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Eye Care Newsletter

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Refractive Surgery Overview

by Russell Williams, OD

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The three common vision ailments that are treatable with refractive surgery are myopia, hyperopia and astigmatism. In myopia (nearsightedness), rays of light entering the eye reach a focal point in front of the retina. Hyperopia (farsightedness) has the focal point behind the retina. In astigmatism, due to an irregularity in the cornea or lens; there is not one focal point, but a range over which light is focused.

Changing the curvature of the cornea affects where light rays are focused within the eye. To surgically correct for myopia, the cornea needs to be flattened, while in hyperopia the cornea needs to be steepened. Astigmatism correction can either flatten or steepen different areas of the cornea (and sometimes will do both), resulting in a more defined focal point.

The first refractive procedure to experience widespread acceptance and use was RK (Radial Keratotomy). Radial incisions were made on the corneal surface. These incisions weakened the cornea resulting in a flatter curvature. The downside to RK was impaired night vision secondary to starbursts and the potential for continued flattening resulting in overcorrection. AK (Astigmatic keratotomy) involved making a tangential incision near the limbus to change the curvature of only a portion of the cornea. The incisions created in the cornea with RK and AK were only able to flatten the cornea, so no hyperopic corrections were possible.

PRK (Photorefractive keratectomy) utilizes the excimer laser to reshape the cornea. Treatment occurs after removing the epithelial layer of cells from the cornea. PRK heals slowly as re-epithelialization must take place following surgery. During the time the epithelium is healing patients can experience pain and discomfort, which is typically mild enough that eye drops are able to control it. A soft contact lens is also placed on the eye as a therapeutic bandage. Initially, vision is quite blurry following PRK and improves with time. It may take several days to a couple of weeks for best vision to return. PRK was initially approved by the FDA for treatment of myopia and astigmatism, but has since been approved for hyperopia as well.

LASIK (laser-assisted in situ keratomileusis) is a two-stage procedure. First a partial thickness lamellar corneal flap is created. Following the creation of the corneal flap, the excimer laser is utilized to reshape the cornea and the flap is then repositioned. LASIK has undergone changes in the technology and technique involved with surgery over the last decade. The microkeratome, a small mechanical device utilizing a blade, was initially used for flap creation. Newer femtosecond laser instruments enable the flap to be created via laser. Custom wavefront guided treatments are available to reduce the risk of night vision difficulty.

The most common refractive surgical procedures are performed on the cornea, however, some patients are better candidates for intraocular lens implantation (IOL). With a phakic IOL, the natural crystalline lens is not removed from the eye. The implant can be placed immediately anterior to the crystalline lens behind the iris (Visian implantable collamer lens - ICL) or the implant can be placed within the anterior chamber and attached directly to the iris (Verisyse/ Artisan). A phakic IOL will improve distance vision for myopic patients, but the FDA has not approved a phakic IOL to treat astigmatism or hyperopia at this time. Refractive lens exchange refers to intraocular lens implantation after removal of the natural crystalline lens. Refractive lens exchange is the same technique as cataract extraction, only the natural lens is removed prior to cataract formation. Implant options with refractive lens exchange can treat myopia, hyperopia or astigmatism. There are intraocular lens implants available that can even treat presbyopia.

Presbyopia is the natural loss of focusing ability of the crystalline lens as we age. Corneal refractive surgery does not counteract the effects of presbyopia. Patients must either use reading glasses or consider monovision. In monovision, one eye is intentionally treated to provide distance vision while the other eye is treated to provide near vision. There is a period of adaptation to monovision and not all patients will successfully adapt. Newer generation implants can overcome presbyopia and allow an eye to see at both distance and near.

Refractive surgery is not without potential risks or complications. Perfect vision can never be guaranteed following surgery. Patients will typically experience a slight increase in light sensitivity, dryness for several months, fluctuating vision during the initial healing and the potential for glare or halos around lights at night. The majority of people would be good candidates for refractive surgery and with proper informed consent consider the procedure a success.

