

Laser Vision Correction

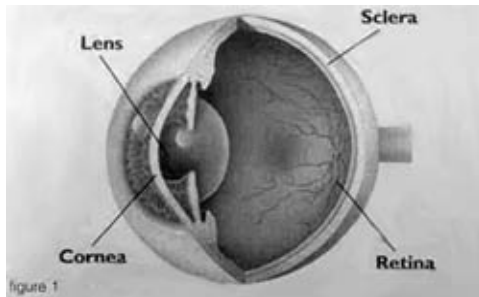
Redefining How You See Through Laser Vision Correction

How would you like to wake up each morning with excellent vision, not needing your eyeglasses or contact lenses to see clearly? That is the potential of Laser Vision Correction. Activities such as skiing, swimming, golf, or any one of a hundred other activities may be well within your reach without contact lenses or eyeglasses through successful Laser Vision Correction. We have written this booklet in order to introduce and educate you about this unique form of vision correction for patients who are dependent on eyeglasses or contact lenses for their nearsighted, farsighted or astigmatic conditions.

LASIK laser vision correction of the eye, is one of a number of techniques that have evolved to alleviate or completely eliminate the need for eyeglasses or contact lenses. We suggest that you become as familiar as possible with the Laser Vision Correction options available to you. There is a long history behind the evolution of **LASIK** surgery and, we will review this and other aspects of the procedure through the course of this document.

Our goal is to make you a knowledgeable consumer regarding Laser Vision Correction. **LASIK** and other means of vision correction, like all medical therapies, are not for every patient. You should understand the procedure and be able to ask your doctor intelligent questions regarding your potential candidacy for the procedure.

What are Refraction and Laser Vision Correction?



The eye is simply a camera with a set of lenses and film. The film of the eye is the retina. This is where the image should be focused and then ultimately transmitted to the brain for processing (*figure 1*).

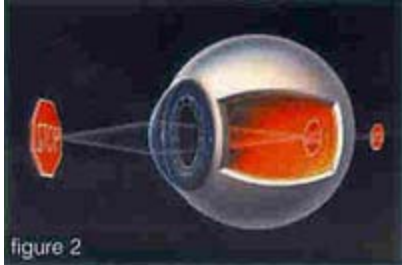
Refraction is the process of bending light waves that represent images intended to be focused on the retina of the eye. Therefore, refractive surgery is a means of modifying the eye so that its refractive state is changed to provide crisp, clear vision and reduce or eliminate entirely the need for eyeglasses or contact lenses.

The refracting system of the eye is made up of the crystalline lens located about a quarter of an inch inside the eye and the cornea, a clear tissue covering the very front of the eye. The cornea is analogous to the clear crystal on the front of a watch. As an aside, when one speaks about cataracts it is the lens of the eye that is affected.

It is the cornea that makes up almost 70% of the eye's ability to focus light. It is constructed of a clear, curved biological tissue capable of being molded and changed through a number of surgical and non-surgical procedures. When a contact lens is fitted it sits **on** the cornea. Using a contact lens is a non-surgical refractive process to avoid

eyeglasses. **Laser Vision Correction** is the next step in technological advancement. It permanently alters the shape of the cornea and therefore the patient's refractive state.

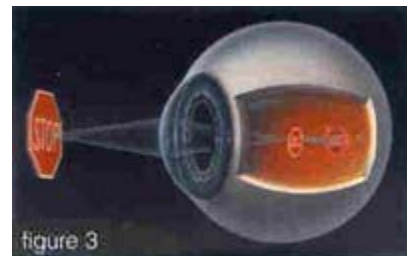
What are Farsightedness, Nearsightedness, and Astigmatism?



Farsightedness, or hyperopia, is the condition, or refractive state, where light rays are focused **behind** the retina. Here the cornea is flat or the eye short. Vision is usually good for farsighted individuals when they are young.

In older individuals, the ability to refocus hyperopic light rays is diminished and eyeglasses are often needed for distance vision and always for near vision (*figure 2*).

Nearsightedness, or myopia, is the condition, or refractive state, where light rays are focused **in front** of the retina. Here the cornea is steep or the eye is long. Vision is usually comfortable for near objects but blurry for far or distant objects (*figure 3*).



