



by Andrew Maxwell, MD, PhD

The AcrySof platform's exceptional design provides excellent vision across all AcrySof IOLs

The AcrySof platform (Alcon, Fort Worth, Texas) includes a family of IOLs that share the key components necessary to provide excellent IOL stability, IOL performance, and postoperative refractive outcomes. These components include highly bioadhesive hydrophobic acrylic material, a single-piece lens design, STABLEFORCE haptics, a yellow chromophore with blue light filtering properties, and a remarkably high index of refraction—all of which play a role in effective lens positioning (ELP) and better patient outcomes.

Treating your monofocal patients

Our first and foremost goal with cataract surgery is to provide our patients with the best possible vision after surgery. Our second goal with a cataract refractive procedure is to leave our patients with as little need for an optical device as possible. Today's monofocal patient may accept the need for spectacle correction, but he or she is understandably unwilling to rely upon them for every visual chore. In my practice, it is important for our monofocal patients to be just as pleased with their outcomes as our

Premium care for your monofocal patients: Achieving optimal ELP with the AcrySof platform

premium lens patients. I think we can do that because of the design of the AcrySof lenses we implant.

As surgeons, we have technology that helps us measure the length of the eye, the curvature of the eye, everything needed to calculate what the lens power implant should be. A very significant component in that is where does the lens fit inside the eye? If the lens shifts forward a little bit after implantation, the patient is a bit myopic. If the lens shifts backward a bit, the patient is a bit hyperopic.

Effective lens positioning simply means the lens stays where we want it to be. All of our IOL calculation formulas presume that if we place a lens in the capsular bag, it will stay where placed and correct the refractive error we thought it was going to correct.

With the AcrySof line, the bioadhesive hydrophobic acrylic material has a little tackiness to it so the bag basically seals to it. In my hands, it means the lens sits where we predict it's going to sit, and I've rarely had any significant surprises.

Those benefits work across the platform—so whether I'm using a toric lens or a monofocal or I'm using a femtosecond laser to create my capsulorhexis, these lenses end up where I expect them to be. Because the capsule shrinks around the lens so quickly, the lens doesn't have a lot of variability whether it's going to shift backward or forward.

The role of the haptics

The STABLEFORCE haptics have a specific amount of compression force that helps fixate the lens in the bag and do not lose that compression force. Before this technology was available, we had lenses with haptics that would lose that compression force within 24 hours, essentially shifting

the lens slightly out of position via tilt or decentration. The STABLEFORCE haptics are designed to hold the lens in place; they're constructed of the same material as the lens itself. These haptics hold the center of the lens well and do not "let go" until the lens is actually fixated in place in the bag.

Biocompatibility and fibronectin

Early in my career, I was heavily involved in helping to design lenses that would be biocompatible—we used fluorocarbon coating on the lens or experimented with other substances we thought would work well. We evaluated explanted lenses (through cadaver donations or implanted/explanted from rabbits) and created a solution that was fairly close to the components of the protein components inside the eye. We measured what kind of materials bound to the lens implant. We found a whole series of proteins, including fibronectin.

Fibronectin is present in human serum. It's also present in the blood aqueous barrier around the eye and can bind to the lens implant. Because of its natural properties, fibronectin helps stabilize the lens in the bag. AcrySof is incredibly well tolerated because it has the same protein that the body manufactures naturally, and has a high level of fibronectin bioadhesion.

The AcrySof platform provides premium outcomes to satisfy the demands of our increasingly savvy patients—for every visual goal.

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by Billy Hammond, PhD

Understanding how the light spectrum functions is necessary to understand how vision works in older patients

As a neuroscientist but a vision scientist as well, understanding vision and how the brain perceives images is the basis for my research. It is common to regard vision strictly in terms of glasses, or refractive errors. Yet for the vast majority of human history, refractive conditions like astigmatism and myopia were very rare. The eye evolved to deal with the challenges posed by the natural environment such as bright light and seeing at a distance through veiling haze. This is why so many species have developed internal ocular filters to aid vision under ecological conditions.

