

# The Miracle of Pi in Eye

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## DEDICATION

This book is dedicated to all my patients who placed their faith in me and trusted their vision in my hands.

## 7 CHOOSING THE BEST PI

The heart of the Prelex procedure is the synthetic biocompatible implants, which allows seeing far and near in each eye. These are called Presbyopic Implants or Pi. They are artificially made and not taken from donors or cadavers. These lenses do not incite any allergic reaction when placed in the eye. In extreme cases they can even be replaced with similar or different lens. Today, there are different FDA approved Pi available in the US.

The accommodating lens is mono-focal lens, which is all light rays are brought to focus at one destination. Forward and backward movement as well as the curved shape of the implant inside the eye increases the depth of field. Being mono-focal yields a clear image. They may not be able to allow clear vision on all 3 zones.

This obstacle is overcome by setting the focus of the two eyes little differently. This is termed as mini mono- vision. The dominant eye is set for distance, middle and some near while the non-dominant eye is set for near, middle, and some distance. The brain is able to fuse the images to yield all three zones of vision with depth perception.

The multifocal Pi works by splitting the incoming light. In the older refractive lenses there were alternating zones for distance and near vision. These have fallen into disfavor as patients were not happy with the quality of vision.

The modern choice is the diffractive Pi. There are apodizations or rings impregnated on to the lens during the manufacturing process. These micro elevations split the incoming light into two images. The brain is then able to choose the desired image. Let's

consider a simple example. Stand in front of a window and look out at a distant object, let's say a tree. Now hold up your finger in front of your eyes. You will notice when you look at your finger the tree gets blurry and finally ignored. When you look at the tree, finger gets blurry and suppressed. We concentrate on what grabs our attention.

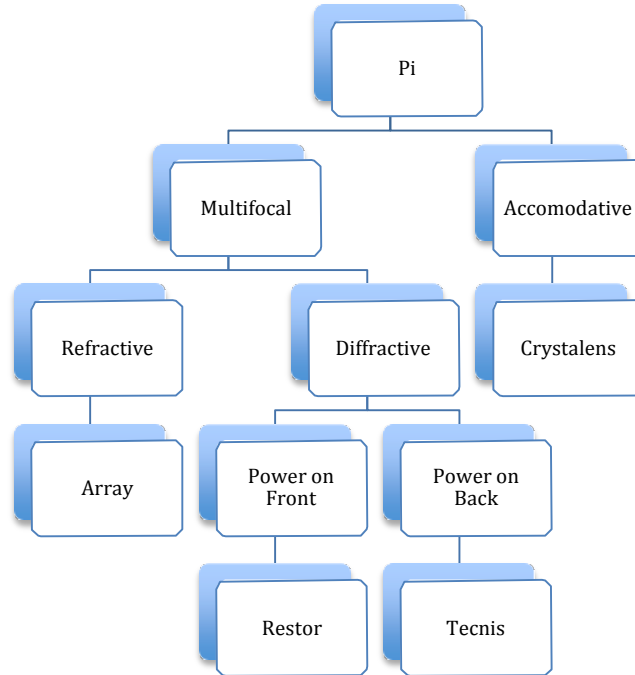


FIGURE 7.1 Presbyopic Implants (FDA Approved)

Personality, work, hobbies, and sports all influence the decision for the final implant chosen. Sometimes different implants may be chosen for the two eyes. Your surgeon will discuss with you your needs before choosing the best lens. The selection process requires careful analysis and consideration of all available choices.

### **Crystalens**

It is an accommodating posterior chamber intraocular lens made of silicone. It is a modified foldable plate haptic lens with hinges across

the plates adjacent to the optic. Two flexible colored polyamide loops are attached to the distal extremity of the plates. It has a small 4.5mm optic zone. It should not be placed in the ciliary sulcus and should not be implanted if the bag is not intact or there is any Zonular rupture.

