Conductive Keratoplasty

Until recently, if you were one of the millions of people with a refractive error, eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people with myopia (nearsightedness), hyperopia (farsightedness), or astigmatism (a cornea with unequal curves), can have their vision improved through surgery.

Conductive keratoplasty (CK) is a minimally invasive thermal refractive procedure used to correct mild to moderate farsightedness in people over age 40. With CK, your ophthalmologist (Eye M.D.) uses a tiny probe that releases controlled amounts of radiofrequency (RF) energy to apply heat to the peripheral portion of the cornea. The heat then causes the sides of the cornea to shrink and to tighten like a belt, increasing the steepness of the central cornea and increasing its optical power. This refocuses the light rays on the retina and improves vision.

CK can also be used to achieve “monovision.” With monovision, CK can be used to improve close-up vision in a presbyopic eye that has good vision but has difficulty focusing up close. To maintain good distance vision, usually only one eye (the non-dominant eye) is set to near-focus vision, while the other is left alone or set at good distance vision. It may be a good idea to try monovision with a special contact lens or eyeglass prescription before opting for surgery. CK does not offer permanent correction; for some patients, farsightedness may return over time.

As with any surgery, there are certain risks associated with CK. Be sure to discuss these possible risks with your ophthalmologist.

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Photorefractive Keratectomy

Until recently, if you were one of the millions of people with a refractive error (which means that light rays do not focus precisely on the retina, causing you to be nearsighted, farsighted, or astigmatic), eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people today can have their vision corrected through refractive surgery.

Photorefractive keratectomy (PRK) is one of several refractive surgery procedures used by ophthalmologists (Eye M.D.s) to permanently change the shape of the cornea to improve the way it focuses light on the retina.

PRK is an outpatient procedure performed with topical anesthetic eyedrops. It takes only about 15 minutes. The epithelium, the outer cell layer of the cornea, is removed with a blade, alcohol, or a laser. An excimer laser, which produces ultraviolet light and emits high-energy pulses, is used to remove a thin layer of corneal tissue. Your ophthalmologist guides the laser with a computer, and the laser beam sculpts the surface of the cornea. By breaking the bonds that hold the tissue molecules together, your cornea is reshaped, which corrects your refractive error and eliminates or reduces the need for eyeglasses or contact lenses. Because no incisions are made, the procedure does not weaken the structure of the cornea.

Immediately following surgery, the eye is patched or a “bandage” contact lens is placed on the eye. Vision is blurry for several days following PRK. It may take a month or longer to achieve your best vision. You may need to use medicated eyedrops for up to three months.

Possible complications of PRK surgery include undercorrection, overcorrection, poor night vision, and corneal scarring. Permanent vision loss is very rare. In recent studies monitored by the U.S. Food and Drug Administration, 95% of eyes were corrected to 20/40, the legal limit for driving without corrective lenses in most states.

To be a candidate for the procedure you must have a stable and appropriate refractive error, be free of eye disease, be at least 18 years old, and be willing to accept the potential risks, complications, and side effects of PRK.

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LASIK with the Microkeratome

Until recently, if you were one of the millions of people with a refractive error, eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people with myopia (nearsightedness), hyperopia (farsightedness), or astigmatism (a cornea with unequal curves) can have their vision improved surgically.

Laser-assisted in situ keratomileusis (**LASIK**) is a refractive procedure that uses a microkeratome cutting device to create a flap in the cornea and a laser to permanently reshape the cornea. The reshaped cornea helps focus light directly onto the retina to produce clearer vision.

LASIK is usually performed as an outpatient procedure using topical anesthesia with eyedrops. The procedure itself generally takes about 15 minutes. The surgeon creates a flap in the cornea with a **microkeratome**. The flap is lifted to the side, and the cool beam of the excimer laser is used to remove a thin layer of corneal tissue. The flap is folded back to its normal position and sealed without sutures. The removal of corneal tissue permanently reshapes the cornea.