Blue light filtration: What is the evidence today?

Given the preponderance of blue light in our atmosphere (via Rayleigh scatter), those filters are inevitably blue-absorbing and appear yellow in color. In humans, this filtering is done by the yellow macular pigments (chromophores accumulated from the dietary intake of green leafy vegetables) and the natural yellowing that occurs with the crystalline lens.¹

What the pigments do

Vision researchers have intensively studied the effect of the macular pigments on daily vision. It has been documented that these pigments improve visual function by reducing the deleterious effects of intense light.² The pigments reduce disability and the discomfort caused by bright light that is largely driven by the blue portion of the visible spectrum. By absorbing very intense light, they reduce the amount of time it takes to recover from short intense light exposures (photostress recovery). They may also aide object detection by improving chromatic contrast (accentuating a colored border by absorbing one side more than the other). By similar mechanisms of strategic filtering, they improve visual range (how far one can see). This is done by absorbing the biggest limiter

of distance vision, which is veiling due to blue haze.

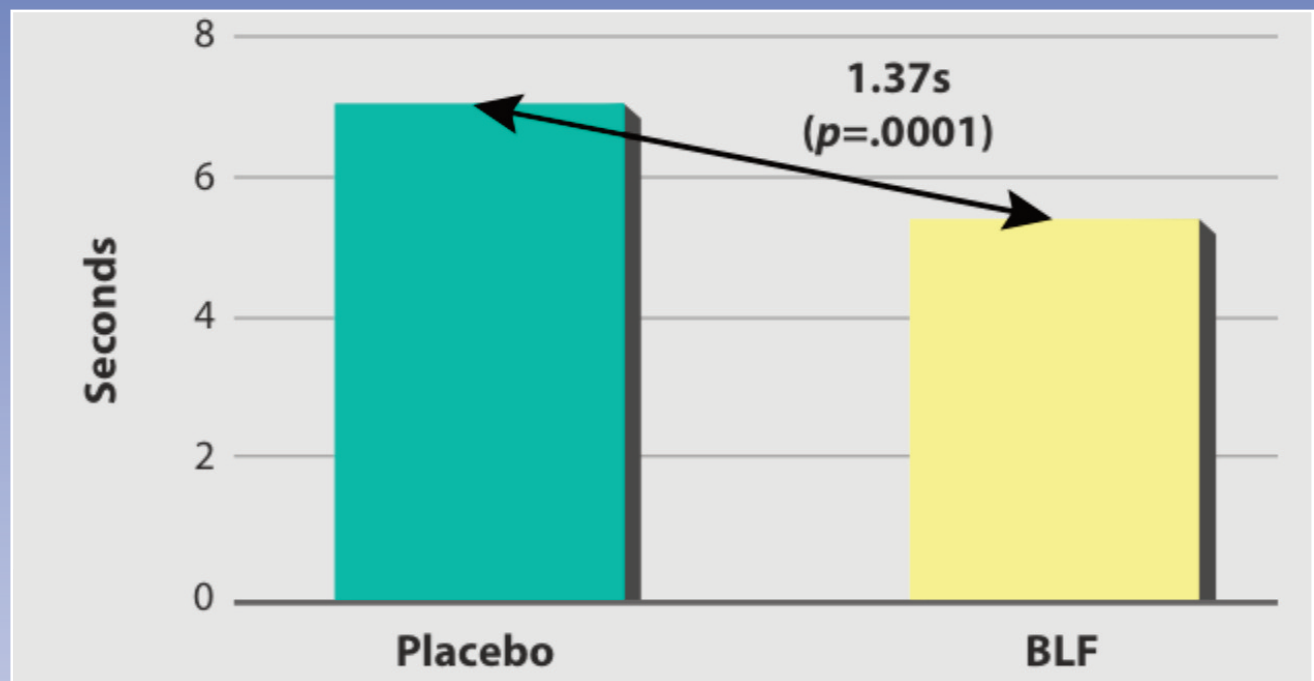
When Alcon (Fort Worth, Texas) developed its AcrySof IQ lens, it created an IOL that mimics the spectral absorbance characteristics of the other major yellow chromophore in the human eye, the natural crystalline lens. This was originally done to reduce actinic damage sometimes referred to as the “blue light hazard.” Light is, of course, necessary for life and optimal function—for instance, to synthesize vitamin D. However, some vision scientists also believe light has the potential of damaging biologic tissue.³ Light can convert oxygen to a more reactive form that can, in turn, peroxidize fats (a big problem for fatty tissues like the retina, which are exposed to a lot of light and oxygen).⁴ It’s believed the energy in light is inversely related to wavelength so shorter wavelengths are more damaging than longer wavelengths; for example, ultraviolet light is a lot more damaging than infrared.⁵