Furthermore, YAG capsulotomies should be delayed for at least 12 weeks after the implant surgery. Even then the capsulotomy should be less than the optic size: lest the lens gets dislocated.

The lens does not significantly absorb UV light. Protective glasses should be worn after the surgery. The lens moves mechanically to yield 1.0 diopter of monocular accommodation. Safety profile is good, as hinge movement of one billion cycles at ten cycles per second has been documented without degradation. Approximately 95% of visible light is transmitted. It has undergone multiple refinements and today the 5th generation Crystalens and Crystalens AO modifications are available. Crystalens HD was recently discontinued as AO was more effective.



Figure 7.2 A Crystalens

### **Crystalens AO**

It transmits 100% of light rays independent of pupil size. This aberration free aspheric lens allows great contrast sensitivity. Patients with astigmatism can tolerate this lens better. It also allows some torque without affecting vision. Patients show better vision seven years after surgery, then at the time of surgery.

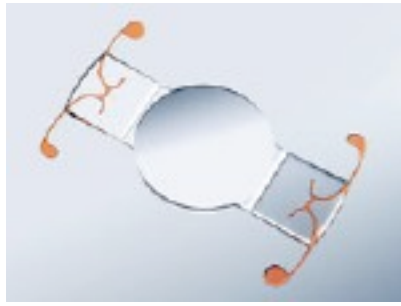


Figure 7.2 B Crystalens AO

### Restor

This acrylic IOL shares the basic construction, a central optic and two arms or haptics for stabilization. It can be a one piece that is implanted into a bag or a three piece, which is implanted in the bag or ciliary sulcus. Both the lenses are foldable. The anterior apodized refractive optics that forms the diffractive zone is found within the central 3.6mm optic zone of the lens.

It comprises of nine concentric steps of decreasing heights allocating energy based on lighting conditions and activities. This lens does not require any ciliary muscle or movement to function. The +3.0 diopter on the lens yields a power on the cornea equal to wearing +2.5 readers, which allows for near vision. A refractive region that directs light to distal focal point surrounds the diffractive region. The asphericity of the optic compensates for the corneal spherical aberrations.



Figure 7.3 Views of Restor Presbyopic Implant

The chromophore filters blue light without impacting color vision or the quality of vision. Some visual effects may be expected including halos around light during low light or in nighttime conditions.

**Tecnis**

Tecnis is made of UV blocking hydrophobic acrylic. It is biconvex like a magnifying glass with diffractive rings on the posterior surface. The addition is a plus 4 diopter. It is manufactured in a proprietary diamond cryolathing process. It means the material and the shape are created in the same step. Being clear, it transmits more light, but increased number of rings may cause glare.



Figure 7.4 Tecnis Multifocal Presbyopic Implant

**“Mirror, mirror on the wall, which lens is the best of all?”**

No one lens is the best. Otherwise others would not exist. The art is to match what lens is compatible with a patient’s lifestyle and work.

	Advantages	Disadvantages
Crystalens	Clear vision for 2.5/3 zone	May need glasses occasionally
Restor	Full range of vision (3/3)	Extra light for reading
Tecnis	Nearly full range	Glare, computers & intermediate vision may be a problem

Figure 7.5 Comparing the Pi





require more light in dark conditions.

Tecnis overcomes the hindrance of needing extra light. So it is desirable in patients working in low light conditions, like telephone maintenance people working at night. The drawback is it is accompanied by glare and haloes while driving and vision for computers is not perfect. Crystalens has the least glare and the best vision for computers.

Let's look at some examples to clarify how lens should be chosen:

**55 yr. old golfer and executive:**

This person requires seeing the ball and the distant hole. Any of the three lenses would work for playing golf. Women can tolerate mini monovision better and may prefer Crystalens. A guy who likes to whack the ball hard and wants depth perception would be better off with the other two.

**47 yr. old kick boxer and salesperson:**

This person is going to be hit often on the head. We need a lens which will be most stable and does not move once implanted. Also since fights occur under artificial lights, glare should not interfere. Therefore Restor lens may be most appropriate.