A clear shield is used to protect the flap for the first day and night after surgery. The vision is usually slightly cloudy immediately after the procedure but clears rapidly, often within just a few hours. Your vision should be clear by the next day. Healing after surgery is often less painful than with other methods of refractive surgery because the laser removes tissue from the inside of the cornea and not the surface. Antibiotic and steroid eyedrops are used several times a day for the first week, along with rewetting drops. After the first week, you should need to use only the rewetting eyedrops.

Some people experience poor night vision after LASIK. The surgery also may result in undercorrection or overcorrection, which can often be improved with a second surgery. More rare and serious complications include a dislocated flap, epithelial ingrowth, and inflammation or infection underneath the flap. Most complications can be managed without any loss of vision. Permanent vision loss is very rare.

The ideal candidate for LASIK has a stable refractive error, has adequate corneal thickness and a normal corneal shape, is free of eye disease, is at least 18 years old, and is willing to accept the potential risks, complications, and side effects of LASIK.

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Phakic Intraocular Lenses

Many people today choose to correct their refractive errors with techniques other than wearing eyeglasses or contact lenses. Surgeries such as **laser-assisted in situ keratomileusis**, or **LASIK**, can improve vision by permanently changing the shape of the cornea to redirect how light focuses on the retina. However, in some cases, instead of reshaping the cornea, the focusing power of the eye's natural lens is enhanced by implanting a special kind of **intraocular lens (IOL**), called a phakic IOL, to treat myopia (nearsightedness). Currently, phakic IOLs are not yet approved to treat hyperopia (farsightedness). They are especially useful in cases when a patient has thin corneas or requires a large correction that may not be readily achievable using other refractive procedures.

The surgical procedure usually takes about 15 to 30 minutes and is performed on an outpatient basis. The procedure actually begins one week before the surgery, when your surgeon uses a special laser called a **YAG laser** to create two tiny holes in periphery of your iris (the colored part of your eye) to reduce one of the rare complications of this procedure, called **pupillary block glaucoma.** At the time of surgery, eyedrops are instilled in the eye to increase pupil size if the lens is to be placed behind the iris or to reduce pupil size if the lens is to be placed in front of the iris. Drops to numb the eyes are administered as well. Your ophthalmologist (Eye M.D.) then makes an incision and inserts the IOL either in front of the iris or between the iris and your natural lens, depending on the type of phakic IOL being used. To close the incision, your ophthalmologist makes tiny stitches, which are either dissolvable or may need to be removed in the future. You will also be fitted with an eye shield to wear for a short time following surgery.

After the procedure, vision is usually instantly improved, although you may experience some mild discomfort. You will need to return for an exam the day after surgery, and you will have a series of routine follow-up visits as well. Most patients are able to drive and return to work the next day. You will need to use antibiotic and steroid eyedrops several times a day, usually for the first week following surgery.

Reversibility appears to be a big advantage of phakic IOLs over many other forms of refractive surgery. The implant can be removed if complications occur or the correction no longer is effective.

Complications are rare but can occur following implantation of phakic IOLs. Risks associated with implanting IOLs include overcorrection or undercorrection, infection, increased "floaters" or retinal detachment, cataracts, dislocation of the implant, halos and glare, dry eye, decreased contrast sensitivity, swelling in the cornea, damage to the optic nerve, and loss of vision.

Phakic IOLs are a relatively new technology; long-term effects and potential risks of lens implantation are unknown.

You and your ophthalmologist should decide together if phakic IOLs are the best treatment option for your specific condition.

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Radial Keratotomy

Radial keratotomy (RK) is surgical procedure to reduce myopia (nearsightedness) by changing the curvature of the cornea. RK was invented in the 1930s and perfected in the late 1970s.

People with myopia have difficulty with distance vision because the cornea has too much power and focuses light rays in front of the retina. RK weakens the midperiphery of the cornea, producing a central flattening and a reduction in its power. This allows the light rays to focus more precisely on the retina without the need for eyeglasses or contact lenses.

RK takes approximately 15 minutes and can be performed with the patient awake. Eyedrops anesthetize the cornea, eliminating pain during the procedure. Using a microscope, microsurgical instruments, and a diamond blade, the surgeon makes several deep incisions (keratotomies) in the cornea in a radial or spoke-like pattern. Following surgery, patients are moderately uncomfortable and often require oral pain medication. Antibiotic and steroid eyedrops are necessary for approximately one week. Clear vision can be present the day following surgery.

