

Care of the Patient with
Presbyopia



American Optometric Association

**OPTOMETRY:
THE PRIMARY EYE CARE PROFESSION**

Doctors of optometry are independent primary health care providers who examine, diagnose, treat, and manage diseases and disorders of the visual system, the eye, and associated structures as well as diagnose related systemic conditions.

Optometrists provide more than two-thirds of the primary eye care services in the United States. They are more widely distributed geographically than other eye care providers and are readily accessible for the delivery of eye and vision care services. There are approximately 36,000 full-time-equivalent doctors of optometry currently in practice in the United States. Optometrists practice in more than 6,500 communities across the United States, serving as the sole primary eye care providers in more than 3,500 communities.

The mission of the profession of optometry is to fulfill the vision and eye care needs of the public through clinical care, research, and education, all of which enhance the quality of life.



OPTOMETRIC CLINICAL PRACTICE GUIDELINE CARE OF THE PATIENT WITH PRESBYOPIA

Reference Guide for Clinicians

Prepared by the American Optometric Association Original Consensus Panel on Care of the Patient with Presbyopia:

Gary L. Mancil, O.D., Principal Author
Ian L. Bailey, O.D., M.S.
Kenneth E. Brookman, O.D., Ph.D., M.P.H.
J. Bart Campbell, O.D.
Michael H. Cho, O.D.
Alfred A. Rosenbloom, M.A., O.D., D.O.S.
James E. Sheedy, O.D., Ph.D.

Revised by: Nancy B. Carlson, O.D.
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Reviewed by the AOA Clinical Guidelines Coordinating Committee:

David A. Heath, O.D., Ed.M., Chair
Diane T. Adamczyk, O.D.
John F. Amos, O.D., M.S.
Brian E. Mathie, O.D.
Stephen C. Miller, O.D.

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NOTE: Clinicians should not rely on the Clinical Guideline alone for patient care and management. Refer to the listed references and other sources for a more detailed analysis and discussion of research and patient care information. The information in the Guideline is current as of the date of publication. It will be reviewed periodically and revised as needed.

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INTRODUCTION

Through their clinical education, training, experience, and broad geographic distribution, optometrists have the means to provide effective primary eye and vision services to adults in the United States.

Optometrists play an important role in evaluating patients with symptoms or functional disability resulting from presbyopia, an expected vision change that, in some way, affects everyone at some point in adult life.

This Optometric Clinical Practice Guideline on Care of the Patient with Presbyopia describes appropriate examination and management procedures to reduce the potential visual disabilities associated with presbyopia. It provides information on the classification, epidemiology, and natural history of the condition, and the care process of examination, diagnosis, and management of presbyopia. This Guideline will assist optometrists in achieving the following goals:

- Identify patients at risk of developing functional disability as the result of presbyopia
- Effectively examine the vision status of patients with presbyopia
- Accurately diagnose presbyopia
- Evaluate the appropriate management options for the patient with presbyopia
- Minimize the visual disability due to presbyopia through optometric care
- Inform and educate patients and other health care practitioners about the visual consequences of presbyopia and the available management options.



I. STATEMENT OF THE PROBLEM

Presbyopia is an age-related visual impairment. It results from the gradual decrease in accommodation expected with age and can have multiple effects on quality of vision and quality of life. Though not incapacitating if corrected,¹ presbyopia without optical correction results in an inability to perform once-effortless near tasks at a customary working distance without experiencing visual symptoms.^{2,3} Presbyopia has been described as "an irreversible optical failure, an unexplained evolutionary blunder that comes as a psychologic shock."⁴ As the amplitude of accommodation diminishes, the range of clear vision may become inadequate for the patient's commonly performed tasks. The impact of this process varies from one person to another. Those who are involved in more frequent or more demanding near vision tasks are likely to have more difficulty. Because the need to read and work at near and intermediate distances is important in all industrialized societies, presbyopia has both clinical and social significance.

A. Description and Classification of Presbyopia

Presbyopia, a natural age-related condition, is the result of a gradual decrease in accommodative amplitude, from about 15 diopters (D) in early childhood to 1 D before the age of 60 years.⁵⁻⁹ An irreversible, normal physiologic condition that affects all primates,¹⁰ it impairs the ability to see clearly at near. If presbyopia is uncorrected, a significant functional visual disability is likely to develop. Although there are a number of approaches for managing the visual disability associated with presbyopia, all of the available modalities are compensatory rather than corrective. There is no substitute equal to the accommodative flexibility of non-presbyopic eyes and their ability to change quickly from seeing clearly at a distance to seeing clearly at close range.

The clinical consequence of presbyopia is that, without optical correction, the amplitude of accommodation is insufficient to meet the near vision demands of the patient.¹¹ Presbyopia can be classified by type.^{2,12}

1. Incipient Presbyopia

Incipient presbyopia represents the earliest stage at which symptoms or clinical findings document the near vision effects of the condition. In incipient presbyopia—also referred to as borderline, beginning, early, or pre-presbyopia—reading small print requires extra effort. Typically, the patient's history suggests a need for a reading addition, but the patient performs well visually on testing and, given the choice, may prefer to remain uncorrected.

2. Functional Presbyopia

When faced with gradually declining accommodative amplitude and continued near task demands, adult patients eventually report visual difficulties that clinical findings confirm as functional presbyopia. The interaction between the patient's amplitude of accommodation and the patient's near vision demands is critical. The age at which presbyopia becomes symptomatic varies. Some patients are symptomatic at an earlier age (premature presbyopia)¹³; others later than expected,¹⁴ largely due to variations in distance vision status, environment, task requirements, nutrition, or disease state.

3. Absolute Presbyopia

As a result of the continuous gradual decline in accommodation, functional presbyopia progresses to absolute presbyopia. Absolute presbyopia is the condition in which virtually no accommodative ability remains.²

4. Premature Presbyopia

In premature presbyopia, accommodative ability becomes insufficient for the patient's usual near vision tasks at an earlier age than expected, due to environmental, nutritional, disease-related, or drug-induced causes.^{2,12}

5. Nocturnal Presbyopia

Nocturnal presbyopia is the condition in which near vision difficulties result from an apparent decrease in the amplitude of accommodation in dim light. Increased pupil size and decreased depth of field are usually responsible for this reduction in the range of clear near vision in dim light.¹⁵

B. Epidemiology of Presbyopia

1. Prevalence and Incidence

The prevalence of presbyopia is higher in societies in which larger proportions of the population survive into old age. With the aging of the U.S. population, unprecedented numbers of patients with presbyopia can be expected to present to optometrists' offices in the coming years. Because presbyopia is age related, its prevalence is directly related to the proportion of older persons in the population.

Although it is difficult to estimate the incidence of a chronic condition such as presbyopia, due to its slow onset, it appears that the highest incidence of presbyopia (i.e., first-reported effects) is in persons ages 42 to 44.¹² When presbyopia is arbitrarily defined as a visual condition of everyone over the age of 40, U.S. Census Bureau figures suggest that in 2006 about 112 million Americans had presbyopia. Over the next 10 years, this number is expected to continue to increase.¹⁶

2. Risk Factors

Age is the major risk factor for development of presbyopia, although the condition may occur prematurely as the result of factors such as trauma, systemic disease, cardiovascular disease, or a drug side effect. Common risk factors are described in Table 1.^{2,17-29}

Table 1
Common Risk Factors for Presbyopia

Age	Typically affects function at or after age 40
Hyperopia	Additional accommodative demand (if uncorrected)
Occupation	Near vision demands
Gender	Earlier onset in females (short stature, menopause)
Ocular disease or trauma	Removal or damage to lens, zonules, or ciliary muscle
Systemic disease	Diabetes mellitus (lens, refractive effects); multiple sclerosis (impaired innervation); cardiovascular accidents (impaired accommodative innervation); vascular insufficiency; myasthenia gravis; anemia; influenza; measles
Drugs	Decreased accommodation is a side effect of both nonprescription and prescription drugs (e.g., alcohol, chlorpromazine, hydrochlorothiazide, antianxiety agents, antidepressants, antipsychotics, antispasmodics, antihistamines, diuretics)
Iatrogenic factors	Scatter (panretinal) laser photocoagulation; intraocular surgery
Geographic factors	Proximity to the equator (higher average annual temperatures, greater exposure to ultraviolet radiation)
Other	Poor nutrition; decompression sickness; ambient temperature

