



สายตาผู้สูงอายุ PRESBYOPIA IN ELDER

สุวรรณี วุฒินรงค์ตระกูล¹

Suwannee Wutinarongtrakul

¹พลตำรวจตรีหญิง แพทย์หญิง

Police Major General

โรงพยาบาลตำรวจ

Police General Hospital

บทคัดย่อ

บทความนี้มีวัตถุประสงค์เพื่อให้ผู้อ่านได้ความรู้ ความเข้าใจถึงสาเหตุ อาการ และวิธีการรักษาในรูปแบบต่าง ๆ ของโรคสายตาผู้สูงอายุ เพราะในขณะที่เรามองภาพระยะไกล เราจะอยู่ในระยะพัก แต่เมื่อเราต้องการดูระยะใกล้ กล้ามเนื้อแก้วตาที่ช่วยในการเพ่งจะเกิดการหดตัวตึงเป็นเหตุให้แก้วตาคนเราโป่งออก ทำให้เพิ่มกำลังการหักเหของแสงจำทำให้ภาพระยะใกล้ชัดเจนขึ้น กลไกการเพ่งเป็นการทำงานโดยปกติและอัตโนมัติ ตั้งแต่เด็กจนถึงอายุประมาณ 40 ปี จากนั้นขบวนการเพ่งจะอ่อนแรงลง ซึ่งได้มีผู้ศึกษาโดยอาศัยวิธีตรวจวัด พบว่า ในวัยเด็กถ้าเพ่งได้มากก็จะทำให้มองภาพที่อยู่ชิดตาได้ชัดเจน และเมื่ออายุมากขึ้นกำลังการเพ่งจะลดลงเรื่อย ๆ จนถึงอายุประมาณ 40 ปี กำลังการเพ่งที่เหลืออยู่ไม่พอที่จะใช้ดูหนังสือที่ระยะ 1 ฟุตได้ (30 เซนติเมตร) จึงต้องเลื่อนหนังสือให้ไกลออกไป หรือใช้แว่นที่มีกำลังเป็นบวก (เลนส์นูน) ชดเชยเพราะกำลังการเพ่งจะลดลงเรื่อย ๆ จนเป็น 0 (ศูนย์) หรือไม่มีเลย ขบวนการเปลี่ยนแปลงนี้จึงเป็นขบวนการปกติของคนเราทุกคนแต่จะเริ่มเสื่อมลงเร็วหรือช้าในระยะเวลาต่าง ๆ กันในแต่ละคน โดยเฉลี่ยจะเริ่มอายุประมาณ 40 ปี โดยผู้หญิงอาจจะเร็วกว่าผู้ชายเล็กน้อย คนบางคนอาจเข้ามาสู่ภาวะสายตาสูงอายุโดยไม่มีอาการอะไรเลย เพียงแค่มองใกล้ไม่ชัด อ่านหนังสือไม่ได้ แต่ในบางคนอาจมาด้วยอาการปวดตาและ/หรือปวดศีรษะ เวลาใช้สายตามองใกล้ และอาจแสบตา เคืองตา ซึ่งควรได้รับการตรวจวินิจฉัยและการรักษาที่ถูกต้องเหมาะสมกับอาชีพอุปนิสัย และวิถีทางการดำเนินชีวิตแต่ละบุคคล

คำสำคัญ : สายตาผู้สูงอายุ

Abstract

This article has been published to provide readers with knowledge and understanding of presbyopia including symptoms and treatments. When we are focusing on the distant object, the eye will have no accommodation. But when we need to focus on the object nearby, ciliary muscles will contract which cause the lens more curve in order to have the clearer vision on the close object. Accommodation mechanism can work both automatically and normally since we were born until the age of 40. After the age of 40, our accommodation mechanism will be weaker. When we are children, we can clearly accommodate the object nearby, but people accommodation mechanisms tend to decrease over time until their age reach 40 which the ciliary muscle performance is insufficient for focusing on the text of the book located at 30 centimeters. In order to read, these people should move the book to more distant or use the convex lens (plus power lens) to compensate weak accommodation. Accommodation power will gradually decrease until zero which is the normal condition of a human. This will happen around 40 years old. Somebody has presbyopia with a little symptom such as difficulty with reading close work but in some cases have eye ache, headache or eye irritation. Patients should be examined to get diagnosis and treatment compatible with their jobs, lifestyles, and personalities.

Keywords : presbyopia in elder

Introduction and overview

Presbyopia is an eye condition in which the eye slowly loses the ability to focus quickly on objects that are close. It's a disorder that affects everyone during the natural aging process.

When light enters the eye, it passes through the cornea. Then, it passes through the pupil. The iris is the colored ring in the eye that opens and closes the pupil to adjust the amount of light passing through it. After passing through the pupil, the light passes through the lens. In its healthiest state, the lens changes shape so it can bend the light rays further and focus them on the retina at the back of the eye. However, the lens becomes less flexible with age. Then, it can't change shape as easily. As a result, it's unable to bend the light properly to focus it on the retina.

Presbyopia is when the eyes gradually lose the ability to see things clearly up close. It is a normal part of aging. In fact, the word "presbyopia" means "old eye" in Greek. People may start to notice presbyopia shortly after age 40. They will probably find that they hold reading materials farther away in order to see them clearly. Presbyopia is the gradual loss of the eyes' ability to focus on nearby objects. It's a natural, often annoying part of aging. Presbyopia usually becomes noticeable in your early to mid-40s and continues to worsen until around age 65.