Presbyopia and surgical treatment options

by Terrence S. Spencer, MD
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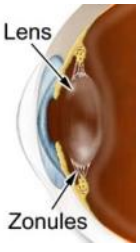
Presbyopia is a natural age-related condition in which the eye loses its ability to change focus from distance to near vision. The word presbyopia, from Greek language, means *aging eye*. The symptoms of presbyopia usually appear in the fifth decade of life, i.e. ages 40 to 50. The first symptom most people notice is difficulty focusing at close length to read small print (assuming the eye has proper distance vision focus), particularly in dim lighting conditions. Many people compensate for this condition by holding reading material further away until they eventually may complain that their arms are "too short". Most of these folks start to use reading glasses, often called either *cheaters* or *readers*. In people whose eyes are *myopic*, or "near-sighted", the onset of presbyopic symptoms may cause them to take off their distance vision corrective lenses in order to see up close. People who need spectacle vision correction for both far and near vision often start to use one of several bi-focal lens options after the onset of presbyopia begins.

Accommodation is the process by which the eye adjusts its focus from far to near vision. In accommodation, fundamental changes in the *crystalline lens* of the eye cause a change in the focal point of light rays entering the eye. In youth, the lens is transparent and flexible. The anterior and posterior surfaces of the lens are convex in shape causing an overall convergence of light rays. Accommodation results in changes to the curvature and changes in focus. The well-established theories of how accommodation takes place have been developed long ago. René Descartes, the French philosopher, mathematician, and scientist, proposed an accurate theory of accommodation in 1677 prior to having scientific knowledge of how the *ciliary muscle* acts on the lens.

The mechanism of accommodation should be understood in order to have a grasp on the concept of presbyopia, so bear with me for one paragraph. The theory of accommodation most commonly accepted was formulated by German physician and physicist, Hermann von Helmholtz. In 1855, Helmholtz described that in the passive, far-seeing state of the eye, the lens is stretched by the *zonules* (*Zonular apparatus* or *Zonules of Zinn*) attached at the peripheral edge of the lens capsule. As the crystalline lens is non-muscular, the accommodative changes in it must be brought about by forces applied to it by the parts of the eye with which it is associated.



The lens is suspended by the zonular apparatus, and connected by the zonules to the ciliary body. The ciliary muscle is a 360 degree muscular ring that, in its relaxed state, applies tension through the zonular fibers to the equator of the lens. This tension on the lens capsule decreases the curvature and optical power of the lens allowing for distance vision focus. When the ciliary muscle contracts the ciliary muscular ring is reduced in diameter, and there is less tension on the suspensory zonules. The reduced tension allows the lens, by its elasticity, to assume its natural free form with a steeper anterior curvature. The steeper curvature optically moves the focal point closer to the eye. The Helmholtz theory of accommodation received some opposition, but science has supported that its basic principles hold true.

The lens-substance is a unique tissue. Its epithelial origin and its continued growth within the capsule lead to its progressive sclerosis (hardening). The Crystalline lens becomes more rigid with age, and is unable to mold into its accommodative form. It is the rigidity in the crystalline lens, and not weakening of the ciliary muscle, that causes the loss of accommodation associated with presbyopia. This is why many scams to improve the condition of presbyopia by means of eye exercises have been debunked as quackery. Presbyopia can not be prevented. Some patients experience less disability from presbyopia than others because they may have an increased depth of focus from small pupils. Some presbyopic patients don't need glasses because they may have myopia in one eye while maintaining good distance vision in the other eye (*monovision*).

The predominant symptom of presbyopia is difficulty seeing clearly at a near working distance (assuming normal distance vision or wearing correction for appropriate distance vision if myopic). The onset of presbyopia also results in delayed ability to change focus from distance to near or vice versa. For example a presbyope might find that after reading or doing computer work for a while, it takes longer to refocus across the room. These patients might also complain of ocular discomfort, fatigue, squinting, and eye strain.