C. Clinical Background of Presbyopia

1. Natural History

The classical explanation of accommodative function is the relaxation theory.^{30,31} According to this theory, accommodative response results from ciliary muscle constriction, which releases tension on the zonules. Due to the strategic position of the insertion of the suspensory ligaments on the equatorial and anterior lens capsule, and to the elastic properties of the capsule, this relaxation of zonular tension shifts the contents of the lens forward, causing the surface of the anterior lens to become more convex. Presbyopia can be explained by the age-related hardening of the lens substance and an associated inability of the lens to be molded by the tension exerted by capsular forces. Although early studies³²⁻³⁵ focused on the roles of the lens capsule and the ciliary body, diminution of accommodation with increasing age continues to be attributed to hardening or sclerosing of the nuclear lens tissue and reduced elasticity of the accommodative mechanism.³⁶⁻³⁹

The mechanical ramifications of normal lens growth, ciliary muscle development, zonular fiber structure and placement, and lens capsule properties have also been considered in theorizing that presbyopia has three causes: normal lens growth, normal ciliary muscle growth, and changes in tissue elasticity.⁴⁰ The increase in equatorial diameter of the lens creates "slack" in the suspensory ligaments and a loss of ciliary muscle power available for flattening the lens. In normal growth, the lens moves forward, altering the angle at which the zonule fibers attach to the lens capsule. Hypertrophy and the proliferation of connective tissue of the ciliary body alter the points of attachment of the zonules. Speculation that these normal alterations in the anterior part of the eye contribute to presbyopia is supported by studies suggesting that surgically increasing the lenticular space can increase accommodative ability.⁴¹⁻⁴⁴

Studies evaluating the effect of capsule elasticity on lens molding and ciliary muscle contraction force⁴⁵⁻⁴⁷ attributed presbyopia to three factors: changes in capsule elasticity, normal lens growth, and increased lens resistance despite increasing ciliary body muscle force. Other research

using impedance cyclography documented that the ciliary muscle maintains contraction force until the seventh decade of life,⁴⁸ suggesting that presbyopia depends on lens changes alone and that ciliary muscle changes have no influence on the amplitude of accommodation. Indeed, pharmacological studies^{49,50} showed that maximum ciliary muscle contraction is needed to produce maximum accommodation at any age. In presbyopia, the capsule's ability to reshape the lens was found to depend upon ciliary muscle contraction and to be limited by lens substance resistance to change in shape.⁵⁰ This resistance (and loss of potential to control the lens) was attributed to sclerosis or growth of lens fibers, lens capsule, or ciliary muscle.⁴⁹ Recent A-scan ultrasonography and magnetic resonance imaging (MRI) studies have shown that the lens capsule becomes less elastic after age 35.³⁶

Scanning electron microscopy studies have led to the postulation that by virtue of attachment point variations among sets of zonular fibers (called the "zonular fork"), the zonular plexus acts as a fulcrum.⁵¹ Model simulations have reconciled the conflict between studies of "extralenticular" mechanisms by demonstrating that the effects of presbyopia are attributable to a change in responsiveness of the lens substance alone.^{37-39,52} The principles of accommodative mechanics support the idea that the ciliary muscle and body move forward and inward in such a way that the pars plana zonular fibers can exert traction directly on the anterior zonular fibers, flattening the lens and decreasing its refractive power.

Studies of other mechanisms that may contribute to presbyopia include one addressing the role of the choroid in accommodation.⁵³ The results of investigating the contractile properties of lens fibers suggest the possibility of a molecular basis for accommodation.¹⁰ However, presbyopia still is most commonly attributed to changes in the elasticity of the capsule and of the lens itself^{54,55} and to changes in the overall size and shape of the lens.⁵²

The decrease in accommodation begins early in life—in childhood or adolescence. During the early adult years and into the fifties, the physiologic changes that reduce the eye's accommodative power occur gradually. Typically, between the ages of 38 and 43 years, these changes

reach the stage at which accommodative loss is sufficient to cause the blurred near vision symptoms of presbyopia. Without treatment, it becomes difficult or impossible to see fine details at near distances. Optometric care can eliminate most, if not all, of the visual disability associated with presbyopia.

2. Common Signs, Symptoms, and Complications

The onset of presbyopia is gradual. Although blurred near vision signals the onset of presbyopia, the symptoms reach significance only when the patient's accommodative amplitude becomes inadequate for his or her visual needs. The patient's difficulty in performing vocational or avocational activities largely determines when the symptoms of impairment are manifest.

Blurred vision and the inability to see fine details at the customary near working distance are the hallmarks of presbyopia. Other common symptoms are delays in focusing at near or distance, ocular discomfort, headache, asthenopia, squinting, fatigue or drowsiness from near work, increased working distance, need for brighter light for reading, and diplopia.^{4,56}

Difficulty seeing at the usual near working distance and changing or maintaining focus is explained by the decreased amplitude of accommodation. Brighter light for reading benefits the patient by causing pupillary constriction, resulting in an increased depth of focus. Fatigue and headaches have been related to contraction of the orbicularis muscle or portions of the occipitofrontalis muscle^{2,57} and are thought to be associated with tension and frustration over the inability to maintain clear near vision. Drowsiness has been attributed to the physical effort expended on accommodation over extended periods of time.² Diplopia may occur as a result of exotropia associated with increased exophoria and decreased positive fusional vergence amplitude, both of which are common in presbyopia.⁵⁸

The accommodative convergence/accommodation (AC/A) ratio is the amount of convergence induced by each diopter of increase in accommodation. The expected AC/A increase with age has been

explained on the basis of increased ciliary body effort required in early presbyopia, which causes an associated convergence response.⁵⁹ Patients with incipient presbyopia occasionally complain of distance blur. Although this complaint is most often associated with myopia, distance blur actually may indicate undiagnosed or latent hyperopia.¹¹ In the case of incipient presbyopia, distance blur may also be due to a slowed response of the lens-ciliary body complex during relaxation from near focus (which has been attained only with considerable effort) to the distance posture. This phenomenon is most likely to occur after an extended period of near focusing effort.^{2,14}

3. Early Detection and Prevention

As an age-related condition, presbyopia generally is not considered in the same context as ocular diseases or other disorders that, if left untreated, can have permanent adverse effects on vision or ocular health. Almost everyone eventually will experience some disability due to presbyopia. Among the rare exceptions are a few patients with very small pupils who benefit from increased depth of focus, some who have little need to see fine details at near, and some with antimetropia, who function in a monovision fashion, using one eye for distance vision and the other for near. Optical correction can successfully remediate presbyopia, no matter when the patient seeks treatment.

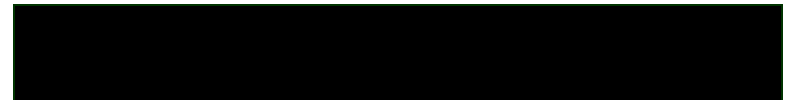
Because presbyopia cannot be prevented, the emphasis must be on detection and amelioration of its consequences. Public education and health promotion enhance the detection of presbyopia. In a study done in 1996, more than half of the patients surveyed did not know the meaning of presbyopia.⁶⁰ Informing persons in their thirties and forties of the symptoms and management options for presbyopia should lead to improvements in early diagnosis and management.

Patients typically experience the initial symptoms of presbyopia at an age when more frequent ocular health examinations are recommended because of higher risk for many age-related diseases (e.g., glaucoma, cataract, macular degeneration, diabetes mellitus, hypertension). The responsibility of the optometrist goes beyond identifying and treating the presbyopia that may have precipitated the visit. It is important to

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identify and manage co-existing vision problems or ocular disease. Early diagnosis and intervention in other systemic diseases identified in the process of caring for the presbyopic patient have public health ramifications.