People may become aware of presbyopia when they start holding books and newspapers at arm's length to be able to read them. A basic eye exam can confirm presbyopia. They can correct the condition with eyeglasses or contact lenses or might also consider surgery.

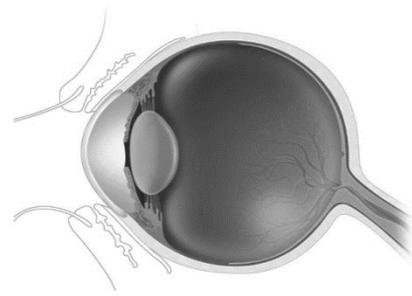


Figure 1: The general structure of human eye.

Symptoms

The most common symptoms of presbyopia occur around age 40 for most people. The symptoms of presbyopia typically involve a gradual deterioration in the ability to read or do work up close.

Presbyopia develops gradually. People may first notice these signs and symptoms after age 40:

- A tendency to hold reading material farther away to make the letters clearer.
- Blurred vision at normal reading distance.
- Eyestrain or headaches after reading or doing close-up work.
- Needing brighter lighting when reading or doing close work.
- Having fatigue from doing close work.

Human eyes will continue to gradually lose their ability to focus on close objects as their age. As a result, the prescription will have to be reviewed and changed according to the advice of eye specialist.

Hyperopia, or farsightedness, is a condition that has symptoms similar to presbyopia. However, they're two different disorders. In both conditions, the closer objects appear blurred.

Hyperopia occurs when the eye is shorter than normal or the cornea is too flat. With these malformations, the light rays focus behind the retina, as in presbyopia. However, hyperopia is a refractive error that can present

at birth or youth. It's possible to have hyperopia and then develop presbyopia with age.

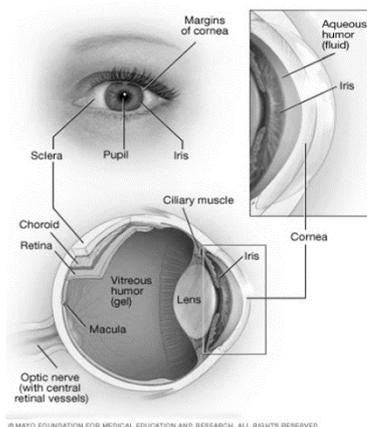
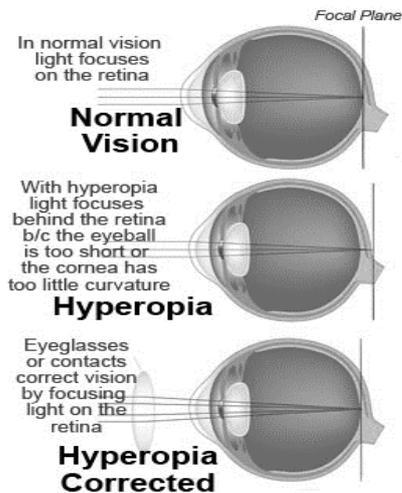


Figure 2: The structure of human eye

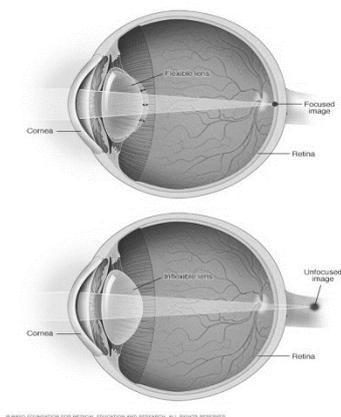


Figure 3: The lens flexibility and inflexibility for focusing object

Causes

To form an image, the eye relies on the *cornea* and the *lens* to focus the light reflected from objects. The closer the object, the more the lens flexes.

- The cornea is the clear, dome-shaped front surface of the eye.
- The lens is a clear structure about the size and shape of an M&M's candy.
- Both of these structures bend (refract) light entering the eye to focus the image on the retina, located on the inside back wall of the eye.

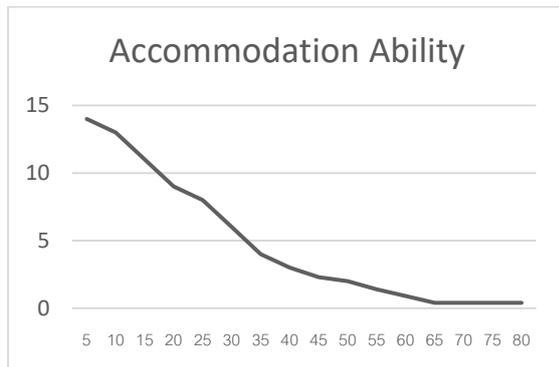
The lens, unlike the cornea, is somewhat flexible and can change shape with the help of a circular muscle that surrounds it. When people look at something at a distance, the circular muscle relaxes. When people look at something nearby, the muscle constricts, allowing the relatively elastic lens to curve and change its focusing power.

When people are young, the lens in the eye is flexible and relatively elastic. It can change its length or shape with the help of a ring of tiny muscles that surround it. The muscles that surround the eye can easily reshape and adjust the lens to accommodate both close and distant images.

Presbyopia is caused by a hardening of the lens of the eye, which occurs with aging. As the lens becomes less flexible, it can no longer change shape to focus on close-up images. As a result, these images appear out of focus.