Postoperative complications include glare, halos, undercorrection, overcorrection, and astigmatism that may not be able to be corrected with glasses. The major disadvantage of RK compared to laser procedures is that it permanently weakens the cornea. Additionally, some patients complain of progressive hyperopia (farsightedness) as well as a fluctuation in vision throughout the day. Radial keratotomy is currently being used to correct low levels of myopia.

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Refractive Lens Exchange

Today, many people choose to correct their refractive errors with techniques other than wearing eyeglasses or contact lenses. Surgeries like laser-assisted in situ keratomileusis, or LASIK**,** improve vision by permanently changing the shape of the cornea to redirect how light is focused on the retina. However, in certain cases, LASIK or other refractive surgeries to reshape the cornea may not be a patient's best option. In these cases, instead of reshaping the cornea, the eye's natural lens can be removed and replaced with an **intraocular lens (IOL)** with a procedure called **refractive lens exchange (RLE).**

IOLs are artificial lenses surgically implanted in the eye. These lenses help your eye regain its focusing and refractive ability. RLE can be used to correct moderate to high degrees of **myopia** (nearsightedness) and **hyperopia** (farsightedness). In many cases, it is especially useful in treating **presbyopia**, the inability to focus at near distances with age.

The most common type of implantable lens is the **monofocal or fixed-focus lens.** It helps you attain clearer vision at one distance. Note that eyeglasses or contact lenses are still required to see clearly at all ranges of distance.

Another type of IOL is the **multifocal IOL.** The multifocal IOL has several rings of different powers built into the lens. The part of the ring you look through will determine if you can see clearly at far, near, or intermediate distances.

A third type of IOL is the **accommodative IOL.** This IOL has a hinge designed to work with your eye muscles, allowing the lens to move forward as the eye focuses on near objects and backward as the eye focuses on distant objects. Other styles of accommodative IOLs are currently being developed.

Implanting an IOL takes about 20 minutes in an outpatient procedure much like cataract surgery. In addition to a preoperative eye exam, the eye surgeon takes certain measurements of the eye. Your eyes are then numbed with topical or local anesthesia. A few small incisions are made at the edge of the cornea. Then a small ultrasound instrument is inserted into the eye to break up the center of the eye's natural lens. The lens is vacuumed out through one of the incisions. The IOL is usually folded and then inserted through the same incision. These incisions are usually self-sealing, requiring no stitches.

Once implanted, multifocal and accommodative IOLs allow you to focus on near or distant objects. You will probably have to take an antibiotic and steroid eyedrop for several days after the procedure, and you will need to wear an eye shield at night for one week to protect the eye.

Some advantages of refractive lens exchange are that unlike other forms of refractive surgery, RLE can be used to treat people with dry eye, thin corneas, or high refractive error. In addition, if you have RLE, you will never develop cataracts, as the natural lens is removed.

Risks associated with implanting IOLs include overcorrection or undercorrection, infection, increased “floaters” or retinal detachment, dislocation of the implant, halos and glare, dry eye, decreased contrast sensitivity, clouding of a membrane behind the IOL (this requires a quick laser procedure to remove it), and loss of vision.

You should consult with your ophthalmologist to determine if refractive lens exchange is the best treatment for your specific condition and vision needs. If you are considering RLE, you should discuss which IOL might be best suited for you.

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Monovision for Presbyopia

Many people use reading glasses to correct presbyopia, the age-related loss of close-up focusing ability. They use their eyeglasses for reading and other close work, taking them off when looking at objects that are farther away, or they use bifocals for clear distance and near vision.

Standard refractive surgery procedures do not correct presbyopia. **Monovision** is a specialized refractive surgery technique that enables one eye to focus at close proximity, while the other eye is left untreated or, if needed, treated for clear distance vision. Having each eye focus at different distances can reduce or eliminate the need for eyeglasses or contacts. It may seem difficult to get used to this, but about six to eight weeks after the monovision procedure, the brain is able to adjust to the two eyes' different focusing ability. Usually, this surgery is performed only after a successful trial of monovision using glasses or contact lenses.

