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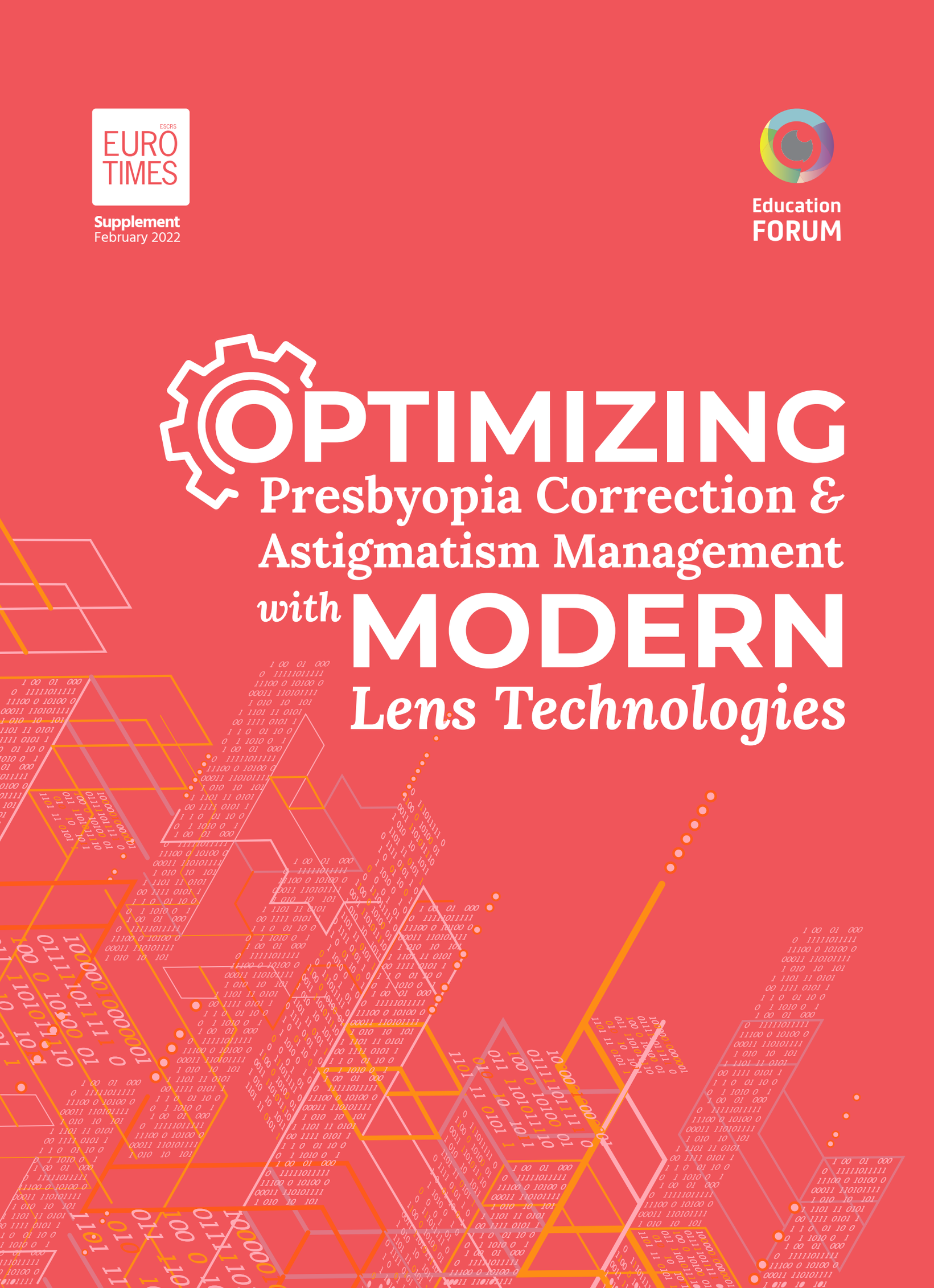
Education FORUM

# OPTIMIZING Presbyopia Correction & Astigmatism Management *with* MODERN *Lens Technologies*



# Trends in Refractive Cataract Surgery

*Annual survey reveals baseline trends and shifts in refractive cataract surgery.*
Rudy M.M.A.Nuijts, MD, PhD

According to the 2020 ESCRS Clinical Trends Survey, since 2016, there has been a 6% increase in implantation of toric intraocular lenses (IOLs) during cataract surgery, whereas implantation of presbyopia-correcting IOLs has remained stable during that time period (Figure 1).