With age, the lens and the muscle fibers surrounding the lens slowly lose flexibility and stiffen. As a result, the lens becomes unable to change shape and constricts to focus on close images. With this hardening of the lens, it gradually loses its ability to focus light directly onto the retina.

Accommodationability



In general, the adding power is up to the age.

45 year+0.50D

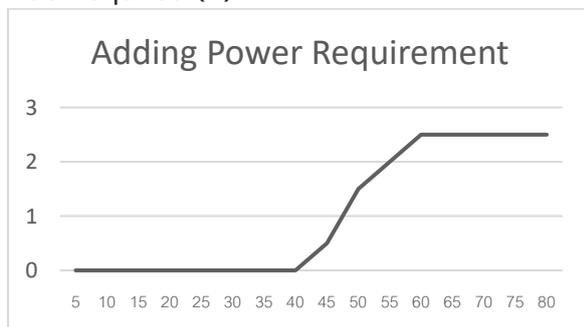
47 year+1.00D

50 year+1.50D

55 year+2.00D

60 year+2.50D

Add Required (D)



Risk factors

Certain factors can make people more likely to develop presbyopia, including:

- Age. Age is the greatest risk factor for presbyopia. Almost everyone experiences some degree of presbyopia after age 40.

- Other medical conditions. Being farsighted or having certain diseases; such as diabetes, multiple sclerosis or cardiovascular diseases; can increase the risk of premature presbyopia, which is presbyopia in people younger than 40.

- Drugs. Certain drugs are associated with premature presbyopia symptoms, including antidepressants, antihistamines and diuretics.

Some studies report that: Certain diseases or drugs can cause presbyopia in people younger than age 40. When the symptoms of presbyopia occur earlier than usual, it's called premature presbyopia. If people notice the symptoms of presbyopia at an age earlier than normal onset, it may be a sign of an underlying medical condition.

People are at a higher risk of premature presbyopia if they have:

- anemia, which is a lack of enough normal blood cells

- cardiovascular disease

- diabetes, or difficulties metabolizing blood sugar

- hyperopia, or farsightedness, which means you have a greater difficulty seeing objects nearby than objects that are far away

- multiple sclerosis, which is an autoimmune disease that affects the spine and brain

- myasthenia gravis, which is a neuromuscular disorder that affects the nerves and muscles

- eye trauma or disease

- vascular insufficiency, or poor blood flow

Some prescription and over-the-counter drugs can reduce the eye's ability to focus on close images. Taking the following drugs can put people at a higher risk of premature presbyopia:

- alcohol

- antianxiety drugs

- antidepressants

- antihistamines

- antipsychotics

- antispasmodics

- diuretics

Other factors that may put people at a higher risk of premature presbyopia are:

- being female

- having intraocular surgery, or surgery done on the inside of the eye
- eating an unhealthy diet

Diagnosis

Presbyopia is diagnosed by a basic eye exam, which includes a refraction assessment and an eye health exam. A refraction assessment determines if people have nearsightedness or farsightedness, astigmatism, or presbyopia. Doctors may use various instruments and ask them to look through several lenses to test the distance and close-up vision.

The eye doctor likely will put drops in patients' eyes to dilate their pupils for the eye health exam. This may make the eyes more light sensitive for a few hours after the exam. Dilation enables doctors to more easily view the inside of the eyes.

The American Academy of Ophthalmology recommends that adults have a complete eye exam every:

- Five to 10 years under age 40
- Two to four years between ages 40 and 54
- One to three years between ages 55 and 64
- One to two years beginning at age 65

People may need more-frequent exams if there are risk factors for eye disease or need glasses or contact lenses.

According to the Foundation of the American Academy of Ophthalmology, adults who don't have any symptoms or risk factors associated with eye disease should have a baseline examination at age 40. An eye screening can identify early signs of disease and vision changes that can begin, sometimes without any symptoms, around this age.

So, Presbyopia can be diagnosed as part of a comprehensive eye examination. A typical exam will include tests to evaluate the eyes

for the presence of diseases and vision disorders. The pupils will probably be dilated with special eye drops to allow doctors to examine the inside of the eye.

Treatment

The goal of treatment is to compensate for the inability of the eyes to focus on nearby objects. Treatment options include wearing corrective eyeglasses (spectacle lenses) or contact lenses, undergoing refractive surgery, or getting lens implants for presbyopia.

Eyeglasses

Eyeglasses are a simple, safe way to correct vision problems caused by presbyopia. People may be able to use over-the-counter (nonprescription) reading glasses if they had good, uncorrected vision before developing presbyopia.

Most nonprescription reading glasses range in power from +1.00 diopter (D) to +3.00 D. When selecting reading glasses:

- Try different powers until find the magnification that allows to read comfortably, starting with the lower powers
- Test each pair on reading material held at a comfortable distance

Most people need prescription lenses for presbyopia. If the over-the-counter glasses are inadequate or if they already require prescription corrective lenses for nearsightedness, farsightedness or astigmatism. The choices include:

- Prescription reading glasses. If people have no other vision problems, they can use glasses with prescription lenses for reading only. They will need to remove these when they're not reading.
- Bifocals. These lenses have a visible horizontal line that separates the distance prescription, above the line, and the reading prescription, below the line.

Some specialized lenses may also have segments at the top for those who need to look upward at objects that are in the intermediate or near range (double-D bifocals).

