacles correctly ✧ After 1 week, follow up re adaptation, enhance patient's confidence and encourage patience to persevere ✧ At 1 & 3 months, return visit to answer any questions, identify any issues and adjust spectacles as required

Section 10.02 Appendix 2: Related instruments for Presbyopia Examination and Refraction

Equipment Classification	Objectives
Ocular Health Screening	Basic examination for the ocular physiological conditions, such as the changes in cornea, lens, vitreous, retina, and intraocular pressure; It is also an essential inspection for contact lenses assessment
Lensometer	Multiple modes to measure spherical, cylindrical, axis, prism, pupillary distance, near addition, including measurement of UV protection index, and blue light of single vision, multifocal and progressive spectacle lenses, soft contact lenses or rigid gas permeable contact lenses
Objective Refraction	Objective assessment: cataract screening, objective refraction, wavefront aberration analysis, topography, keratometry, pupil diameter dynamic assessment, anterior eye segment analysis, non-contact IOP measurement, retro-illumination of crystalline lens for opacity check.
Subjective Refraction	Subjective refraction, accommodation and convergence function, near addition and heterotropia or heterophoria measurement and visual acuity, binocular vision, stereopsis assessment
Binocular Function Examination	To measure binocular function, e.g., heterophoria, convergence, accommodation amplitude, etc.
Pupillary Distance Measurement	To measure pupillary distance.
Spectacle Dispensing Position Measurement	Precise measurement of spectacle and dispensing parameters; 3D posture and effect comparison, data comparison between cohort average and individual, multimedia presentation.

Section 10.03 Appendix 3: Selection of the suitable frames for progressive lens

The general selection requirements of the suitable frame for progressive lens include adequate vertical height, adequate nasal side area, firmness, with adjustable nose pad, not too high weld points on the temples, and not too wide temples. (Qu J & Chen H. 2017)

	Requirements
Positioning	Ensure cross-marks can be accurately positioned after lenses are fit into the frame, avoid full round frames, multi-point perforated rimless frames, etc.
Stability	Not easily get deformed. Accurate positioning of lens can be maintained after prolonged use.
Adjustability	Frame selection should consider adjustment flexibility according to the customer's face shape and wearing position. The nose pad should be as easy to adjust as possible, and the length of the temples should be long enough to fit the head. Choose epoxy resin, wood and precious metal materials considerably.
Size and Shape	The nasal width should be as small as possible, the nasal tilting angle should not be too large, the corridor should be chosen according to the mounting height, the height of the rim should meet the requirements of the progressive lens design.

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