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II. CARE PROCESS

A. Diagnosis of Presbyopia

This Guideline describes the optometric care provided for a patient with presbyopia. The examination components described herein are not intended to be all inclusive, because professional judgment and the individual patient's symptoms and findings may have significant impact on the nature, extent, and course of the services provided. Some components of care may be delegated (see Appendix Figure 2).

1. Patient History

The major components of the patient history are the chief complaint and history of the present illness/condition, the patient's visual, ocular, and general health history, family eye and medical history, the use of medications, medication allergies, and vision requirements (vocational and avocational).

Complaints associated with presbyopia may be expressed in a variety of ways. Patients often report problems with reading: being able to read for short periods only, noticing blurred or double print, being unable to read fine or low-contrast print, tearing, needing increased lighting or distance, headache, and drowsiness. Other tasks, such as threading a needle or seeing fine details on objects at near distances, become difficult for many. Such problems are likely to be greater when patients become fatigued, for example, at the end of the day or the end of the work week. Patients who wear spectacles for myopia may report removing their spectacles to read.

An important consideration in identifying and treating presbyopia is the patient's age. A number of authors have published tables of accommodative amplitude expected with changes in age (Table 2).⁶¹⁻⁶⁴ These values are not perfectly consistent across tables, largely because of different measurement methods.⁶⁵ For example, some authors' analyses of the classical studies suggest that when depth of focus is controlled, patients may reach absolute presbyopia 10 to 20 years earlier than indicated by the studies cited.^{1,2,4,11} Therefore, although tables predicting

the required addition power according to the patient's age are useful in guiding optometrists in prescribing spectacles,^{63,66} the optometrist should consider all aspects of the patient's needs and examination results to arrive at an appropriate lens prescription.

Table 2
Expected Values of Accommodation (Diopters)

Age (years)	Donders	Duane (mean)	Hofstetter (probable)
10	14	13.4	15.5
15	12	12.6	14
20	10	11.5	12.5
25	8.5	10.2	11
30	7.0	8.0	9.5
35	5.5	7.3	8
40	4.5	5.9	6.5
45	3.5	3.7	5
50	2.5	2.0	3.5
55	1.75	1.3	2
60	1.00	1.1	0.5
65	0.50	1.1	0.5
70	0.025	—	—

The medical history is important in the diagnosis of premature presbyopia, particularly when the patient has significant systemic disease. Conditions such as diabetes mellitus, vascular disease, neurologic disorders, trauma, or the use of certain medications (e.g., antianxiety or antidepressant agents) may contribute to premature presbyopia. When premature presbyopia suggests systemic disease, further medical evaluation may be indicated.

Obtaining information about vocational and avocational activities is important in the diagnosis of presbyopia. Changes in workplace environments, such as the use of computer technology, may create new types of visual demands.⁶⁷ Only by gaining knowledge of the patient's near vision tasks through a careful and detailed history can the clinician properly identify and prescribe treatment options suited to individual needs.

2. Ocular Examination

a. Visual Acuity

Visual acuity testing is fundamental to the evaluation of presbyopia. Testing both habitual distance visual acuity (uncorrected or with the current correction) and corrected near visual acuity provides an indication of refractive error or ocular disease and enables assessment of the patient's ability to function during near tasks. Patients with uncorrected or undercorrected myopia are less likely to experience difficulty with near tasks, while those with hyperopia are more likely to experience difficulty with near tasks.

b. Refraction

Careful distance refraction provides the foundation for determining the management of presbyopia. The optical correction for presbyopia is the sum of the refractive correction for distance plus the power of the near addition. The nature of the distance correction itself influences the near addition.¹¹ Due to lens effectivity, patients who wear spectacle corrections for myopia experience presbyopia later than those with emmetropia or hyperopia. Patients with myopia typically require less powerful bifocal additions than same-age patients who wear spectacle corrections for hyperopia. Conversely, persons with spectacle corrections for low to moderate hyperopia show the opposite effect; they usually need their first near addition at an earlier age or need a stronger addition than their contemporaries with myopia.

The clinician should exercise care to control accommodation in patients with incipient presbyopia because failure to recognize its influence

during refraction may lead to prescribing too little plus lens power. This risk is especially high in the case of latent hyperopia or in uncorrected hyperopia with incipient presbyopia. When evaluating the older patient who has small pupils or media opacities, the clinician may need to modify the usual retinoscopic and refractive techniques,¹¹ reducing the working distance for retinoscopy, or moving off axis to improve the retinoscopic reflex. Keratometry can provide an estimate of refractive cylinder power. This information is especially useful when prescribing for the patient with aphakia or pseudophakia, in which case there is no lenticular cylinder component to the patient's astigmatism.

More time is often required for subjective refraction with older patients. A decline in visual acuity can reduce the ability to detect blur. The magnitude of lens changes required for the patient to detect just-noticeable differences increases, due to the eye's increased depth of field (associated with small pupils). Furthermore, slowed reaction time related to generalized central nervous system changes that accompany normal aging⁶⁸ can, in some cases, increase examination time. Consequently, the optometrist may need to slow the presentation of lens alternatives, to make repeated presentations, or to present changes of larger magnitude.⁶⁹ Refraction using trial frame or trial lens clips over the current correction can aid the clinician in arriving at the appropriate spectacle correction, particularly for the patient with visual impairment, with limited access to the phoropter (e.g., wheelchair user), or with cognitive impairment.^{70,71} When refraction does not improve visual acuity to expected levels, it is likely that ocular disease is present.

c. Binocular Vision and Accommodation

Although traditional clinical approaches to the evaluation of presbyopia have emphasized measurement of the amplitude of accommodation,⁴ the measurement of accommodation in presbyopic patients has limited reliability. Many variables affecting accommodative testing are difficult to control, including illumination, depth of focus, target size, contrast, visual angle, lens effectivity, monocular and binocular cues, kinesthetic feedback, and the rate at which accommodative demand is changed during testing.⁷² One clinical rule of thumb is that the patient should be

able to sustain up to half of his or her total amplitude of accommodation.¹¹

Common procedures to determine the near lens prescription include:

- **Plus lens to clear near vision.** A common method of determining the required addition is to increase plus power over the distance correction until clear near vision is achieved. This test may be performed monocularly or binocularly, usually using a phoropter, although a trial lens is sometimes used. The binocular procedure may yield a lower addition power, due to convergence accommodation. When performing this test, the clinician should take care to simulate, insofar as possible, the patient's habitual viewing circumstances, such as lighting and working distance. Using illumination that is significantly greater than that in the habitual visual environment can cause an increased depth of focus and thereby provide a potentially misleading estimate of the accommodation. To help determine the most appropriate addition power for specific tasks, the clinician can have the patient measure his or her usual working distance(s) and bring this information to the examination. The patient may also be encouraged to provide sample near vision tasks.
- **Balanced range of accommodation (NRA/PRA).** Another method of prescribing the near addition is to place the dioptric midpoint of the range of clear vision at the patient's customary near working distance.^{11,72,73} Measurement of the negative relative accommodation (NRA) and positive relative accommodation (PRA) provides useful information concerning the dioptric midpoint. NRA is a measure of maximum ability to relax accommodation while maintaining clear, single binocular vision of a test object at a specified distance. PRA is a measure of the maximum ability to accommodate while maintaining clear, single binocular vision of a target at a specified viewing distance. To measure NRA and PRA, the clinician places the patient's distance refraction in the phoropter with a tentative add and the nearpoint test card at the reading distance (usually 40 cm).⁷³ The NRA is determined by adding plus power lenses binocularly until the

patient is no longer able to read the fine print on the test card. The PRA is determined by adding minus power lenses until the patient is no longer able to read the fine print.^{73,74}

The NRA/PRA balance is achieved by prescribing just enough add to equalize the negative and positive relative accommodation for a target at the patient's usual working distance. This procedure maintains half of the accommodation in reserve.¹⁴ The range of clear vision is the linear range from the nearest point at which the patient can see clearly to the farthest point at which the patient can see clearly through the near lens correction.^{11,75} The measured range of clear vision is expressed in linear units (inches or centimeters). Typically, this measurement is made with the patient looking through the near vision correction in the phoropter while the nearpoint card is moved along the nearpoint rod, although the measurement may be done in free space with the patient looking through trial lenses.