- Trifocals. These glasses have corrections for close-up work, middle distance vision; such as for computer screens; and distance vision. Trifocals come with two visible horizontal lines in the lenses.

- Progressive multifocal. This type of lens has no visible horizontal lines, but has multiple powers for distance, middle distance and close-up corrections. Different areas of the lens have different focusing strengths. Function generally is the same way as bifocals or trifocals; however, they have a smooth transition between distance and near focal areas instead visible dividing lines. While the invisible transition of progressive lenses may be more aesthetically pleasing, the focal areas are relatively small because more lens space is used for the transitional areas. Progressive lenses cause more distortion than other types of lenses, making them more difficult to wear for approximately 10 percent of the population.

- Office progressives. These lenses have corrections for computer-distance and close work. People generally use these at a computer or for reading and remove them for driving or walking around.

Contact lenses

People who don't want to wear eyeglasses often try contact lenses to improve their vision problems caused by presbyopia. This option may not work for them if they have certain conditions related to their eyelids, tear production or the surfaces of the eyes such as dry eye.

Bifocal and multifocal contact lenses come in both soft materials and rigid gas permeable (GP) materials. They are also available as hybrid contact lenses. Some can be worn on a disposable basis. That means people have the convenience of throwing the lenses out at specified intervals (even daily, in some cases) and replacing them with fresh, new lenses.

Several lens manufacturers offer multifocal contact lenses made of silicone hydrogel material. These lenses allow significantly more oxygen to reach the cornea than conventional soft lenses for greater wearing comfort.

Brands of multifocal silicone hydrogel contact lenses available in the U.S. include: Air Optix Aqua Multifocal (Alcon); Bausch + Lomb Ultra for Presbyopia (Bausch + Lomb); Biofinity Multifocal (CooperVision); and AcuvueOasys for Presbyopia (Johnson & Johnson Vision Care). Other options include Duette Progressive (SynergEyes) and Duette Multifocal (SynergEyes) hybrid contact lenses, which have a central optical zone made of GP lens material for crisp optics and a peripheral fitting zone made of soft silicone hydrogel material for comfort.

Gas permeable contact lenses are rigid lenses made of durable plastic that transmits oxygen. These lenses also are called GP lenses, rigid gas permeable lenses, RGP lenses and oxygen permeable lenses. Gas permeable contact lens were first introduced in the late 1970s; they are actually a newer technology than soft lenses. Most GP lenses incorporate silicone, which makes them more flexible than PMMA (polymethyl methacrylate). Silicone is oxygen permeable, so oxygen can pass directly through GP lenses to keep the cornea healthy without having to rely solely on oxygen-containing tears to be pumped under the lens with each blink.

In fact, modern rigid gas permeable contacts allow more oxygen to reach the cornea than most soft contact lenses (although some silicone hydrogel soft lenses are comparable to GP lenses in oxygen transmission).

Soft Contact Lenses

Contacts made of gel-like plastics (hydrogels) containing varying amounts of water. Includes silicone hydrogel lenses, which are more oxygen-permeable than regular hydrogel lenses.

Silicone hydrogel contact lenses are advanced soft lenses that allow more oxygen to pass through the lens to the cornea than regular soft ("hydrogel") contact lens. In fact, silicone hydrogel lenses enable up to five times more oxygen to reach the cornea than regular hydrogel lenses. Silicone hydrogel and regular hydrogel lenses both are made of plastics that are hard when dry but readily absorb water and become soft and gel-like when hydrated.

Hybrid Contact Lens

Contact lenses that have a central optical zone made of rigid gas permeable (GP) plastic, surrounded by an outer "skirt" of silicone hydrogel or regular hydrogel material. Hybrid contacts are designed to provide the crisp optics of GP contact lenses and wearing comfort comparable to that of soft lenses.

Several lens types are available:

- *Bifocal contact lenses.* Bifocal contact lenses provide distance and close-up correction on each contact. In one type of bifocal lens, the bottom, reading portion of the lens is weighted to keep the lens correctly positioned on the eye. Newer types of bifocal contact lenses offer one type of correction through the edges (periphery) of each lens and the other type of correction through the center of the lenses.

Bifocal contacts lenses have two prescriptions in the same lens.

- *Monovision contact lenses.* With monovision contacts, people wear a contact lens for distance vision in one eye (usually your dominant eye) and a contact lens for close-up vision in the other eye.

These correct one eye for distance vision and the other for close-up vision. Wearers need to adapt to monovision lenses and train their brain to see this way. They may find they lose their ability to judge something's distance or speed with monovision lenses.

- *Modified monovision.* With this option, people wear a bifocal or multifocal contact lens in one eye and a contact lens set for distance in the other (usually the dominant eye). They use both eyes for distance and one eye for reading.

- *Multifocal contact lens.*

Multifocal contact lenses have a range of powers. These lenses have several rings or zones set at different powers. With this design, people are actually using both near and far vision at the same time. However, their brains learn to automatically select the right focus for what they want to see. They may find that using the multifocal lens make their vision less sharp than when using a monofocal lens.

Multifocal contact lenses offer a lot of performance ability, but may also be:

- More difficult to adjust to due to a different viewing experience.

- Accompanied by nighttime glare and hazy or shadowy vision during the adjustment period.

- More expensive because of the increased complexity in design.