Real world applications

Although protection from actinic light may be a strong advantage of blue-absorbing filters, it is likely that natural chromophores like the macular pigments have effects that manifest

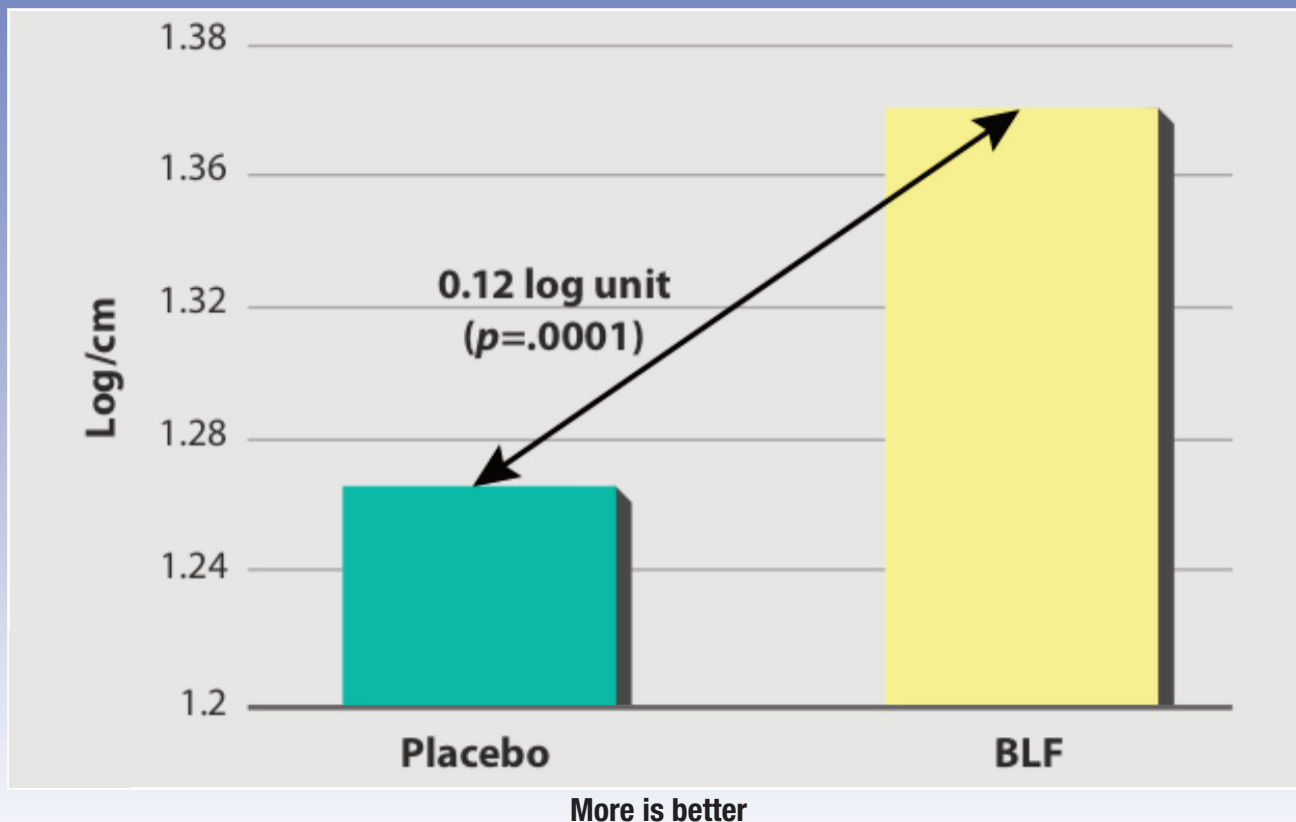
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Photostress recovery time