Astigmatism is the state of refraction where light waves are focused in **two different meridians** on the retina. Simply put, one part of the eye is more nearsighted or more farsighted than another part of the eye. A moderate amount of astigmatism is not a disease, just as moderate amounts of nearsightedness and farsightedness are not diseases.

A Brief History of Laser Vision Correction:

Corneal Refractive surgery is a technique used to reshape the cornea, changing its refractive power. The goal is to create clear, comfortable vision for an individual with "normal" eyes that happens to be nearsighted, farsighted, or astigmatic.

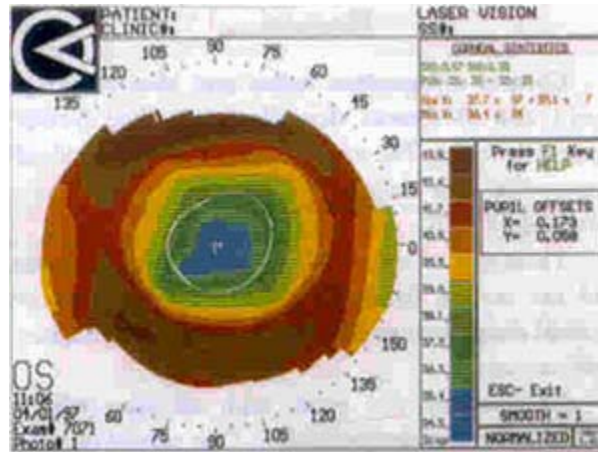
A Brief History of the State of The Art of Corneal Refractive Surgery

Almost sixty years ago Dr. Sato, a Japanese eye surgeon, noted that making radial cuts in the cornea flattened the cornea, in effect making nearsighted people less nearsighted. In the early 1970's Dr. Fyodorov of the Soviet Union made improvements in the technique by refining the radial cuts on the *outside* surface of the cornea. Thus was born Radial Keratotomy, the first real, useable refractive surgical procedure of the cornea.

Radial Keratotomy fell out of favor for several reasons. For one, there was no holistic means of looking at and evaluating corneal shape and therefore no way to assess the patient's cornea with precision before or after a procedure. Therefore diagnosis, predictability, and reproducibility were of consequence for the patients undergoing

Radial Keratotomy. The technology simply did not exist to define these parameters. Surgeons were literally "flying blind".

By the mid-1980's two events were driving refractive surgery simultaneously: Dr. Richard Koplin and his associates took on the challenge of developing technology that would allow refractive surgeons to evaluate corneal shape and move refractive surgery into the modern era. The second was the development of laser systems that promised to refine refractive surgery and significantly improve on the incisional surgery known as radial keratotomy.



The result of Dr. Koplin's and his associates' efforts resulted in the device known as the **Corneal Modeling System** (figure 4). It provides the refractive surgeon with a computer generated mapping system that helps ensure the best results possible when performing refractive surgery, and in particular LASIK surgery.

With the development of **Corneal Modeling** technology and ablative lasers, modern day refractive surgery was born.

What are Lasers?

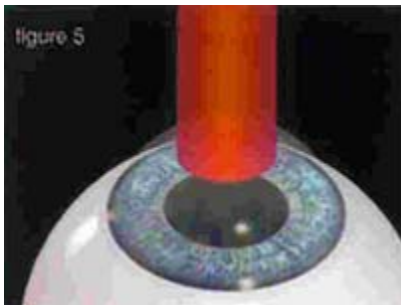
Laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation and is a technology that allows normally scattered rays of light to be highly focused into powerful beams of various wavelengths. The process that emits the laser light determines the wavelength and makes a specific laser useful for a particular purpose. Certain wavelengths of laser light make a laser "hot" and are used to treat disorders such as diabetic retinal disease. These lasers work to seal leaky blood vessels. Some laser are "cold disrupters" and are used to treat cataracts. Unique to refractive lasers --- those used to reshape the cornea --- is that these lasers do nothing more than accurately and predictably break molecular bonds--- they *ablate* the tissue precisely as the surgeon designed the procedure. The ablated tissue simply disappears as a gas.