There are no hard and fast rules. But, in general, aspheric multifocal contact lenses tend to work best for mild to moderate presbyopia, and concentric or segmented

multifocal contacts often are more successful for advanced presbyopia.

Multifocal contact lens alternatives

If multifocals don't sound like they're a good fit, there are a number of other options, including:

- Pairing reading glasses with normal contact lenses
- Monovision contact lenses
- Bifocal contact lenses

Many contact lens wearers prefer wearing glasses with progressive lenses rather than reading glasses because:

1. Full-size eyeglasses with line-free progressive lenses looks more youthful than store-bought "readers."
2. Progressive lenses can correct any mild residual astigmatism or other refractive error not fully corrected by your contacts. For this reason, eyeglasses with progressive lenses may give them sharper vision for specific activities like night driving.
3. Progressive lenses allow them to see clearly at all distances without having to constantly put on and take off reading glasses.

How Multifocal and bifocal Contact Lenses Work

Different bifocal and multifocal contact lenses work in different ways, depending on the design of the lens. The designs fall into two basic groups:

1. Simultaneous vision designs. These multifocal contact lenses have specific regions of the lens designated for far and near (and sometimes intermediate) viewing. Depending on the object being viewed, the wearer's eye uses the region(s) of the lens that provide the sharpest vision. There are two types of simultaneous vision designs: concentric and aspheric (see illustration).

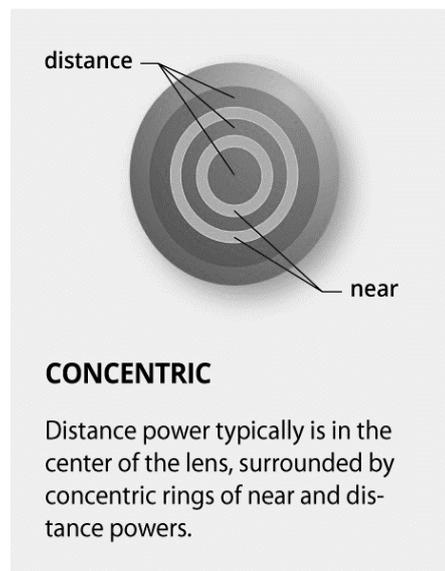
2. Segmented designs. These rigid gas permeable multifocal lenses are designed much like bifocal and trifocal eyeglasses: the center and top portions of the lens contain the appropriate power for viewing distant objects, and the lower portion of the lens has added magnifying power for viewing near objects. Segmented designs sometimes are called alternating or translating designs.

Concentric Multifocal Contacts

Concentric multifocal contact lenses typically contain the lens power for seeing distant objects in the center of the lens, which is surrounded by concentric rings of near and distance powers of the bifocal contact lens prescription.

Typically, at least two concentric power rings are within the pupil area in normal lighting, but this varies as the pupil dilates and constricts due to varying light conditions.

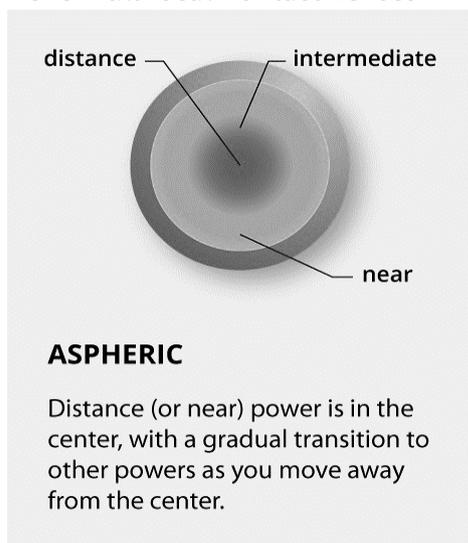
Concentric multifocal lenses can be made of either soft or rigid gas permeable (RGP or GP) contact lens materials.



The locations of the powers in a concentric design can vary:

1. GP multifocal usually have the distance power in the center (called center-distance).
2. Soft multifocal contact lenses sometimes have the near power in the center (center-near).
3. Some concentric multifocal contacts have a center-distance design (D) for the dominant eye and a center-near design (N) for the non-dominant eye.

Aspheric Multifocal Contact Lenses

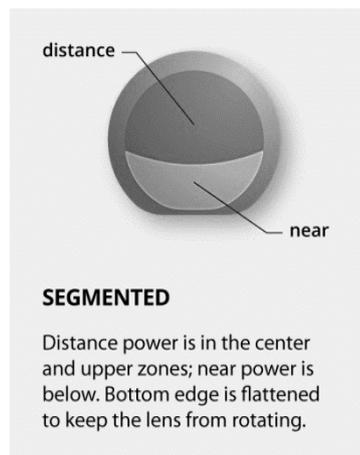


The design of aspheric multifocal contact lenses is similar to that of progressive eyeglass lenses, there's a gradual change in power from far to near, with no visible lines in the lenses.

Unlike eyeglasses, however, aspheric multifocal contacts are simultaneous vision lenses, so the visual system must learn to select the proper lens power for the moment.

A number of aspheric multifocal contacts are now available as daily disposable lenses for the ultimate convenience in contact lens wear for presbyopes. Brands include 1 Day multifocal (Johnson and Johnson) and Proclear 1 Day Multifocal (CooperVision).

Segmented Bifocal Contact Lenses



A segmented bifocal GP lens stays in place when the eye moves, enabling the pupil to be aligned with the distance or near power.