On the basis of the patient's preferred working distance and the amplitude of accommodation, the optometrist can estimate the near addition power required to give a range of clear vision appropriate to the patient's visual needs. When the range of clear vision and the preferred working distance are both expressed in diopters, centering the working distance within the range requires an addition power equal to the working distance minus half of the range.⁷⁶

The difference between the NRA and the PRA is called the relative accommodative amplitude. Using PRA and NRA measurements, the optometrist can achieve the indicated addition by using the sum of the lens power required to achieve the NRA endpoint and half of the relative accommodative amplitude. Such an addition balances the NRA and the PRA (in diopters) around the dioptric demand for the reading distance. In this method, the ranges are equalized dioptrically, not linearly.⁷⁷

A tentative addition can also be determined by subtracting one half of the patient's amplitude of accommodation, either measured

or obtained from a table of expected amplitude of accommodation, as shown in Table 2, from the patient's preferred working distance in diopters (half the amplitude in reserve rule). This addition can then be refined by performing the NRA/PRA and choosing the dioptric midpoint as the refined near addition.⁷⁸

- **Amplitude of accommodation (AA).** A table of age-expected accommodative amplitudes (Table 2) can serve as a starting point for determining a near addition.² However, the values in the tables represent population averages, and the measured amplitude of accommodation for the individual patient may differ significantly from the age-group average. Measuring the amplitude of accommodation provides a more appropriate indication of the patient's accommodative ability and range of clear vision.

Typically, with the patient viewing through his or her distance correction, measurement of the amplitude of accommodation involves one of two common methods: (1) In the "push-up" method, a target is moved toward the eyes until it blurs. An alternative is the "push-away" method, in which the target is moved from blurred to clear.⁷⁹ Because this binocular test simultaneously changes the accommodation and convergence demands, the test should be done monocularly.⁸⁰ (2) In the "minus lens to blur" method, minus lenses are added over the distance correction monocularly until the distant target appears to be blurred, while the target distance is kept constant.⁸¹ This method changes the accommodation demand, but the convergence demand remains constant at the distance posture.⁸²

For older persons with presbyopia who have difficulty reading a near chart without an addition, the amplitude of accommodation can be measured by the push-up method or the minus lens to blur method through the patient's addition. The amount of the add is then subtracted from the result of the test.

- **Crossed cylinder test.** For this measurement, a cross-grid target is placed on the nearpoint rod of the phoropter at the patient's working distance, room illumination is reduced, and the crossed

cylinder (with the minus axis vertical) is positioned before both eyes. With the distance correction in place, the optometrist adds plus lenses monocularly or binocularly until the vertical lines on the target become clearer and darker than the horizontal lines. The plus power is then reduced until the horizontal lines become darker or equal. This method is believed to determine the power that creates an appropriate accommodative demand at the reading distance.^{72,73} Performing this test binocularly usually results in less plus power being required to reach the end point. For older presbyopes who cannot see the cross-grid target through the distance correction, the test can be started with +3.00 OU in front of the patient's eyes. The patient most likely will report that the vertical lines are clearer or darker. The plus can then be reduced until the horizontal lines become clearer or darker.

Procedures to evaluate accommodative/convergence response, convergence, and vertical imbalance include:

- **Accommodative convergence/accommodation (AC/A) ratio.** As accommodation diminishes, there is an increase in the response AC/A ratio, which is the number of prism diopters of convergence induced by each diopter of exerted accommodation.⁸³ Evidence of this relationship is sometimes observed in the patient with uncorrected or undercorrected presbyopia who exhibits excess convergence in an attempt to stimulate the accommodative-convergence system to clear the near vision.⁸⁴ Prescribing plus lens power for near can result in underconvergence due to less stimulation of accommodative convergence. On occasion, the addition is associated with higher exophoria at near in presbyopic patients. However, in most cases this is not problematic because of proximal convergence, an involuntary response to placement of a target close to the eyes.² Through their reading prescriptions, most patients maintain single binocular vision without discomfort.
- **Heterophoria and vergence.** Measuring the lateral heterophoria and appropriate fusional vergence reserves through the tentative near lens prescription can verify that proximal convergence is adequate to compensate the expected exophoria. These

measurements can be made using the phoropter or hand-held Risley prisms with the trial frame or the patient's glasses. Tests of fixation disparity have also been recommended to assess binocular vision problems in presbyopic patients.⁸⁵ For patients who report symptoms that suggest binocularity problems at near (e.g., doubled print, words moving, or loss of place in reading), base-in prism or vision therapy may be indicated.⁸⁶

- **Vertical imbalance.** Because vertical fusional amplitudes are relatively small, compared with horizontal fusional amplitudes, the anisometric or antimetric prescription is more likely to result in vertical diplopia when the person with presbyopia is reading. Recently acquired anisometropia is sometimes related to developing cataracts.⁸⁷ Thyroid eye disease or previous extraocular muscle surgery can cause the patient to experience vertical diplopia when reading.⁸⁸

d. Ocular Health Assessment and Systemic Health Screening

Thorough assessment of the health of the eyes and associated structures is an integral component of the comprehensive adult eye and vision examination.* This examination can lead to the diagnosis of systemic diseases and disorders that have ocular manifestations. When ocular health assessment detects abnormalities, the optometrist should conduct more extensive investigations.

Many ocular and general health problems can affect refractive error and accommodation.⁸⁹ In the older presbyopic population, the onset of cataract is a common cause of refractive change. Conditions such as orbital masses, thyroid ophthalmopathy, and macular edema may also cause refractive changes. Systemic health disorders such as diabetes, uremia, and drug side effects⁸⁹ associated with presbyopic symptoms warrant further attention. Decreased accommodation can be associated with medications such as phenothiazine, chloroquine, anti-Parkinson

*Refer to the Optometric Clinical Practice Guideline for Comprehensive Adult Eye and Vision Examination.

drugs, or smooth muscle relaxants, as well as less common systemic conditions (e.g., myasthenia gravis or syphilis).⁹⁰

The patient who presents with complaints typical of presbyopia should have a thorough ocular health evaluation to rule out ocular disease or ocular manifestations of systemic disease. Given the multitude of health problems that can occur with advancing age, the onset of presbyopia may serve to heighten the patient's awareness of the need for regular eye and health evaluations.

3. Supplemental Testing

When indicated by the results of objective and subjective tests, supplemental tests are sometimes used to obtain additional information that might influence prescribing decisions or reveal more about the patient's binocular visual function at near.

- **Near retinoscopy.** Near or dynamic retinoscopy is an objective method of determining the amount of plus lens power needed at near. Room lights are dimmed to improve the clinician's observation of the retinoscopy reflex, and a fixation target with letters slightly larger than the patient's best visual acuity is selected. With the distance refraction in place, both the fixation target and the retinoscope are held at the patient's near working distance. Plus power lenses are added until reaching the neutral point at which no motion is observed in the retinoscopic reflex. In the prescription of an addition by this method, the common procedure is to subtract 0.50 D from the lens power required to achieve the neutral point.⁷²
- **Intermediate distance testing.** Patients with advanced or absolute presbyopia may complain of blur at intermediate distances as well as at near working distances.¹¹ These complaints relate to the progressive loss of remaining accommodative ability, which prevents a wide range of clear vision. In the earlier stages of presbyopia, there is an overlap between the range of clear vision through the distance correction and the range of clear vision obtained through the addition for near. With advanced or absolute

presbyopia, these ranges no longer overlap and there is an intermediate range in which vision is not clear, typically at distances of 40 to 100 cm. Frequently, another optical correction is required to provide clear vision within this intermediate range.