The refractive procedures most commonly used to treat presbyopia are **laser-assisted in situ keratomileusis (LASIK)** and **conductive keratoplasty (CK)**.

With LASIK, your ophthalmologist (Eye M.D.) will use an excimer laser to reshape your cornea to correct your dominant eye for distance vision and will leave your other eye slightly nearsighted, so that you can use that eye for close-up vision.

Conductive keratoplasty is a minimally invasive thermal refractive procedure. Your ophthalmologist uses a tiny probe that releases controlled amounts of radio frequency (RF) energy to apply heat to the peripheral portion of the cornea. The heat then causes the sides of the cornea to shrink and to tighten like a belt, increasing the steepness of the central cornea and its optical power. This refocuses light rays on the retina and improves vision. Your ophthalmologist will use CK to correct your dominant eye for distance vision and leave your other eye slightly nearsighted.

In addition to these procedures, other refractive procedures may be used to correct presbyopia, including the following:

- laser thermal keratoplasty (LTK);
- scleral expansion bands (SEBs);
- refractive lens exchange (RLE); and
- multifocal LASIK (presby-LASIK).

Be sure to discuss your options with your ophthalmologist to choose the best refractive procedure for your needs, if surgery is a good option to correct your presbyopia. It may be best to test monovision with contact lenses before you opt for refractive surgery to be sure you will be comfortable with the adjustment following surgery and will achieve the results you desire.

As with any surgery, there are certain risks associated with LASIK, CK, and other refractive procedures.

Be sure to discuss these possible risks with your ophthalmologist.

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Phototherapeutic Keratectomy

The cornea is the smooth, clear window of the eye in front of the colored iris that helps bend light rays so they focus directly on the retina, the light-sensing layer of cells at the back of the eye. If the corneal surface is rough or cloudy, the rays of light do not focus properly on the retina and images are blurry. Until recently, ophthalmologists (Eye M.D.s) treated rough corneas by scraping them smooth with a surgical blade, while cloudy corneas required a partial or full corneal transplant. Now, **phototherapeutic keratectomy (PTK)** is an option.

PTK is an **excimer laser** surgical procedure that removes roughness or cloudiness from the cornea by using a cool beam of light to evaporate tissue. The principal advantage of laser surgery over conventional surgery is that the laser is able to create a smoother corneal surface than a blade and smaller amounts of tissue can be removed.

Potential complications after PTK include poor wound healing, excessive corneal flattening resulting in farsightedness, and irregular astigmatism or poor vision that cannot be corrected completely with glasses.

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Ectasia

Ectasia is a condition that occurs when the cornea is so thin that intraocular pressure (IOP) leads to instability and bulging of the cornea. This causes blurring, myopia, and irregular astigmatism.

During **laser-assisted in situ keratomileusis (LASIK),** the surgeon creates a flap in the outer layer of your cornea and uses the laser to remove some of the lower corneal tissue that is exposed when the flap is moved aside. If your corneas are thinner than normal, you may be at an increased risk for ectasia following LASIK, especially if you require additional LASIK procedures to fine-tune your vision correction. It is even possible (though extremely rare) for ectasia to develop following **photorefractive keratectomy (PRK),** a surface laser procedure that does not involve creating a corneal flap.

If you have thin corneas, you may not be a good candidate for LASIK. Ask your ophthalmologist (Eye M.D.) if alternative refractive procedures such as epi-LASIK or PRK might offer you a better chance at improved vision without any unnecessary risk of adverse side effects.

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Epi-LASIK

Until recently, if you were one of the millions of people with a refractive error, eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people with myopia (nearsightedness), hyperopia (farsightedness), or astigmatism (a cornea with unequal curves), can have their vision improved through surgery.

If you have thin corneas and are not a candidate for **laser-assisted in situ keratomileusis**, or **LASIK** (a corneal refractive procedure that requires the creation of a partial-thickness flap before the cornea is sculpted with a laser), **epithelial LASIK(epi-LASIK)** may be a good option for you.