Segmented bifocal contacts work much like bifocal eyeglass lenses. These rigid gas permeable (GP) contacts have two power segments, with an obvious line of separation between the distance correction on top and the near correction below. The eye looks through either one or the other, depending on whether you're looking far or near.

With bifocal eyeglasses, this mechanism works because the lenses stay in place even as the eye moves. Unlike multifocal contact lenses (which move with the eyes), segmented GP bifocal contacts can be designed to stay in a certain position while the eye moves behind the lens.

Segmented GP lenses are smaller in diameter than soft contact lenses and rest on a layer of tears above the margin of the lower eyelid. Therefore, when people gaze shifts downward, the lens stays in place, allowing them to see through the lower, near-correction part of the lens.

Custom GP lenses also can be made with a segmented trifocal design, which includes a small, ribbon-shaped segment for intermediate vision, like trifocal eyeglass lenses.

Refractive surgery

Refractive surgery changes the shape of the cornea. For presbyopia, this treatment can be used to improve close-up vision in nondominant eye. It's like wearing monovision contact lenses. Even after surgery, patient may need to use eyeglasses for close-up work.

Talking about the possible side effects is important, as this procedure is not reversible. Patient might want to try monovision contact lenses for a while before committing to surgery. That way patients can tell if monovision is a comfortable option for them.

Refractive surgical procedures include:

- Conductive keratoplasty. This procedure uses radiofrequency energy to apply heat to tiny spots around the cornea. The heat causes the edge of the cornea to shrink slightly, increasing its curve (steepness) and focusing ability. The results of conductive keratoplasty are variable and may not be long lasting.

- Laser-assisted in situ keratomileusis (LASIK). With this procedure, the eye surgeon makes a thin, hinged flap deeper into the cornea, then uses a laser to remove inner layers of the cornea to steepen its domed shape. Recovery from LASIK surgery is usually more rapid and less painful than other corneal surgeries.

- Laser-assisted subepithelial keratectomy (LASEK). The surgeon creates an ultra-thin flap only in the cornea's outer protective cover (epithelium), then uses a laser to reshape the cornea's outer layers, steepening its curve, and then replaces the epithelium.

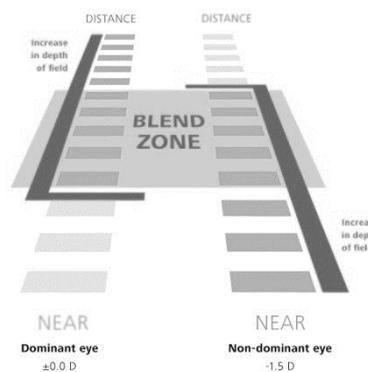
- Photorefractive keratectomy (PRK). This procedure is similar to LASEK, except the surgeon completely removes the epithelium, then uses the laser to reshape the cornea. The epithelium is not replaced, but will grow back naturally, conforming to your cornea's new shape.

- Presbyond Laser Blended Vision

Presbyond is the next level vision correction beyond conventional monovision.

Although similar to conventional monovision laser treatments in terms of the workflow, PRESBYOND Laser Blended Vision takes customized vision correction a step beyond, particularly with respect to the outcomes.

PRESBYOND Laser Blended Vision



A new, physiologically optimized laser treatment method for presbyopic patients, PRESBYOND Laser Blended Vision represents the next stage in eye care excellence. Similar to conventional monovision, the dominant eye is corrected for distance vision to almost plano, whereas the non-dominant eye is corrected to be slightly myopic for near vision to -1.5 D. This micro-monovision strategy is further enhanced by a decisive difference: an increase in the depth of field of each eye using a wavefront-optimized ablation profile to create a continuous refractive power gradient for the whole optical zone of the cornea.

PRESBYOND Laser Blended Vision is an absolutely individualized treatment plan based on preoperative spherical aberrations and the functional age of the eye. As a result, a customized fusion of the two images for near and distance vision is created for each patient: the so-called "Blend Zone".

The Unique Blend Zone

Essentially, the Blend Zone makes it easier for the brain to merge the images of both eyes, thereby achieving true binocular vision. This is a significant advantage over conventional monovision. In addition to excellent near and far vision, PRESBYOND Laser Blended Vision patients also experience very good visual acuity and contrast sensitivity in the intermediate range. They adapt faster and most are delighted about not having to wear glasses anymore.

Not surprisingly, PRESBYOND Laser Blended Vision is tolerated by a high number of patients – up to 97 % in some study.

Laser ablation profile corrects presbyopia by manipulating spherical aberration. The treatment creates a new aspheric corneal profile that increases the depth of focus and recovers about 2 D of near acuity in the presbyopic eye, Ocular Surgery News Europe/Asia-Pacific Edition Editorial Board Member José L. Güell said at the Florence Symposium.

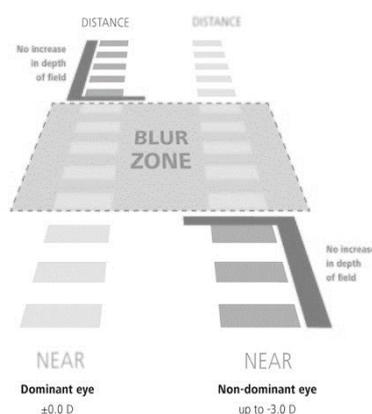
The key point is spherical aberration. A previous study by Franco Bartoli, MD, demonstrated that spherical aberration is zero or slightly negative in the nonaccommodating eye, while during accommodation the center of the anterior surface of the lens vaults forward and induces positive spherical aberration. The treatment was aimed at inducing a certain amount of spherical aberration to compensate for the loss of accommodation in presbyopic eyes. These are normally aimed at creating a multifocal cornea with specific refractive zones for near and distance vision.