**52 yr. old tennis player and businessperson:**

Tennis requires depth perception and force to hit the ball. Sometimes people play under artificial lights. If the person is adaptable then Restor would be appropriate. Crystalens would be better if he/she wanted sharpest vision and was willing to wear readers at office.

**63 yr. old tailor and avid reader:**

Tailors require depth perception to thread the needle and work and read in lower light conditions. This may be a person best suited to Tecnis.

**72 yr. retired cyclist:**

This person would need good distance vision. If the cyclist wants to read maps on his cell phone Crystalens or Restor would be beneficial. Reading small printed maps would be possible with

Restor or Tecnis. Depending on the needs of computers and reading, the final choice could be made.

**57 yr. old skier and CEO:**

Here again depth perception is important. Crystalens is usually preferred as reflection of light from snow and ice can cause glare.

**49 yr. old actress and hiker:**

An actress needs to concentrate on emoting not straining to read cue cards. As it is there is the heat and light from the overhead light fixtures. Mini monovision with Crystalens will work both for her acting and hiking needs.

**75 yr. old retired grandma:**

She would rather enjoy the company of her grandchildren than search for glasses. Tecnis or Restor would give her that independence.

**54 yr. old stunt pilot:**

Pilots love the freedom they enjoy in the air. So its natural they would want to have freedom from glasses too. Pilots have to check gauges and read maps while in the air. Restor or Crystalens may be an option to liberate them.

**60 yr. old speedboat and car racer:**

These machines move at such high speed that vision is mostly a blur. They are exposed to lot of forces. Tecnis or Restor are safer and deliver required vision.

**64 yr. old fireman/cop:**

They need to have good distance and middle vision at all times without glare. Crystalens would be a choice if they are not likely to be involved in trauma, and don't mind readers if needed. Otherwise Restor would make them happy.

**59 yr. old physician:**

Physicians are a big group. A surgeon using microscopes may want to avoid any glare and prefer Crystalens. They can adjust the eyepiece on the microscope to allow for the mini monovision.

General practitioners, internal medicine doctors may want Restor.

**56 yr. old nurse and half marathon runner:**

Nurses have a need for reading small drug labels. Their shifts vary between day and nights in well lighted hospitals. As a runner distance and middle vision is required, glare or light is not a problem. This person would be happy with a Restor implant.

**54 yr. old contact lens wearer using monovision:**

In this scenario the person is already used to clear monovision at all distances. It is appropriate to replicate similar but better vision with Crystalens.

As can be deduced from examples, choosing the best lens is a scientific art.

	<b>Restor</b>	<b>Tecnis</b>	<b>Crystalens</b>
Far	Yes	Yes	Yes
Middle	Yes	Some issues	Yes
Near	Yes	Yes	Read at arm's length
Glare	Some	Most	Least
Extra light at night	Yes	No	No
Lens movement	No	No	Yes
Tolerate astigmatism	No	No	Yes
Treat Dry Eye	Yes	Yes	Less

Figure 7.7 Choosing a PI for your needs

Sometimes, patient have already had one eye cataract done either before the modern Presbyopic Implants(PI) were available or with a doctor who does not do PI. The question asked is should the second eye have the modern advanced implant. And what if anything should be done with the first eye.

The simplest plan is to have an extensive discussion regarding, monofocal lenses, accommodative lenses and types of multifocal. Only then proceed with a PI. This would still free them from the constant dependence of glasses. Nearly all patients we did in this scenario were happy with their choice. It does take time to adapt to the different visions in the two eyes.

If the patient is happy and able to adjust, than nothing more need be done. If they are happy and want a similar lens in the other eye, it needs to be considered on a case by case basis. If the first surgery has been recently been performed and the eye has not undergone a YAG procedure the exchange may be possible. On the other hand if the procedure had been performed many years ago and had already undergone a large capsulotomy and the patient is happy with vision in that eye than it is safer to leave the eye alone.