Epi-LASIK is usually performed as an outpatient procedure using topical anesthesia with eyedrops. Your ophthalmologist (Eye M.D.) uses a highly specialized type of cutting device, called an epikeratome, to precisely separate the thin epithelial sheet—much thinner than a LASIK flap—from the rest of the cornea. Once your ophthalmologist separates the epithelium from the rest of the cornea, the thin sheet of epithelial cells is lifted to one side. After the cool beam of an excimer laser is used to permanently reshape the cornea, the thin sheet is then either moved back into place where it will self-adhere, or it is removed completely, in which case the epithelium heals inward from the corneal periphery in just a few days.

Reshaping the cornea helps focus light directly onto the retina to produce clearer vision. After the procedure, a transparent “bandage” contact lens is placed on the cornea to promote healing.

As with any surgery, there are certain risks associated with epi-LASIK. Be sure to discuss these possible risks with your ophthalmologist.

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LASEK

Until recently, if you were one of the millions of people with a refractive error, eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people with myopia (nearsightedness), hyperopia (farsightedness), or astigmatism (a cornea with unequal curves), can have their vision improved through surgery. If you have thin corneas and are not a candidate for **laser-assisted in situ keratomileusis**, or **LASIK** (a corneal refractive procedure that requires the creation of a partial-thickness flap before the cornea is sculpted with a laser), **laser epithelial keratomileusis (LASEK)** may be a good option for you.

LASEK is usually performed as an outpatient procedure using topical anesthesia with eyedrops. Your ophthalmologist (Eye M.D.) uses an alcohol solution to loosen and peel back the **epithelium**, the outermost layer of the cornea, to expose the corneal tissue beneath it. A cool excimer laser is used to permanently reshape the cornea, and the epithelium is either placed back into position, where it will self-adhere, or is removed completely, in which case the epithelium heals inward from the corneal periphery in just a few days.

Reshaping the cornea helps focus light directly onto the retina to produce clearer vision. After the procedure, a transparent “bandage” contact lens is placed on the cornea to promote healing.

As with any surgery, there are certain risks associated with LASEK. Be sure to discuss these possible risks with your ophthalmologist.

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Laser Surgery of the Eye

The word “laser” is an acronym for Light Amplification by Stimulated Emission of Radiation. A laser is a concentrated beam of light, created when an electrical current passes through a special material. Used in eye surgery since the 1970s, the laser is popular for its unparalleled degree of precision and predictability. Lasers are being used for an increasing variety of eye diseases.

A laser’s specific wavelength allows energy to be absorbed in selected tissues and not damage surrounding tissues. The laser beam is so precise it can cut notches in a strand of human hair without breaking it.

Thermal lasers convert light to heat. This type of laser seals blood vessels and destroys abnormal tissues. Photoablative lasers cut or sculpt tissue and are used to remove tissue, changing the shape and surface of the eye.

For diabetics with **diabetic retinopathy**, lasers can preserve vision, sometimes for many years. In treating diabetic retinopathy, the laser light seals leaking blood vessels in the retina, the light-sensitive layer of cells lining the back of the eye. Lasers also treat unusual retinal disorders, including blood vessel problems and tumors.

Also used to treat **glaucoma**, lasers can create a new passage through the iris to relieve eye pressure or open the eye’s blocked drainage canals.

Although lasers do not remove cataracts, they may one day. Right now, they open the **posterior capsule**, which often becomes cloudy after cataract surgery, restoring vision in a matter of hours.

More recently, the excimer laser has received a great deal of attention as a tool for permanently correcting **refractive errors** such as nearsightedness, farsightedness, and astigmatism. Refractive laser surgery can decrease or eliminate the need for eyeglasses and contact lenses by reshaping the cornea.

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Wavefront-Guided Laser Surgery

Laser-assisted in situ keratomileusis,or **LASIK,** is an outpatient surgical procedure that uses an **excimer laser** to reshape the eye's cornea (the clear window in the front of the eye) to correct refractive errors. Refractive errors are problems with the way the eye focuses light, which cause nearsightedness (myopia), farsightedness (hyperopia), or astigmatism. LASIK is used to surgically correct refractive errors, rather than using eyeglasses or contact lenses.