Multifocality requires a variable period of adaptation and is not equally well accepted by all patients.

In addition, the light scattering from transition zones produces a loss of contrast

sensitivity, and the contour changes between refractive zones might require a long period of epithelial healing which, at the same time, may reduce the initial effect. In the worst cases, these treatments could be responsible for a series of distressing complications, such as diplopia, regression, glare, halos and ghost images, as well as the loss of visual acuity and contrast sensitivity. A treatment that basically maintains the monofocal aspheric profile of the cornea and spreads contour changes over the entire optical zone has, theoretically, less risk of any of these complications.

Conventional monovision



With conventional monovision treatment methods (both surgical and contact lens), the dominant eye is corrected for distance vision to almost plano. The non-dominant eye, on the other hand, is corrected for near vision, usually to be myopic up to -3.0 D. Accommodation is thereby often diminished. The method aims to achieve optimal vision at distance and near range. Following the procedure, the brain must contend with two separate images with different levels of correction.

According to scientific studies, only about 59-67 % of patients are able to successfully merge the two images to experience sharp binocular vision at near and distance range. Patients that tolerate the method are left with an uncorrected, compromised gap in the intermediate range, the so-called “Blur Zone.” In addition to the fuzzy image, it can also cause other side effects such as reduced contrast sensitivity and stereoacuity. Also, it often takes patients a long time to get used to merging the two images into one picture.

Conventional monovision is a correction method with compromises. For a number of patients, it is not a suitable option.

Lens implants

Refractive lens exchange involves the removal of the natural lens. It's replaced with a synthetic lens, called an intraocular lens implant, inside the eye.

In the other word, ophthalmologists use a procedure in which they remove the lens in each eye and replace it with a synthetic lens. This is called an intraocular lens.

In the past, the primary goal of cataract surgery was to restore a person's vision for driving, watching television, and other distance vision tasks. To see clearly up close, a person would need to wear bifocals or reading glasses after cataract removal to correct the inevitable post-surgical presbyopia.

But today, cataract patients have the choice of multifocal intraocular lens that can correct vision far away, up close and all distances in between. Many patients who choose multifocal intraocular lenses find they can be glasses-free or may only need reading glasses occasionally for reading small print after cataract surgery.

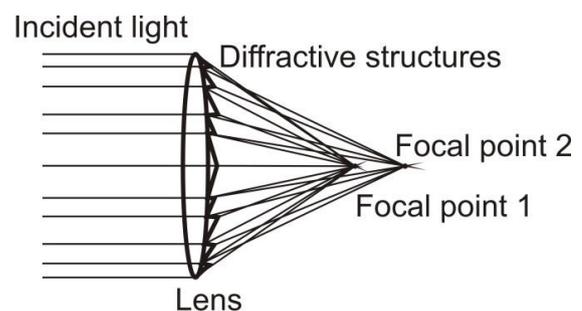
Several types of lens implants are available for correcting presbyopia. Some allow the eye to see things both near and at a distance. Some change position or shape within the eye (accommodative lens). But lens implants can cause a decrease in the quality of the near vision, and people may still need reading glasses.

Intraocular lens implants (IOLs) are used in both refractive lens exchange and cataract surgery to replace the natural lens of the eyes and correct for refractive errors. Over recent years, many improvements in intraocular lenses have allowed for the development of a wide- spectrum of lenses beyond the traditional monofocal lens implants. These developments include presbyopia-correcting IOLs which provide a treatment option for presbyopic patients who do not qualify for laser refractive surgery and do not want to rely on reading glasses. Presbyopia- correcting lenses can be divided into two broad categories: multifocal IOLs and accommodative IOLs.

Multifocal IOLs

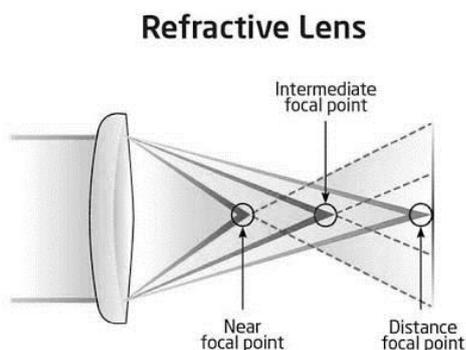
Multifocal IOLs consist of multiple zones of lens power that produce more than one focal point, allowing for enhanced vision at both near and far. The multifocal IOLs can be further subdivided into diffractive and refractive lenses.

-Diffractive IOLs



Diffraction IOLs such as Tecnis and ReSTOR create two distinct images at near and far. ReSTOR was the first diffractive lens approved by the FDA in 2005. Its mechanism of action is based on apodization, in which a near-dominant central area is surrounded by 12 concentric rings of decreasing height that result in diffraction of light at both distance and near. The Tecnis diffractive IOL is an acrylic lens with an aspheric anterior surface and a posterior surface with diffractive rings that focus both near and distance light regardless of pupil size. Diffraction IOLs are typically less limited by pupillary diameter, but can result in poorer intermediate vision.