This class of lasers--- known as excimer lasers (for **excited dimer**, the combination of gases used to initiate the laser pulse)--- neither emit heat nor disrupt adjacent tissue. What they do is simply, and without discomfort, make tissue disappear precisely where the beam is aimed. Each pulse of the cool ultraviolet beam of light removes a microscopic amount of central corneal tissue, less than one-thousandth of one millimeter. It does this with amazing precision and predictability without affecting any other surrounding tissue.

Excimer lasers (the very type used today) began their use in the United States in FDA sponsored programs in the late 1980's. Hundreds of thousands of patients have undergone procedures during the intervening years in Great Britain, Canada and Europe--- well before approval was granted here in the States in late 1995.

Laser development has meant, for the most part, refining the laser delivery systems--- the power of the laser, the period the laser energy is applied to the cornea, as well as the design of the laser movement across the cornea. The study period--- over ten years-- -- gave ample time to evaluate how biological tissue responded to these special lasers used to treat refractive errors. Also during this time, whole new categories of pharmaceuticals were born to support corneal refractive surgery.

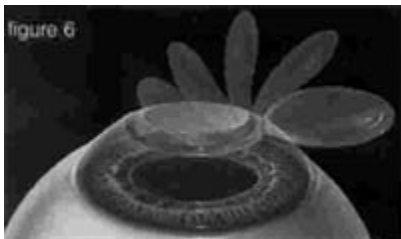
PRK and LASIK Defined:



of the eye and, in less than a minute (for the average patient), the procedure is completed (*figure 5*).

Refractive procedures of the cornea, using excimer laser technology, began with what is called photo refractive keratectomy (*photo* = light, *refractive* = bend light waves, *keratectomy* = removing surface tissue from the cornea: better to remember the procedure as **PRK**). With **PRK** the laser beam is simply passed across the surface of the cornea using a beam diameter approaching 6 millimeters (less than a quarter of an inch). Under *eye drop anesthesia* (topical anesthesia) the laser is focused carefully within the pupillary portion

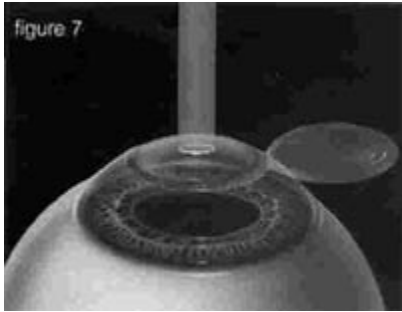
After the laser-**PRK** procedure the patient is left with a small corneal abrasion: with treatment using eye drops and often wearing a soft, *bandage* contact lens the abrasion clears in 24-48 hours and the patient begins to see clearly without their eyeglasses. Useful vision returns in a few days but can fluctuate for 2-3 months.



LASIK is a variation on the **PRK** technique. **LASIK** is an acronym for Laser Assisted In-situ Keratomileusis. Here, using a sophisticated device known as a "keratome," a very thin hinged flap of corneal surface is raised (*figure 6*).

There is no pain and the surface tissue raised is far

from the inside of the eye: all laser refractive procedures are superficial in nature.



Once the flap is raised the same technique used in **PRK** is then applied to the underlying tissue. At the conclusion of the procedure the flap is simply laid down across the laser treated area and in a few minutes the flap adheres (*figure 7*).

Intuitively you can see the advantages of the **LASIK** technique, by not causing an abrasion of the cornea there is rather rapid rehabilitation: there are minimal after-effects, the vision stabilizes quickly and the use of medications is lessened. Patients undergoing **PRK**, on the other hand, must wait for the abrasion to heal, during which time they have moderate discomfort and blurry vision.

Then why, you might ask, does anyone bother with **PRK**? **PRK** has its proponents with low degrees of nearsightedness where, because of the depth of laser application, the result is a very superficial abrasion. Compared to the **LASIK** technique, **PRK** is not as technically difficult to perform since it does not have the additional step of raising the "flap". Therefore **PRK** is not as surgeon dependent.