A practical way to demonstrate and assess the value of an intermediate distance correction is to use an addition that is less than the power of the addition for near. This power may be +0.50 D or greater. Then a nearpoint card can be placed in the intermediate distance range and moved toward and away from the patient to demonstrate and measure the linear range over which clear vision can be obtained with the intermediate addition. This procedure can be performed in a phoropter or with trial lenses. When an intermediate addition is indicated, the correction may take one of several forms: single vision lenses for the intermediate distance; trifocals with intermediate lens power that usually equals half the power of the near addition; an occupational progressive lens (OPL) design or a progressive addition lens (PAL) design.²

B. Management of Presbyopia

1. Basis for Treatment

Unmanaged presbyopia can result in significant visual disability, depending on factors such as the individual patient's amplitude of accommodation, refractive error, and nature of the near vision tasks. Given the variety of spectacle and contact lens management options available, most patients should not experience significant disability due to presbyopia. (See Appendix Figure 1 for an overview of patient management.)

2. Available Treatment Options

A variety of options are available for optical correction of presbyopia, and the optometrist makes recommendations on the basis of the patient's specific vocational and avocational needs. It is the optometrist's responsibility to counsel the patient regarding these options and to guide the patient in the selection of appropriate eyewear. All types of

corrections for presbyopia represent some visual compromise, compared with normal accommodative ability. Ultimately, the success of treatment depends on the lens power, the optical correction, the specific visual tasks, characteristics of the individual patient, and the appropriate patient education given by the practitioner.

a. Optical Correction with Spectacle Lenses

- **Single vision lenses.** The use of spectacles containing single vision lenses is an appropriate option for some patients with presbyopia. Typical candidates for this treatment are patients with emmetropia, patients with a low degree of ametropia (who do not require distance correction), and patients with uncorrected myopia whose uncorrected vision meets their near task needs (who may either remove their glasses for near tasks or use "reverse half-eye" glasses). Some patients who experience significant difficulty using multifocal lenses may prefer to use separate pairs of glasses for seeing at distance and near.

Single vision spectacles with the near correction provide a wide field of view unmatched by any other form of spectacle correction for presbyopia, but they cause blurring of distance vision. The distance blur should be demonstrated to the patient before prescribing single vision spectacles to use at near only.⁹¹ One option for patients without significant refractive error is traditional half-eye spectacles that allow them to look over the near vision lens and view distant objects clearly.

- **Progressive addition lenses.** By means of a corridor of progressively changing power that connects the distance portion with the near portion of the lens, progressive addition lenses (PALs) can provide clear vision for a range of distances. Many available PAL designs have different power distributions and power transition that can be considered for individual patient needs. Relevant design parameters include length of the progressive corridor; size, shape, and location of the near zone; transition between distance and near zones; and asphericity. Some patients may require time to adapt and accept these PAL designs.⁹²

Several studies have shown that many patients with presbyopia prefer PALs over bifocal or trifocal lenses.⁹³⁻⁹⁷

- **Bifocal lenses.** These lenses incorporate the distance vision and the near vision prescriptions into a single spectacle lens. In the typical design, the majority of the lens area contains the distance vision correction while the near vision correction is confined to a smaller segment in the lower portion of the lens. This configuration allows the patient to alternate between lens segments, according to the visual tasks at hand. A variety of designs and sizes of bifocal lenses are available (e.g., flat-top, curve-top, executive, round, Ultrex, blended) and should be selected on the basis of the characteristics and needs of the specific patient.^{2,98-100}
- **Trifocal lenses.** These multifocal lenses incorporate distance, intermediate, and near lens prescriptions, which is often important for patients who have advanced or absolute presbyopia. Trifocal lenses are manufactured in a variety of types and sizes, including flat-top, curve-top, executive, and round. The option of a greater-than-standard vertical dimension of the intermediate segment of these lenses may improve vision for the patient who is frequently involved in intermediate distance tasks. The prescription for trifocal lenses should be tailored to the patient's specific vocational or avocational needs.
- **Occupational lenses.** Many occupational situations create a wide range of accommodative demands, due to variation in working distance and task characteristics.¹⁰¹ Special spectacle lenses (e.g., single vision, segmented multifocals, PALs, or some combination of these designs) may be required for specific vocational and avocational tasks. Spectacle lens designs that incorporate double or triple segments may be indicated for patients who have special vision needs or whose work involves near vision tasks when the objects of regard are above eye level (e.g., postal workers, librarians, painters, carpenters, or electricians). For some, upper bifocals will be more useful than traditional bifocal segments. Some segmented multifocal lenses incorporate traditional distance

and near lens segments in the usual bifocal or trifocal placement but have the second near addition segment designed for intermediate distance focus and placed in the top part of the lens.

Some PAL designs address occupational vision needs. Several occupational lens designs have been developed for computer users who have a high intermediate vision demand coupled with the high near vision demand. Some PALs for computer use also provide clear distance vision. Studies have shown that these lenses are well accepted by persons who use computers 20 to 50 percent of the work day.¹⁰²⁻¹⁰⁵

- **Compensation for vertical imbalance.** To look through the near addition, the wearer must look below the optical center of the distance prescription. In the patient with anisometropia, this creates a vertical imbalance at the reading level. Compensatory prism can be provided for symptomatic patients, most often those with at least 1.5 to 2 prism diopters of imbalance.¹⁰⁶

Two commonly used methods of determining the amount of vertical prism required are (1) measurements of vertical imbalance at the reading position (e.g., heterophoria or associated phoria), and (2) prediction from calculations (i.e., using Prentice's rule by multiplying decentration in centimeters by lens power in diopters for each lens). Because of fusional adaptation, the calculated vertical imbalance frequently does not match the measured vertical deviation and anticipated symptoms are not always manifested.¹⁰⁷

Generally, one-half to three-quarters of the amount of the heterophoria imbalance¹¹ is corrected through one of the following.¹⁰⁷

- Lowering distance optical centers
- Raising bifocal segment heights
- Using dissimilar segments
- Using compensated segments
- Using "slab-off" prism.

Alternatively, separate single vision glasses for distance and near, or contact lenses, may be prescribed.

- **Lens and frame materials.** In addition to spectacle lens designs, variables such as lens material, frame style, and lens coatings or tints usually require consideration. Glass, plastic, or polycarbonate lens materials may be recommended, depending on the patient's visual needs and eyeglass frame preferences. High-index lens materials or aspheric designs should be considered for persons who require high lens powers. This generally applies to corrections of over 6 D of myopia or hyperopia,¹⁰⁸ although the advantages may be noticeable in patients who require as little as 3 D of correction. Safety lenses should be prescribed or suggested when the patient is monocular or any time vision in one eye is significantly worse than in the fellow eye.¹⁰⁹ Filters may be added to lenses by applying coatings, dyes, or tints to lessen glare or light intensity problems.^{110,111} To reduce the thickness and weight of the spectacles, frames should be strong but lightweight, no larger than necessary to accommodate facial size, and chosen to allow the frame pupillary distance to approximate the patient's interpupillary distance (IPD).¹¹²

b. Optical Correction with Contact Lenses

Both rigid and soft lens designs can be used for contact lens correction of presbyopia.¹¹³ When fitting contact lenses for presbyopia, the clinician should consider the patient's refraction, appropriate lens design, and ocular physiology. The patient's refractive error can limit contact lens options. Some lens design options may be more suitable than others for a given patient. Evaluation of ocular physiology is important to ascertain which patients cannot tolerate contact lens wear (e.g., the patient with dry eye or corneal dystrophy). Other factors, such as the patient's motivation and understanding, vocational and avocational activities, support system, manual dexterity, personal hygiene, and financial situation are also important.^{114,115} Contact lenses may be used to successfully manage presbyopia, but, as with spectacle lens corrections, some compromise may be necessary.