Less is better

Glare disability threshold



early in life while an individual is still fecund. Hence our interest in whether blue-absorbing filters, like the macular pigments, affect visual functions that would influence daily life. We recently analyzed the effect of added blue light filtration among pseudophakic eyes implanted with UV filtering IOLs.⁶ In this study, we measured visual performance as quantified by photostress recovery time and glare disability thresholds. Using a crossover design, 154 pseudophakes with best corrected visual acuity of 20/40 or better were randomized to be tested with an added blue-absorbing or placebo filter. All patients had to be at least 12 months past implantation with a UV filtering IOL. In our study, the addition of the blue-absorbing filter improved photostress recovery by 28%. Glare disability thresholds were improved by 8% (subjects could tolerate more light before losing sight of a central grating target) when subjects were wearing the blue light filtering clip-on glasses compared to the placebo glasses.

Improving vision under duress likely has many real world benefits.

For example, filtering blue light has been shown to reduce photostress by reducing the intensity of the exposure (and hence the amount of photopigment that is bleached and must be regenerated). So if one were driving 60 mph and was blinded for 10 seconds by oncoming headlights, that translates to about 880 feet. Improving recovery speed by 28% would mean that one was only blinded for about 7 seconds, which translates to about 634 feet (meaning you shaved off about 246 feet or two-thirds the length of a football field). To put this into perspective, only .35 seconds of additional breaking response time was a key rationale supporting the National Highway Traffic Safety Administration mandate that all cars incorporate a third break light.⁷

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by Warren E. Hill, MD

To understand the value of asphericity for an intraocular lens, we must first appreciate the fact that the human visual system is, in essence, a contrast sensitivity detection system. For most optical systems, image quality is measured by an ability to faithfully transmit contrast from the object being viewed to the image being formed, and maintaining contrast is a fundamental aspect of image quality. One need look no further than the image quality differences between television technology from 20 years ago and what is readily available today for the importance of maintaining contrast to become immediately apparent.

More than 60 years ago, a Dutch physicist named Fritz Zernike described a method for quantifying how image contrast may be influenced in the presence of different types of aberrations, referred to as the Zernike polynomials. The spherical and astigmatic corrections in a typical pair of glasses, referred to as defocus and regular astigmatism, are known as second order aberrations. A significant increase in any aberration results in a decrease in image contrast. When we describe something as being “in focus” what is actually meant is that it has high contrast at high spatial frequencies. In the visual world in which we live, maintaining contrast plays an important role and the presence of aberrations work against this.

For traditional spherical IOLs, the image quality degrades toward the optic’s periphery.¹ This is because the marginal rays are brought into focus in front of the central rays. It’s well known that the human cornea is also an imperfect lens and shares this property resulting in an elevated fourth order aberration known as positive

Aspheric profiles: What is the real impact?

spherical aberration. In the pseudophakic state, combining a traditional spherical IOL with the naturally occurring positive spherical aberration of the cornea will result in a significant increase in the total amount of spherical aberration. Above a certain level, this leads to an increasing loss of contrast with increasing pupil size. One of several important goals of cataract surgery should be to maintain image quality—said another way, to maintain contrast.