Non-surgical treatment options for presbyopia include optical correction with spectacle lenses, contact lenses or a combination of contact lenses and glasses. Presbyopic patients who have good distance vision without spectacle correction typically get reading glasses. Myopic patients who develop presbyopia often simply take their distance vision glasses off to read and put them back on to see far away. Bifocal, trifocal, blended bifocal, and progressive addition lens glasses can be more convenient than repeatedly putting glasses on and taking them off. Presbyopic patients who have excellent distance vision can use a contact lens in one eye, giving that eye better near vision. This is where the term monovision comes from. The trade-off for increased spectacle freedom in monovision is reduced depth-perception that some patients never adapt to. Presbyopes who are accustomed to wearing contact lenses in both eyes for best distance vision can simply use reading glasses for near vision. There are also bifocal contact lenses.

Surgical treatment for presbyopia involves either altering the shape of the cornea or can be done by replacement of the crystalline lens. The cornea is the clear front layer of the eye that contributes to its overall focus. Various forms of *LASIK* (laser-assisted in situ keratomileusis) and *PRK* (photorefractive keratectomy) are corneal based laser refractive surgeries that can be performed with monovision targeted as the intended outcome. Naturally, pre-presbyopes don't need to bother with monovision since their crystalline lens can still change focus on its own. Since this surgery is permanent, a presbyopic patient considering surgical monovision should undergo a trial with contact lenses first to make sure they tolerate monovision's limitations.

Prior to the widespread acceptance of corneal laser surgery, radial keratotomy (RK) was the refractive surgery of choice. RK was done by making radial partial-thickness incisions in the cornea. Because RK is less predictable than laser, and has progressive drifting of the refractive results, it has lost favor as an option in the refractive surgery world. In some cases, the cornea can also be altered temporarily with heat or electric probes to create monovision in procedures called *conductive keratoplasty* (CK) and the older *laser thermal Keratoplasty* (LTK). Many patients who have corneal procedures done for presbyopia still occasionally wear glasses for some tasks.

There are experimental laser correction patterns that can result in a multifocal cornea, but this treatment option has not reached the mainstream ophthalmic world as of this time. There are also experimental devices for corneal implantation that increase depth of focus by creating a pinhole effect, but these also are not ready for FDA approval. Some researchers have also proposed a presbyopia-correcting procedure that expands the scleral wall of the eye in the area of the ciliary body, theoretically increasing the tension effect of the ciliary muscle and zonules on the crystalline lens.

Refractive Lens Exchange (RLE) is one approach to surgical presbyopia-correction in patients who cannot tolerate monovision. RLE is a more invasive surgery than LASIK or PRK, but RLE has an optical advantage over monovision in that can allow each eye to see both distance and near focus. This form of refractive surgery has become more popular with recent advances in intraocular lens (IOL) options. Intraocular lenses were developed initially to replace the crystalline lens when it becomes cloudy due to cataract formation. Cataract surgery is the most common surgical procedure performed by general ophthalmologists, and refractive lens exchange is by and large the same procedure performed but prior to the onset of a cataract. It is the recent advances in IOL options that have fueled the increase in numbers of elective procedures of this nature. The standard IOL implants were only fixed at a single-focus and would leave a patient without a range of vision, just like presbyopia. However, there are IOLs now available that can change focus with the eye's natural accommodative reflex. There are also multifocal IOLs that have two focal points (near and far) without relying on accommodation. The technology continues to improve every year with new options available to the refractive and cataract surgeons.

Like LASIK, refractive lens exchange is an elective procedure that is accompanied by risks and ethical considerations. For many people the improvement in quality of life by eliminating their visual disability outweighs the risks. No refractive surgery can create perfect vision, like that of a young fighter pilot. But we can reduce dependence on spectacles, thus improving visual freedom. If your presbyopic patients wish to consider any of these elective surgery options, please feel free to have them set up a no-obligation consultation where we can discuss a treatment plan based on their individual needs.