- **Monovision lenses.** A common contact lens management for presbyopia¹¹⁶ is the monovision option, which uses a single vision contact lens in each eye or, when no distance correction is required, a lens in only one eye. The dominant eye is generally corrected for distance viewing; the fellow eye, for near. Modest decreases in contrast sensitivity¹¹⁷ and in stereopsis¹¹⁸ occur and sometimes affect the patient's driving¹¹⁹ and on-the-job performance. Some patients have difficulty with even a mild loss of stereopsis and report spatial disorientation and difficulty performing critical distance vision tasks.¹¹⁶ The reported rates of success with monovision correction range from 60 to 80 percent.¹²⁰⁻¹²²
- **Bifocal contact lenses.** The correction of presbyopic vision with bifocal contact lenses is theoretically similar to that with multifocal spectacle lenses. Bifocal contact lenses may be made of either rigid or soft lens materials. Two basic design strategies are "alternating" vision and "simultaneous" vision.
- **Alternating vision bifocal contact lenses.** Whether of rigid or soft lens materials, bifocal contact lenses may be designed to facilitate an alternating (translating) vision process. Typically, when the patient looks straight ahead, the distance portion of the contact lens occupies a position in front of the pupil. Upon down gaze, the action of the lower eyelid causes the lens to move upward on the cornea so that the near vision segment is raised to a position in front of the pupil. To facilitate this action, the bifocal contact lens may incorporate prism ballast or truncation. Both of these features minimize lens rotation that could otherwise degrade vision. Pupil coverage by the distance and the near portions of the contact lens varies in the dynamic process of continual lens movement.^{116,123}
- **Simultaneous vision contact lenses.** By design, the "simultaneous" vision contact lens simultaneously positions the distance and near portions of the lens over different parts of the pupil,¹¹⁹ producing two images of the object of regard, one superimposed on the other. When the object is at a distance that is

appropriately focused by either the distance portion or the near portion of the lens, the image will be in sharp focus on the retina. Overlying it will be the out-of-focus image formed by the other portion of the lens. The net effect is that, even though the contrast will be somewhat reduced, there will be a rather sharp image of the object of regard. Sometimes patients report "ghosting" or shadows around images, and they may notice reduced contrast and reduced visual acuity (especially for low-contrast details).¹²⁴

An aspheric contact lens design incorporates a gradually changing curvature of the contact lens, producing an addition power effect similar to that achieved by progressive addition spectacle lenses. Considered to be a version of simultaneous vision contact lenses, the aspheric bifocal lens effectively forms a series of superimposed images of the object of regard. Although the contrast will be reduced, a sharp image will form on the retina when the object of regard is within the focusing range of the distance and near portions of the lens.

The concentric-design simultaneous vision contact lens is constructed with a small circular central zone surrounded by another, annular optical zone. Either the distance (most often) or the near correction can occupy the central zone.

In another design, diffraction contact lenses use a central diffractive zone in which distance focus is provided by refraction of light, while near focus is created by diffraction. Patients using these lenses may experience ghost images and difficulty in low levels of illumination^{116,124} and, as with other simultaneous vision contact lenses, contrast will be reduced.

The patient's motivation and the purpose of the contact lens correction are important indicators of success. Many patients are highly successful with full-time contact lens wear; others gladly accept some performance deficiencies in exchange for the functional and cosmetic benefits of occasional wear, such as for social events or sports participation.

c. Combination of Contact and Spectacle Lenses

Many contact lens wearers gain some advantage by combining the use of spectacles with their contact lenses. One common example is the patient who uses contact lenses for distance viewing and adds glasses over the contact lenses for reading. A second example is the patient who has critical near vision tasks for most of the day and chooses to wear contact lenses for near, adding glasses for distance tasks. A third example is the monovision contact lens wearer who sometimes wears glasses to improve binocular vision for the performance of specific tasks. Some contact lens wearers use spectacles to correct residual astigmatism when performing more critical visual tasks.

d. Refractive Surgery

Patients with presbyopia who undergo refractive surgery may intentionally be made anisometropic to achieve monovision. The issues that confront monovision contact lens wearers should be considered and thoroughly explained to these patients. Patients should be informed of the range of possible side effects of refractive surgery (e.g., overcorrection, undercorrection, induced astigmatism, regression, delayed epithelial healing, stromal haze, diplopia, ocular tenderness).¹²⁵ Patients need to understand fully that, unlike treatment with ophthalmic lenses, refractive surgery is irreversible. A trial period with monovision contact lenses may be recommended prior to the patient's commitment to surgery.^{120,122}

Another approach sometimes used in refractive surgical management is to leave patients with a low degree of myopia in both eyes, so they can focus reasonably well for near vision tasks. In this case, distance vision spectacles might be required for more critical distance vision tasks. Presbyopia patients contemplating refractive surgery should be informed of the likelihood of postsurgical need for reading spectacles to achieve clear vision for near tasks.

e. Experimental Surgical Techniques

Several surgical techniques for the correction of presbyopia are currently under evaluation and are still considered experimental. The safety, efficacy and patient satisfaction of these techniques have yet to be established:

- Multifocal intraocular lens implants^{126, 127, 128}
- Accommodating intraocular lens implants^{129, 130}
- Small-diameter corneal inlays¹³¹
- Modified corneal surface techniques to create multifocal corneas^{132, 133}
- Conductive keratoplasty (CK)¹³⁴⁻¹³⁶
- Moldable intraocular lens implants (IOLs) to develop pseudophakic accommodation.^{137, 138}

3. Management Strategies for Correction of Presbyopia

a. Incipient Presbyopia

For the patient with incipient presbyopia, appropriate management depends upon his or her specific vision needs. The patient who does little near work, or who does not experience significant difficulties or discomfort from doing near work, probably does not require correction. Such patients should be advised about expected vision changes and scheduled for periodic re-evaluation as appropriate. The clinician may also advise them of ways to compensate for reduced accommodative ability, such as increasing the amount of available light or moving the reading material or computer screen further away.

Symptoms of presbyopia are more likely to occur in persons who do visually demanding or prolonged near vision work. Patients with moderate to high degrees of presbyopia are more likely to experience symptoms when performing near vision tasks. Symptomatic patients are likely to benefit from a low-power reading addition, in either single vision or bifocal form. Patients with low to moderate myopia may also be advised to remove their spectacles for extended near activities.

b. Functional Presbyopia

Patients with functional presbyopia usually derive significant benefit from using corrective lenses for near vision. Clinicians generally should prescribe the minimum of plus lens power required to provide clear, comfortable vision at near.¹³⁹ Management decisions should be based on the results of clinical assessment and vocational and avocational history. The power of the near lens addition required can be expected to increase with the patient's age. When a greater change in lens power is needed because the patient delayed seeking care, it may be advisable to increase the power of the addition gradually over 6 to 12 months to avoid patient adaptation difficulties.

c. Absolute Presbyopia

Although most patients with absolute presbyopia have worn near vision corrections for many years, age-related changes in distance refraction can necessitate periodic re-evaluation and modification of the correction. The need for a lens correction for intermediate viewing is more likely in cases of absolute presbyopia than in other types of presbyopia.

d. Premature Presbyopia

The management of premature presbyopia generally requires taking a careful patient history and thoroughly examining the eyes to identify environmental, nutritional, disease-related, or drug-induced causes. Consultation with or referral to the patient's primary care physician or other health care practitioner may help in identifying or ruling out potential contributing factors and determining appropriate treatment and management.

Removal or treatment of the underlying causative factors generally improves accommodative ability and reduces or eliminates the symptoms of premature presbyopia. However, some patients with premature presbyopia benefit from the use of a near addition, at least on a temporary basis.



e. Nocturnal Presbyopia

The patient who experiences vision difficulties under low-light conditions might be advised to improve lighting in the work area. Enhanced lighting reduces pupil size and improves depth of field.

Such patients might benefit from a plus lens correction for near activities. Careful review and analysis of the patient's specific complaints and visual work environment help to determine whether correction will be beneficial.

f. General Considerations

Although managing the patient with presbyopia by prescribing a reading addition for near vision may at first appear uncomplicated, a host of factors should be considered. The relative importance of these factors varies greatly from patient to patient, but there are some common approaches.