In low degrees of myopia (say -0.75 to -1.50 diopters of nearsightedness) a refractive surgeon *may* opt to perform **PRK**. However, **LASIK** is the procedure of choice for most patients at higher amounts of nearsightedness.

The benefits of **LASIK** over **PRK** are:

- Very little or no discomfort.
- Rapid recovery time. Most people attain vision approximating 90% of their best correction in 24-72 hours. Most patients return to their normal activities within a day or two.
- Fewer post procedure eye drops. With **LASIK** eye drops are used for 5-7 days, whereas with **PRK**, drops may be required for up to several months.
- More stable and accurate results, especially in patients with higher degrees of refractive error. (Both **PRK** and **LASIK** are capable of treating astigmatism up to 4 and 5 diopters.)

Treatment of farsightedness, or hyperopia, is similar to nearsighted treatment except that the goal is *steepen* the cornea (in nearsighted patients the goal is to flatten the cornea).

Are you a Candidate for Laser Vision Correction?

Let's review the basic parameters-

Except in special conditions you should be at least 20-21 years old with a stable eyeglass or contact lens prescription: this means that your prescription should have had

only negligible changes over the past two years. You should be free of significant pathology (disease) on the surface or in your eye; patients with very extreme nearsightedness must be careful, glaucoma patients in certain cases may not be candidates, and patients with previous retinal detachments may not be candidates. Patients with inflammatory disorders of the eye may not be candidates.

Your Corneal Modeling evaluation should reveal a normal shape profile and be free of irregularities that might complicate the outcome.

If you are free of eye disease, your refraction is stable, and your Corneal Modeling profile is acceptable then you are probably *physically* a good candidate.

Now, about your expectation of what LASIK surgery can achieve for you. Candidates must be realistic and thoughtful about the treatment parameters. Although we can never promise patients "perfect" 20/20 vision, more than 90% of patients achieve their targeted vision (even more when an "enhancement" procedure is performed). But it should be understood that occasionally a patient does not reach their visual expectations. We will deal with these issues later on.

Stepping Through a LASIK Procedure:

Things to note the day of your LASIK treatment-

LASIK is an outpatient, ambulatory procedure using only anesthetic eye drops to numb the eye. The surgery is essentially pain free. You do not have to change out of your clothes (wear comfortable, loose clothing) and there is no sedation or unusual preoperative routines to be followed. (We may have you use eyelid scrubs the day before surgery.) Do not sedate yourself. This is unnecessary, and besides we need you alert and cooperative during the procedure.

Do not wear your contact lenses for at least three weeks prior to the procedure (or as directed). Do not wear eye make up the day of the procedure. Do not bring cell phones or beepers into the laser correction suite.

You may be asked to wear an operating room cap to keep hair under control and booties over your shoes in the OR suite.

The first step in the procedure is to simply anesthetize the eye to be treated with eye drops. You will then lie on your back under the laser delivery system, which is open on all sides and not at all claustrophobic. Your eye will be gently washed to free loose debris.

A thin metal lid holder keeps your lid wide open during the procedure: your surgeon will adjust this from time to time-- making your lid wider or smaller as necessary.

Remarkably, the anesthetic eye drops remove any urge to blink. A small circular suction ring is placed on the outside of the eye and in a matter of seconds the flap is completed. You will hear and feel a slight vibration as the miniature motor drive completes the flap.

The flap is now raised and you will be asked to concentrate on a red fixation light. The laser portion of the procedure is then begun. If your gaze wanders from the fixation beam the laser will be stopped and you will be reoriented to the fixation beam. For the average patient, laser application takes approximately 30 seconds.

The flap is then replaced and allowed to adhere for four minutes with only gentle rinsing of the eye: then it's over! On average, the entire procedure takes less than 20 minutes per eye.