Ten Things to Know About Dry Eye

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1. Symptoms
   Patients with dry eye often complain about foreign body sensation, grittiness, itching, burning, redness, or transient blurriness of vision that resolves with blinking. These symptoms may worsen when the patient reads or uses the computer, as these activities lead to a decreased blink rate.

2. Reflex tearing may be a paradoxical presentation of dry eye
   Because the eye may produce excess tears in response to dryness, patients with dry eye may complain of tearing. Although several tests at the slit lamp may be used to differentiate dry eye from tear drainage obstruction, several historical clues are often helpful. Patients with tearing due to dry eye ("reflex tearing") may complain of worsening when they read or use the computer, and often will acknowledge that their tearing is worse when they are outside or when the wind blows.

3. Blepharitis may cause dry eye
   Blepharitis is a chronic condition that is more common in patients with rosacea. Bleparitis is the thickening of the oil producing glands (meibomian glands) that produce the anti evaporative layer of the tear film. Blepharitis may also involve low grade staph infection of the meibomian glands. It is treated with warm compresses to liquefy the secretions, lid scrubs with baby shampoo to fight staph infection, steroid / antibiotic combination drops, and sometimes oral doxycycline, which can thin the meibomian gland secretions.

4. LASIK
   During LASIK surgery, a flap of corneal tissue is lifted, and the underlying bed of corneal tissue is reshaped with laser. The creation of this flap cuts corneal sensory nerves, and predisposes patients to dry eye. In fact, patients with substantial dry eye are not good candidates for LASIK.

5. Eyelid Surgery
   Rarely, uncomplicated blepharoplasty or ptosis surgery may cause dry eye due to cutting and/or excision of the orbicularis muscle, which causes impaired eyelid closure. Caution must be taken during blepharoplasty or ptosis surgery to prevent exacerbation of dry eye

6. Thyroid eye disease may cause dry eye
   "Thyroid eye disease" is due to autoimmune inflammation in the periocular tissue (orbit) and not the direct result of hormone abnormalities. As such, it can present in patients with no detectable thyroid hormone abnormality, and in patients whose thyroid gland has been surgically removed or radiated. The most feared complication of thyroid eye disease is optic neuropathy due to optic nerve compression by edematous extraocular muscles. However, thyroid eye disease may be an overlooked cause of dry eye. Patients with thyroid eye disease often have proptosis and lagophthalmos (lack of eyelid closure). Other findings diagnostic of thyroid eye disease are increased palpebral fissures, chemosis (conjunctival edema), temporal flaring of the upper lids, and lid lag (the upper lid does not move down well in down gaze).

7. Over the counter treatments
   Most dry eye patients respond to topical lubrication with over the counter drops or ointment. Over the counter drops usually have a preservative, which may sometimes incite an allergic response. Patients who develop such a response may use preservative free artificial tears, which are also available over the counter.

8. Prescription therapy
   Topical cyclosporine (Restasis®) increases tear production by decreasing inflammation in the lacrimal gland. Some patients complain of stinging upon instillation of Restasis®.

9. Mechanical therapy
   Each of the four eyelids has a canaliculus that drains tears into the nose via the lacrimal sac and nasolacrimal duct. The opening of the canaiculus at the surface of the eyelid, the punctum, can be occluded with a silicone plug to increase the availability of natural tears. If patients have difficulty with comfort or retention of plugs, cauterization of the puncta is another option.

10. Surgical therapy
    In patients with increased palpebral fissures or lagophthalmos, surgery can be performed to weaken the retractors of the upper and/or lower eyelids to reduce the palpebral fissure and improve eyelid fissure. Such patients may or may not have thyroid eye disease.

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