One important issue is whether the patient has had previous management for presbyopia. First-time multifocal lens/spectacle users are often challenging cases, in part due to the psychological factors that sometimes accompany the use of bifocals. The need for help in reading, whether by single vision or multifocal spectacles or contact lenses, reminds the patient that he or she is getting older and that some functional abilities are decreasing as a result of aging. Some patients find it extremely difficult to accept reading glasses or multifocals and their implications. In one study, 46 percent of multifocal spectacle lens users reported some difficulty getting accustomed to their spectacles.¹⁴⁰ Some common complaints which may arise from the use of multifocal lenses include:

- Difficulty navigating curbs or stairs
- Jumping of image when the line of vision crosses the bifocal line
- Distortions of vision with the use of PALs
- Difficulty driving when wearing multifocal contact lens corrections
- Night vision problems associated with multifocal contact lens corrections.

The patient should receive understanding, education, and encouragement.¹⁴¹ By showing empathy and explaining that presbyopia is part of the normal physiological process of aging, the clinician can facilitate patient acceptance of the condition and the treatment. Time should also be devoted to reviewing various options for correcting presbyopia and discussing the application of clinical findings to treatment recommendations.

When the patient has a high degree of denial and resistance, it is important that the clinician discuss the various alternatives of spectacles and contact lenses. Patients who are particularly resistant to the use of multifocals may repeatedly report significant problems with their new glasses—problems that are not confirmed by objective evidence. These problems may include complaints of blurred vision when visual acuity is normal and there is no change in refraction, complaints about the frame fit, despite repeated frame adjustments, or unsubstantiated dissatisfaction with the new glasses. Although the clinician should consider these complaints carefully and search for explanations, one should be aware that such complaints may simply represent conscious or subconscious effort to avoid wearing bifocals.¹⁴²

When prescribing for an experienced multifocal user, the optometrist should base decisions on the patient's symptoms and history. Improving the patient's functioning often requires only an increase in the power of optical correction. However, when the patient reports that his or her vocational or lifestyle needs are not fully met by the correction, and when there is evidence that increasing the power of the addition is not sufficient, other treatment options should be considered and discussed.

Regardless of the method the clinician uses to determine the lens prescription for presbyopia, the goal is invariably to provide the patient with clear, comfortable vision for his or her habitual visual tasks. An overview of prescribing considerations is provided in Table 3.²

4. Patient Education

Advising patients about presbyopia has important ramifications in the areas of patient understanding and successful treatment as well as safety



Table 3
Prescribing Considerations for Presbyopia*

1. Beware of changing the form of correction if the patient is satisfied (e.g., conventional spectacles to progressive addition lenses, multifocal spectacles to contact lenses, monovision contact lenses to multifocal contact lenses).
2. Beware of changing any aspect of the near segment if the patient is well adapted.
3. Beware of over delaying the initial near correction.
4. Beware of overplussing the near correction.
5. Beware of fully correcting refractive changes of more than 1.00 D at distance or near.
6. Beware of reducing total plus power of the near correction.
7. Beware of prescribing cylinder, especially that which is monocular or obliquely oriented, for previously uncorrected astigmatism.
8. Beware of changing cylinder axis if the patient is well adapted to the existing cylinder axis.
9. Beware of different cylindrical axes for distance and near in moderate to high astigmatic corrections.
10. Beware of changing plus-cylinder correction to minus-cylinder correction.
11. Beware of fitting the borderline presbyopic spectacle-corrected myopic patient with contact lenses.
12. Beware of the loss of intermediate field when prescribing an initial near addition for the low-myopic presbyopia patient or when prescribing minus power at distance for the presbyopic patient undergoing a myopic shift in both eyes.
13. Beware of induced near vertical imbalance when the anisometric presbyopia patient views through the near segment of a multifocal spectacle.

*Adapted from Patorgis CJ. Presbyopia. In: Amos JF, ed. Diagnosis and management in vision care. Boston: Butterworths, 1987:227.

and professional liability.¹⁴³ Education, begun during the examination, reinforced at the time of dispensing, and continued at subsequent visits for follow-up evaluation or spectacle adjustment, can help to minimize such adjustment problems. Patients should be informed about the signs, symptoms, clinical course, and treatment options for presbyopia. Information should be provided about the potential visual implications of alternative types of optical correction and their use.

5. Prognosis and Follow-up

Virtually all presbyopic patients can succeed in using one or more of the available treatment options discussed in this Guideline (see Appendix Figure 1). In some cases (e.g., presbyopic patients new to optical correction, contact lens wearers, patients who have a history of difficulties adapting to visual correction), additional follow-up visits may be required. During these visits, the optometrist can continue patient education, verify lens prescriptions and frame adjustments, and attend to any remaining difficulties. Occasionally, changes in lens design or prescription power may be required. Patients with contact lenses generally require regular follow-up over an extended period. Such follow-up allows the clinician to modify the contact lens design or fit, to monitor the patient's eye health and response to contact lens wear, and to consider changes in vocational and avocational needs.



CONCLUSION

The evaluation and management of presbyopia are important because significant functional deficits can occur when the condition is left untreated. Furthermore, the onset of presbyopia frequently motivates the individual to seek eye care, presenting the optometrist the opportunity to check for the presence of other disorders, some of which might threaten sight or life. This opportunity underscores the public health benefit of comprehensive optometric care for patients with presbyopia. As primary eye care providers, optometrists have the expertise to examine, diagnose, treat, and manage a wide variety of eye and vision problems. For patients requiring other health care services related to systemic conditions detected in the course of their eye examination, the optometrist becomes the point of entry into the broader health care system.

Undercorrected or uncorrected presbyopia can cause significant visual disability and have a negative impact on the patient's quality of life. Gaining an understanding of the patient's specific vocational and avocational visual requirements helps the optometrist recommend the treatment most appropriate for enhancing visual performance.

Traditional treatment options include single vision and multifocal spectacle and contact lenses. More recently, several surgical treatments for presbyopia have become available. Patients should be counseled appropriately, as the safety and efficacy of these methods improve and studies are conducted to demonstrate that they are viable options for patients. Although each of these options requires some degree of compromise and adaptation, the patient with presbyopia who receives appropriate optometric care can continue to function well.



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Figure 1
Optometric Management of the Patient with Presbyopia:
A Brief Flowchart