Wavefront-guided LASIK is an enhanced version of LASIK. It uses a special device to precisely measure the eye's unique irregularities and variations as well as your need for corrective lenses. This procedure has been compared to taking a fingerprint of the eye. You may benefit from this customized approach.

Wavefront measuring devices, called "analyzers" or "**aberrometers**," create a precise map of the eye. It is very detailed and records subtle distortions in your eye's visual system. Using this map, the excimer laser can be programmed to correct for these measured distortions, giving you clearer vision than was possible before with conventional treatments.

With your chin resting on the aberrometer, you will be asked to stare past what is called a target light. A targeted beam of light will be sent through your eyes and will focus on the retina. A sensor will measure the irregularities in the wavefront pattern of the light as it emerges from your eye. Using wavefront technology before performing LASIK can help your ophthalmologist (Eye M.D.) enhance the outcome of your surgery by correcting the unique visual distortions present in your eye.

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LASIK With the Femtosecond Laser

Until recently, if you were one of the millions of people with a refractive error, eyeglasses and contact lenses were the only options for correcting vision. But with the development of refractive surgery, some people with myopia (nearsightedness), hyperopia (farsightedness), or astigmatism (a cornea with unequal curves), can have their vision improved surgically.

Laser-assisted in situ keratomileusis (LASIK) is a refractive procedure that uses a laser to permanently reshape the cornea. The reshaped cornea helps focus light directly onto the retina to produce clearer vision.

LASIK is usually performed as an outpatient procedure using topical anesthesia with eyedrops. The procedure itself generally takes about 15 minutes. The surgeon creates a flap in the cornea with a special laser called a **femtosecond laser.** Tiny, quick pulses of laser light are applied to your cornea, creating microscopic bubbles at a specific depth and position within your cornea. Your ophthalmologist creates a flap in the cornea by gently separating the tissue where the bubbles have formed, and the flap is then folded back. The cool beam of a second laser, called an **excimer laser,** is used to remove a thin layer of corneal tissue. The flap is folded back to its normal position and sealed without sutures. The removal of corneal tissue permanently reshapes the cornea.

A clear shield protects the flap for the first day and night. Vision is usually slightly cloudy immediately after the procedure, but it clears rapidly, often within just a few hours. Your vision should be clear by the next day. Healing after surgery is often less painful than with other methods of refractive surgery, because the laser removes tissue from the inside of the cornea and not the surface. You will need to use antibiotic and steroid eyedrops several times a day for the first week, along with rewetting drops. After the first week, you will need to use only the rewetting eyedrops.

Some people experience poor night vision after LASIK. The surgery also may result in undercorrection or overcorrection, which can often be improved with a second surgery. More rare and serious complications include a dislocated flap, epithelial ingrowth, and inflammation or infection underneath the flap. Most complications can be managed without any loss of vision. Permanent vision loss is very rare.

The ideal candidate for LASIK has a stable refractive error, adequate corneal thickness and normal corneal shape, is free of eye disease, is at least 18 years old, and is willing to accept the potential risks, complications, and side effects of LASIK.

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Intracorneal Rings

Intracorneal rings (ICRs) are plastic inserts placed in the cornea. The rings flatten the central cornea to correct low levels of myopia (nearsightedness). Unlike other refractive surgery procedures, ICR procedures can be reversed. When the inserts are removed, the cornea usually returns to its preoperative shape and vision is once again myopic.

The ICR procedure is generally performed on an outpatient basis, using eyedrops for anesthesia. It is a quick procedure and can take less than half an hour.

Research is being done on intracorneal rings for correcting presbyopia (farsightedness) and astigmatism. Rings have recently been used with success in treating corneal disorders such as **keratoconus**, irregular astigmatism, and **progressive corneal thinning** that follows other corneal refractive procedures.

Complications with intracorneal rings are rare but can include undercorrection, overcorrection, induced astigmatism, infection, glare, halos, and extrusion of the insert. Minimal scarring may also occur in the area of the rings.

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