The crystalline lens in the youthful eye, without a cataract, has somewhere between $-0.138\ \mu\text{m}$ and $-0.24\ \mu\text{m}$ of negative spherical aberration, which means it typically has more power in the center than it does toward the periphery.²⁻⁵ The mean value for positive spherical aberration in the human cornea is about $0.274\ \mu\text{m}$.⁶ The net result is that, on average, a small amount of naturally occurring positive spherical aberration is commonly present for those at the peak of visual function in early adulthood. It is interesting to note that this amount is often symmetrical.⁷

The AcrySof difference

In the presence of a small pupil, the AcrySof IQ (Alcon, Fort Worth, Texas), Tecnis (Abbott Medical Optics, Abbott Park, Ill.), and any aberration neutral IOL, such as the SofPort AO (Bausch + Lomb, Bridgewater, N.J.), perform about the same in terms of contrast sensitivity. With a pupil size of 4 mm or larger, however, helping to neutralize the naturally occurring positive spherical aberration of the cornea begins to make a difference in terms of both image quality and visual performance as shown by contrast sensitivity testing.⁸⁻¹⁰

Beiko found that targeting a residual positive spherical aberration of $0.10\ \mu\text{m}$ following cataract surgery resulted in superior visual performance at a 6-mm pupil size.⁶ And Legras et al found that for a 6-mm pupil the optimal value for spherical aberration was not $0.0\ \mu\text{m}$ but actually $0.08\ \mu\text{m}$.¹¹ It’s this research that led Alcon to target a value for spherical aberration with the AcrySof IQ lens of about $0.10\ \mu\text{m}$ for the average pseudophakic eye.

The strategy behind the AcrySof IQ lens is to offset this naturally occurring

positive spherical aberration of the cornea with a slightly lower negative spherical aberration value such that the final residual amount of spherical aberration approximates that of the youthful eye.

Including an additional correction for any regular corneal astigmatism further increases contrast and improves visual quality. This is one reason why our AcrySof toric IOL patients with corneal astigmatism are often very happy with the quality of their vision. Here, three separate aberrations are being addressed: defocus, regular astigmatism, and spherical aberration.

The AcrySof IQ adds a physiologic amount of negative spherical aberration to help offset the naturally occurring amount of positive spherical aberration of the cornea. Such a strategy has been developed to maintain contrast and is less likely to result in an over correction. Maintaining contrast to maintain visual quality is the name of the game.

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by Lawrence Woodard, MD

My surgical goal: improved functional vision

Monofocal patients can be well served with the AcrySof IQ

According to the 2014 ASCRS Clinical Survey, while the average ASCRS member performs 490 cataract surgeries per year, 414 of these are monofocal implants. We owe it to these patients to give them excellent functional vision with a monofocal lens. I believe the AcrySof IQ (Alcon, Fort Worth, Texas) provides that.

For most patients, the amount of information available about their options can be a bit overwhelming. Some feel the monofocal option is a “bargain basement quality lens.” I dispel that myth as quickly as possible—one lens is not better than the other, it is just that these lenses do different things. So, for instance, if reading without glasses is not important to the patient, then I tell them a monofocal lens is by far the best lens because it delivers the best possible distance quality vision. We discuss blue light filters and how that affects vision, how asphericity affects vision, and how these two concepts together can provide the high quality functional vision today’s technology can deliver.