When you gaze about after your LASIK procedure the room will appear somewhat foggy. This is normal and clearing of vision will occur rapidly over the following six to twelve hours. After the procedure you will leave *without* needing your old eyeglasses. By the next day most patients have attained significant clarity and are well on their way to approaching their optimum vision. Occasionally patients wear an *eye shield* at bed for the first night (to prevent eye rubbing in their sleep). Normally you will use several eye drops (antibiotic and an anti-inflammatory) for 5-7 days. For most patients superb visual function is achieved with 2-5 days. Stabilization of vision is dependant on the degree of treatment (how much nearsightedness or farsightedness was corrected) and age. Most people return to work within 24-48 hours. There are few restrictions in the first week. No eye rubbing and no swimming are among these.

Post treatment visits after your **LASIK** treatment will vary with your doctor; however, here is a typical schedule for **post-LASIK** evaluations:

The first post-treatment day: the flap is checked and your vision evaluated.

One week post-treatment: check vision and healing. Depending on your progress, checkups are scheduled at intervals of one month, two months, six months, and one year. After this period, visits are made on a biannual basis.

What are the Published Results of LASIK and PRK?:

Except in higher orders of nearsightedness (above -6.00 diopters) the results with **PRK** and **LASIK** *over time* (by the third to sixth month) are about the same. There is no doubt the **PRK**, on average takes longer to stabilize--- and the greater the amount of laser treatment the longer the march to stability.

Post-treatment haze may occur with both **PRK** and **LASIK**-- each for different reasons. This is much more common with **PRK** and rare with **LASIK**. Although this can be very annoying it generally goes away with treatment. Within 3-6 weeks over 95% of our patients are within one line of their best-corrected vision.

Published results suggest that anywhere from 3-15% of patients may require or request an enhancement to one eye or the other (touch-ups), which are easily performed in both **PRK** and **LASIK**. This occurs if a patient is under- or over- corrected to a degree that they decide does not meet their needs. In **PRK** the patient simply undergoes several more seconds of direct laser treatment and in **LASIK** the flap is painlessly raised and several seconds of laser treatment is applied.

A frequent question is "are all the results permanent?" The answer is in almost all instances, "yes". Some regression-- the reversal of the treatment parameters-- may occur to a slight degree during the healing phase. Regression, when it occurs, is more common in older individuals; however, significant changes in vision status are rare.

Perfect Vision?

Although you may not need eyeglasses at all after your **LASIK** treatment, we prefer to think of the goal as the elimination of eyeglasses or contact lenses for *most* activities. In spite of the fact that 96% of our patients no longer require eyeglasses for distance vision, patients should not always expect "perfect" vision.

We hope that all patients, through proper education about Laser Vision Correction, will have realistic expectations based on the facts about the procedure.

What Complications can be Encountered When Performing Laser Procedures of the Cornea?

Firstly, you should understand that complications of **PRK** and **LASIK** occur infrequently and most are minor and can be addressed satisfactorily. However, no surgical intervention should be taken lightly. Each surgeon's experience will differ and you should use your time with the laser surgeon and his or her associates to ask enough question to feel comfortable that you are in the hands of a well trained physician.

Most of the complications of LASIK are *Temporary, Avoidable or Treatable-*

Most technical problems are avoided by careful attention to detail. Flap difficulties usually mean that the procedure is to be aborted. In most instances, the surgery can be completed at a later date.

Infection is avoided by paying attention to the patient's eyelid hygiene prior to surgery. The use of antibiotic eye drops at surgery and afterward assures the prevention of infection.

The careful establishment of the patient's true refractive error avoids over- and under-correction. This means that patients wearing contact lenses may have multiple preoperative visits where measurements are performed without contact lens wear. Surgery should not be performed until the patient's true refractive state is stable and repeatable.

Regression, in almost all cases, is usually minimal and more common when farsighted laser vision correction is performed. Regression is ameliorated by the occasional "enhancement" procedure.

Patients under the age of 19 or 20 should probably wait a year or two prior to **LASIK** or **PRK** treatment. Some of these individuals will not have reached a stable refraction (typically these patients will relate that they have yearly or more frequent changes in eyeglasses or contact lenses).

Reading Eyeglasses After Age 40-

Patients undergoing **LASIK** will often require reading eyeglasses after age 40 (like all normally sighted patients who never needed glasses to see in the distance). This is due to the process of presbyopia, a result of the normal aging of the human lens and its loss of flexibility.