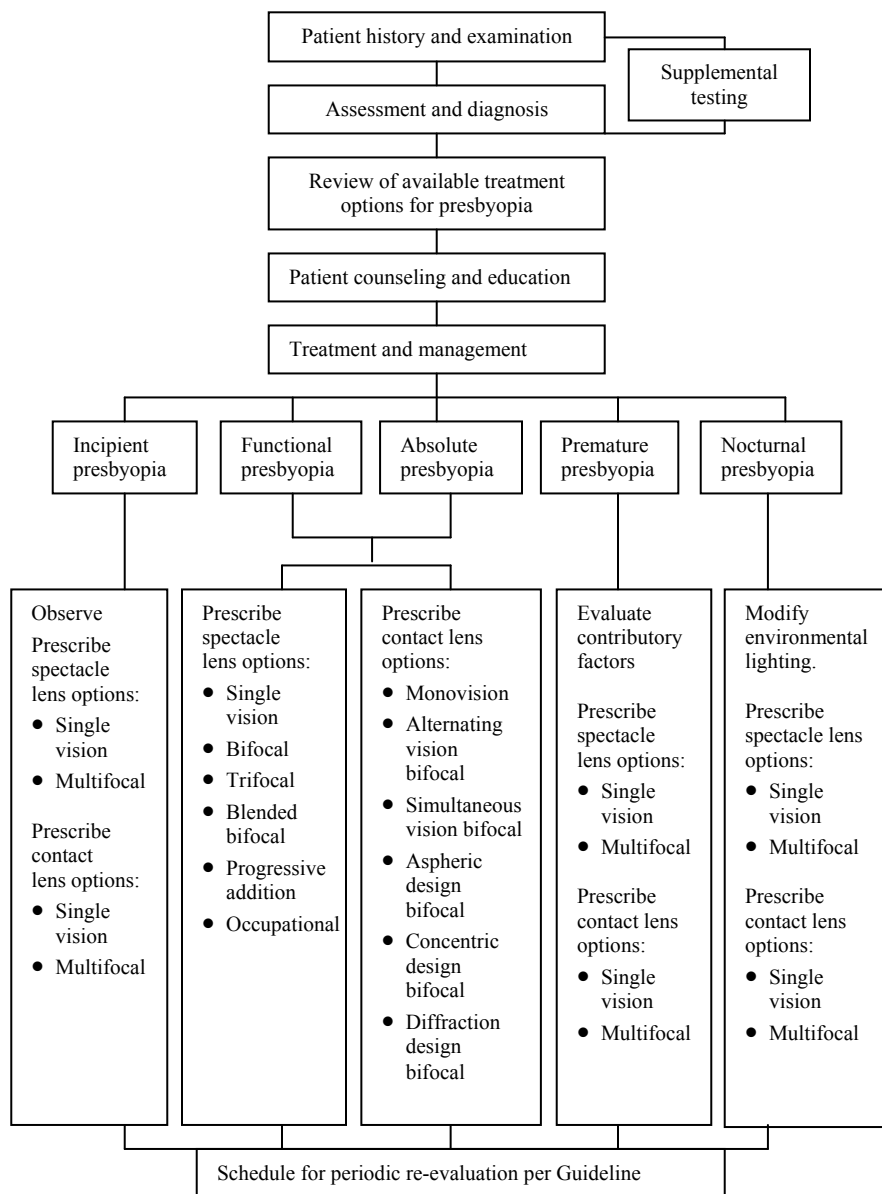


Figure 2
Potential Components of the Diagnostic Evaluation for Presbyopia

- A. Patient history
 1. Presenting problem and chief complaint
 2. Visual and ocular history
 3. General health history
 4. Medication usage and medication allergies
 5. Family eye and medical histories
 6. Vocational and avocational vision requirements
- B. Visual acuity
 1. Distance visual acuity testing
 2. Near visual acuity testing
- C. Refraction
- D. Binocular vision and accommodation
 1. Plus lens to clear near vision
 2. Positive and negative relative accommodation
 3. Amplitude of accommodation
 4. Crossed cylinder test
 5. Accommodative convergence/accommodation ratio
- E. Ocular health assessment and systemic health screening
- F. Supplemental testing
 1. Near retinoscopy
 2. Intermediate distance testing

**Figure
Frequency and Composition of Evaluation**

Type of Patient	Number of Evaluation Visits	Treatment Options	Frequency of Follow-up Visits*
Incipient presbyopia	1-2	Optical correction; modify habits and environment	1-2 yr
Functional presbyopia	1-2	Optical correction	1-2 yr
Absolute presbyopia	1	Optical correction	Annually
Premature presbyopia	2-3	Optical correction	3-6 mo
Nocturnal presbyopia	1-2	Optical correction; modify habits and environment	1-2 yr

NOTE: p.r.n. = as necessary.

*Patients prescribed contact lenses may require more frequent follow-up to monitor eye health and lens performance.

**3
and Management Visits for Presbyopia**

Composition of Follow-up Examinations				
Visual Acuity	Refraction	Accommodation/ Vergence Testing	Ocular Health Evaluation	Management Plan
Each visit	Each visit	Each visit	Each visit	No treatment or provide refractive correction; educate patient
Each visit	Each visit	Each visit	Each visit	Provide refractive correction; educate patient
Each visit	Each visit	Each visit	p.r.n.	Provide refractive correction; educate patient
Each visit	p.r.n.	Each visit	p.r.n.	Address ocular or general health issues; provide refractive correction; educate patient; monitor
Each visit	Each visit	Each visit	Each visit	No treatment or provide refraction; educate patient



Figure 4
ICD-10-CM Classification of Presbyopia

Presbyopia	367.4
Disorders of accommodation	367.5
Paresis of accommodation	367.51
Cycloplegia	
Total or complete internal ophthalmoplegia	367.52
Spasm of accommodation	367.53
Other disorders of refraction and accommodation	367.8
Transient refractive change	367.81
Other	367.89
Drug-induced disorders of refraction and accommodation	
Toxic disorders of refraction and accommodation	
Unspecified disorder of refraction and accommodation	367.9

Abbreviations of Commonly Used Terms

AA	Amplitude of Accommodation
AC/A	Accommodative convergence/accommodation ratio
D	Diopter
IOL	Intraocular lens
IPD	Interpupillary distance
NRA	Negative relative accommodation
PALs	Progressive addition lenses
PRA	Positive relative accommodation
PRK	Photorefractive keratectomy
OPLs	Occupational progressive addition lenses
CK	Conductive keratoplasty
OU	Both the right eye and left eye



Glossary

Accommodation The ability of the eyes to focus clearly on objects at various distances.

Accommodative convergence/accommodation (AC/A) ratio The convergence response of an individual to a unit stimulus of accommodation.

Anisometropia Condition of unequal refractive state for the two eyes, in which one eye requires a different lens correction than the other.

Antimetropia (mixed anisometropia) Anisometropia in which one eye is myopic, the other hyperopic.

Astigmatism Refractive anomaly due to unequal refraction of light in different meridians of the eye, generally caused by a toroidal anterior surface of the cornea.

Convergence The turning inward of the primary lines of sight toward each other.

Crossed cylinder (lens) A compound lens in which the dioptric powers in the principal meridians are equal but opposite in sign, usually mounted on a rotating axis or handle midway between the principal meridians, commonly used in the clinical measurement of the power and the axis of astigmatism, and designated in terms of the powers in the two principal meridians.

Diopter/dioptic A unit used to designate the refractive power of a lens or an optical system, the number of diopters of power being equal to the reciprocal of the focal length in meters.

Diplopia (double vision) A condition in which a single object is perceived as two rather than one.

Exotropia (divergent strabismus) Ocular misalignment in which the non-fixating eye is turned outward.

Fixation disparity Overconvergence or underconvergence, or vertical misalignment of the eyes under binocular (both eyes) viewing conditions small enough in magnitude so that fusion is present.

Fusion The process by which stimuli seen separately by the two eyes are combined, synthesized, or integrated into a single perception.

Heterophoria A latent condition of the eyes from the orthophoric position which requires vergence for bifixation to be maintained.

Hyperopia (farsightedness) Refractive condition in which the light entering the nonaccommodated eye is focused behind the retina.

Monovision Vision provided by the optical correction of one eye for distance and the other for near in lieu of bifocals, especially with contact lenses, whether or not fixational binocularity is retained.

Myopia (nearsightedness) Refractive condition in which the light entering the nonaccommodated eye is focused in front on the retina .

Near point of convergence (NPC) The maximum extent the eyes can be converged.

Negative relative accommodation (NRA) A measure of the maximum ability to relax accommodation while maintaining clear single binocular vision.

Positive fusional vergence A vergence movement of the eye occurring as a response to disparate or unfused binocular stimuli, or the range or extent of such movement with respect to given conditions of reference.

Positive relative accommodation (PRA) A measure of the maximum ability to stimulate accommodation while maintaining clear single binocular vision.

Appendix 61

Presbyopia A reduction in accommodative ability that occurs normally with age and necessitates a plus lens addition for satisfactory seeing at near.

Refraction The determination of the refractive errors of the eye.

Refractive status (refractive error) The degree to which images received by the eyes are not focused on the retina (e.g., myopia, hyperopia, astigmatism).

Retinoscopy The determination of the conjugate focus of the retina, hence an objective measurement of the refractive state of the eye, with a retinoscope.

Stereopsis The perception of three-dimensional depth or solidity due to retinal disparity.

Visual acuity The clearness of vision that depends upon the sharpness of the retinal image and the integrity of the retina and visual pathway.

Sources:

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