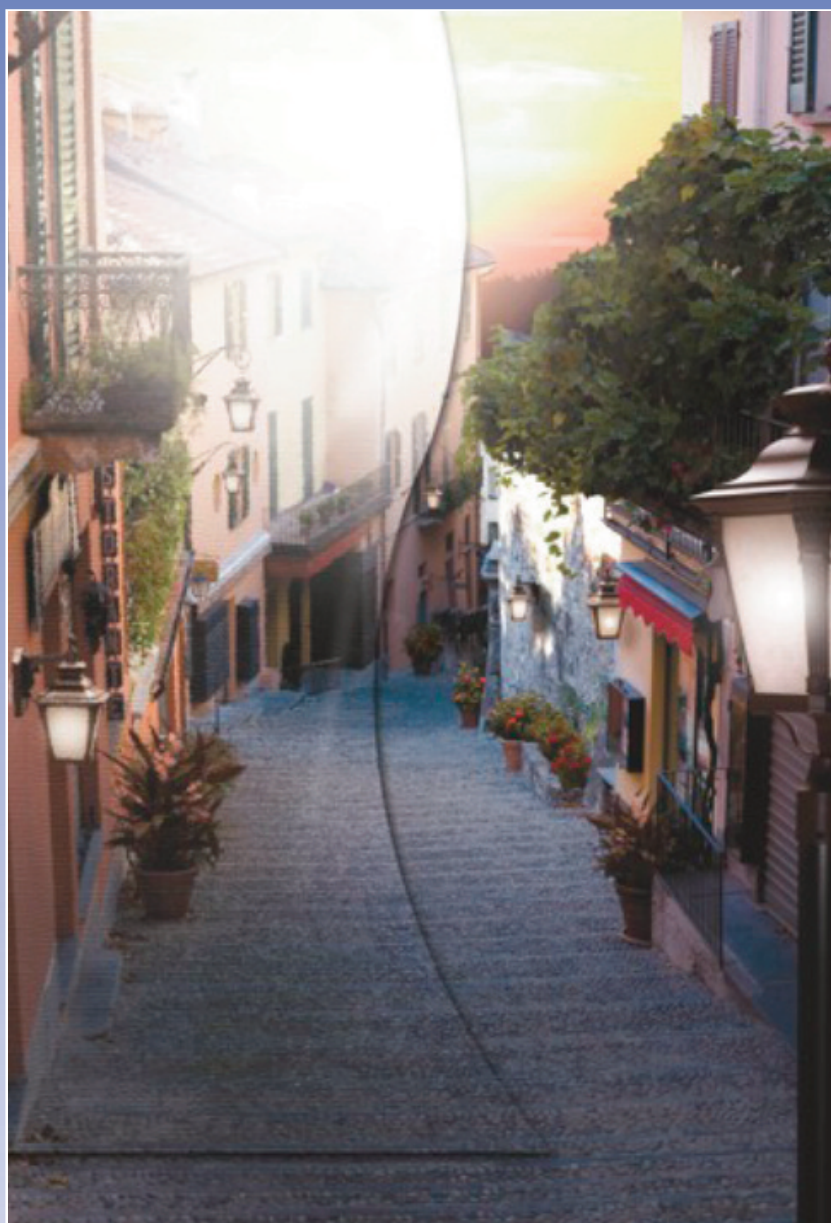
Spherical aberrations can reduce the image quality of a lens, especially in low-contrast situations. Positive spherical aberrations occur when light rays are over refracted at the periphery of a spherical IOL. An aspheric lens aligns the light rays to adjust for positive corneal spherical aberrations. The AcrySof IQ, however, features negative spherical aberration to compensate for the positive aberration of an average cornea. When I discuss this with patients, they immediately “get” how this type of technology improves contrast sensitivity and that the IOL has been designed to replicate the youthful human crystalline lens.

Blue light filtering

I only use the aspheric blue light filtering AcrySof IQ platform lenses. The biggest benefit I see for my patients with these lenses is how they perform in low light conditions, as well as how improved the overall contrast sensitivity is. Once patients grasp the concept that the lens itself does not have a yellow tint but a chromophore that does not affect color perception, they “get it.”

At least half my cataract patients complain about glare and inability to see in low light conditions. Cataract surgery has significantly changed. Today’s patients are not waiting until their vision is extremely poor to correct their cataracts. Today’s cataract patients are coming in early for options to improve their functional vision.

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AcrySof IQ IOLs can help reduce the impact of glare disability.

A persuasive study found the AcrySof IQ produced significantly greater reduction in glare and increased the ability of drivers to execute turns more safely in low light conditions.¹ Simulator studies have also shown patients are able to recognize targets faster with an aspheric IOL compared to a standard or spherical IOL.² Being able to recognize objects better under photostress conditions (such as a significant amount of glare or a setting sun) is also improved with the AcrySof IQ.³

That makes a big difference to patients—even when the patient is only interested in a monofocal lens, glare and imperfect lighting conditions are common complaints this lens can improve.