- Refractive IOLs

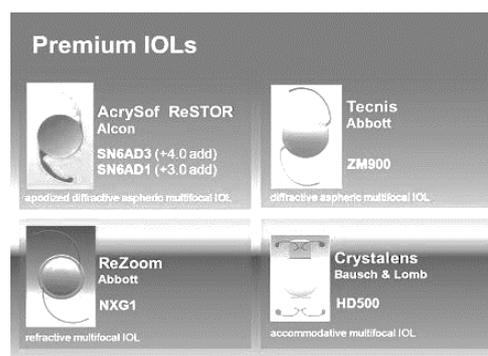


Refractive IOLs such as ReZoom and Array function by creating multiple focal points that allow for viewing at all distances. The Array zonal progressive silicone IOL consists of five concentric zones alternating between distance- and near-dominant. The ReZoom IOL is a second-generation refractive IOL, that enhanced some aspects of the Array design, such as enlargement of the second and third zones, reduction of the fourth and fifth zones and an aspheric transition between zones so that visual disturbances could be reduced. While refractive IOLs produce good quality distance, intermediate, and near vision, they are limited

by pupillary diameter because of the zonal design of the lens.

Accommodative IOLs

The only accommodative IOL to be FDA-approved is the Crystalens IOL, a 4.5 mm optic with two haptic plates and four polyimide loops that help fix it into place within the capsular bag. Its placement within the capsular bag allows it to simulate the natural accommodative process in the eye by changing power in response to ciliary muscle contraction. The Crystalens accommodative IOL provides good distance vision and the advantage of fewer visual disturbances compared to multifocal IOLs.



Complications

IOL implantation after cataract extraction or as part of refractive lens exchange is a relatively safe procedure but carries the risks that come with invasive eye surgery. These surgical complications include, but are not limited to infection, increased IOP, corneal edema, posterior capsular opacification (PCO), IOL decentration, and retinal detachment.

The other major side effect experienced by patients after IOL implantation are visual disturbances. Reduced visual quality and visual phenomena such as halos, glare, and starbursts are characteristic of multifocal IOLs due to the light scatter that naturally occurs

when transitioning between near and far zones. Patients with monofocal IOLs experienced less visual distortions and halos compared to patients with multifocal IOLs. In a prospective study of 95 eyes comparing multifocal IOLs to monofocal IOLs, 29% of multifocal patients reported glare while 25% reported halos, compared to 19% and 12% in the monofocal group respectively. Accommodative IOLs as a whole produce less visual disturbance compared to multifocal IOLs. This can be explained by the design of the accommodative lens which contains a smooth central surface and acts to enhance near vision through movement in conjunction with ciliary muscle contraction. This is in contrast with multiple zones of optical power in a multifocal IOL that can result in scattering of light and visual disturbances.

In addition, this surgery carries with it the same risks as those associated with cataract surgery, such as inflammation, infection, bleeding and glaucoma.

Corneal inlays

Some people have had success with a presbyopia treatment that involves inserting a small plastic ring with a central opening, into the cornea of one eye. The opening acts like a pinhole camera and allows in focused light so that patients can see close objects.

If they don't like the results of the corneal inlay procedure, the eye surgeon can remove the rings, leaving patients free to consider other treatment options.

PEARL (Presbyopic Allogenic Refractive Lenticule) is a procedure that places a small piece of tissue from one part of the cornea into another part. This inlay changes the shape of the cornea, improving near vision.

With the PEARL procedure, the eye surgeon uses a laser to make a small cut in

the cornea. A small disc of corneal tissue, called a lenticule, is removed through this cut. The lenticule is sculpted and reshaped with a laser, then placed into a small pocket made in the patient's cornea.

PEARL may offer safety advantages over artificial corneal inlays for presbyopia. Because the inlay is made of the patient's own tissue, it is biologically compatible, making it less likely to cause complications. The corneal tissue inlay is expected to allow oxygen and nutrients to flow through the patient's cornea better than a synthetic inlay, helping to keep the cornea healthier.

The research is being led by Soosan Jacob, MD, FRCS, DNB, at Dr. Agarwal's Refractive and Cornea Foundation in Chennai, Tamil Nadu, India.

Complications of Presbyopia

If the presbyopia is undiagnosed or uncorrected, the vision will likely deteriorate gradually. It will increasingly affect people lifestyle over time. Patient may experience a significant visual disability if a correction isn't made. They will develop problems maintaining their usual levels of activity and productivity at work and in everyday activities. When tasks such as reading small print become difficult and remain untreated, they're at risk of headaches and eyestrain.

Since everyone develops presbyopia as they age, it's possible to have presbyopia in addition to another type of eye problem. Presbyopia can combine with:

- astigmatism, which is an imperfection in the curvature of your cornea that causes blurred vision
- hyperopia, or farsightedness
- myopia, or nearsightedness

It's also possible to have a different type of eye problem in each eye.

Conclusion

In most cases, the vision that is lost by presbyopia can be corrected with eyeglasses, contact lenses, or surgery. The gradual decline of the elasticity required to focus the lens on near objects continues until about age 60-65, which is when most of the elasticity is gone. However, even at that point, correction to see close objects is possible.

No exercise or medication can reverse presbyopia. Delaying the use of reading glasses is of no benefit. Patients will probably need to change their eyeglass prescription from time to time between the ages of 40 and 60 because the eye's natural lens will continue to lose flexibility and, therefore, focusing ability.

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