Benefits of longevity

I personally have years of experience implanting this particular lens, and that also eases patient concerns. I can point to studies that confirm how well tolerated the lens is and how long it's been commercialized in the U.S., and they find great comfort in that.

From a surgical standpoint, this lens is incredibly stable in the eye, and most surgeons are familiar with the platform.

I am happy to provide my monofocal cataract patients with an option that is anything but “bargain basement.” The benefits of this lens have consistently been greatly appreciated by my patients—and knowing I can give them back their driving confidence in lower lighting situations is yet another bonus.

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Important product information

AcrySof IQ Intraocular Lenses

Caution: Federal (USA) law restricts this device to the sale by or on the order of a physician.

Indications: The AcrySof IQ posterior chamber intraocular lens is intended for the replacement of the human lens to achieve visual correction of aphakia in adult patients following cataract surgery. This lens is intended for placement in the capsular bag.

Warning/precaution: Careful preoperative evaluation and sound clinical judgment should be used by the surgeon to decide the risk/benefit ratio before implanting a lens in a patient with any of the conditions described in the Directions for Use labeling. Caution should be used prior to lens encapsulation to avoid lens decentrations or dislocations.

Studies have shown that color vision discrimination is not adversely affected in individuals with the AcrySof Natural IOL and normal color vision. The effect on vision of the AcrySof Natural IOL in subjects with hereditary color vision defects and acquired color vision defects secondary to ocular disease (e.g., glaucoma, diabetic retinopathy, chronic uveitis, and other retinal or optic nerve diseases) has not been studied. Do not resterilize; do not store over 45 degrees C; use only sterile irrigating solutions such as BSS or BSS PLUS Sterile Intraocular Irrigating Solutions.

Attention: Reference the Directions for Use labeling for a complete listing of indications, warnings, and precautions.

AcrySof IQ Toric Intraocular Lenses

Caution: Federal (USA) law restricts this device to the sale by or on the order of a physician.

Indications: The AcrySof IQ Toric posterior chamber intraocular lenses are intended for primary implantation in the capsular bag of the eye for visual correction of aphakia and pre-existing corneal astigmatism secondary to removal of a cataractous lens in adult patients with or without presbyopia, who desire improved uncorrected distance vision, reduction of residual refractive cylinder, and increased spectacle independence for distance vision.

Warning/precaution: Careful preoperative evaluation and sound clinical judgment should be used by the surgeon to decide the risk/benefit ratio before implanting a lens in a patient with any of the conditions described in the Directions for Use labeling. Toric IOLs should not be implanted if the posterior capsule is ruptured, if the zonules are damaged, or if a primary posterior capsulotomy is planned. Rotation can reduce astigmatic correction; if necessary lens repositioning should occur as early as possible prior to lens encapsulation. All

viscoelastics should be removed from both the anterior and posterior sides of the lens; residual viscoelastics may allow the lens to rotate.

Optical theory suggests that high astigmatic patients (i.e. >2.5 D) may experience spatial distortions. Possible toric IOL related factors may include residual cylindrical error or axis misalignments. Prior to surgery, physicians should provide prospective patients with a copy of the Patient Information Brochure available from Alcon for this product informing them of possible risks and benefits associated with the AcrySof IQ Toric Cylinder Power IOLs. Studies have shown that color vision discrimination is not adversely affected in individuals with the AcrySof Natural IOL and normal color vision. The effect on vision of the AcrySof Natural IOL in subjects with hereditary color vision defects and acquired color vision defects secondary to ocular disease (e.g., glaucoma, diabetic retinopathy, chronic uveitis, and other retinal or optic nerve diseases) has not been studied. Do not resterilize; do not store over 45 degrees C; use only sterile irrigating solutions such as BSS or BSS PLUS Sterile Intraocular Irrigating Solutions.

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