The survey also indicated that there is increased interest in extended depth of focus IOLs, at the expense of trifocal and bifocal IOLs (Figure 2).

When respondents were asked about their most current procedure to manage astigmatism in a patient receiving monofocal IOLs during cataract surgery, 80.8% used a toric IOL in patients with 2.50 D of astigmatism; in patients with 1.75 D of astigmatism, 66% used a toric IOL; and in patients with 1.25 D of astigmatism 46% used a toric IOL, which is basically the threshold.

> ***"The ESCRS survey indicated that there is increased interest in extended depth of focus IOLs..."***
> ***— Rudy M.M.A.Nuijts, MD, PhD***

55% believe 0 to 5 degrees of rotational error is acceptable, however, 45% believe 5 degrees or greater is acceptable. I believe that depends on the IOL power or toricity.

In this supplement, we feature the insights of several experts who will detail best practices for optimizing presbyopia correction and astigmatism management with advanced technology IOLs.

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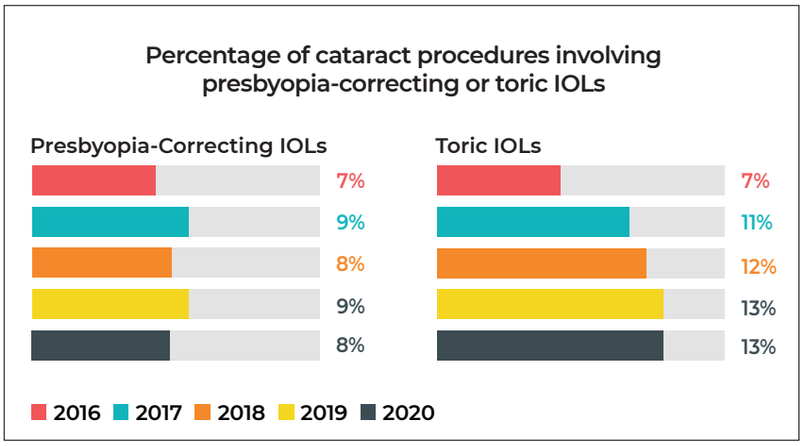


Figure 1. The 2020 ESCRS Clinical Trends Survey shows that, during the last 5 years, use of presbyopia-correcting IOLs has remained stable while implantation of toric IOLs has increased.

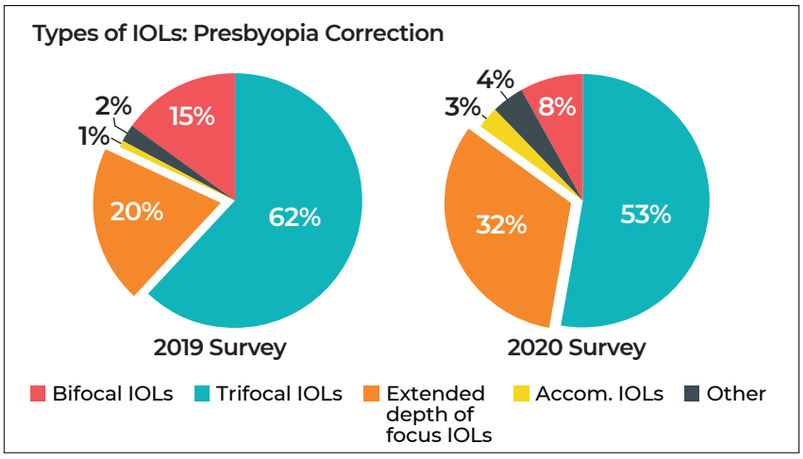


Figure 2. Comparison of 2019 and 2020 ESCRS Clinical Trends Survey results show an increased interest in extended depth of focus IOLs.

***Dr. Nuijts is a consultant/advisor for and receives lecture fees and grant support from Alcon Laboratories, Inc.; he receives grant support from Carl Zeiss Meditec and Johnson & Johnson; and he receives lecture fees from OPHTEC.***

# Enhanced Monofocals: Matching New Presbyopia Patients to New Lenses

*New lenses decrease dysphotopsia rates.*
Gerd U. Auffarth, MD, PhD, FEBO

Despite advances in presbyopia-correcting intraocular lenses (PC-IOLs), the 2020 ESCRS Clinical Trends Survey showed that respondents' top vision-related concerns leading them to avoid PC-IOLs are worries regarding loss of contrast visual acuity (39%) and nighttime quality of vision (52%) (Figure 3).

Multifocal IOLs are associated with the most dysphotopsia and extended depth of focus (EDOF) IOLs the least. However, typical complaints are glare, flare, halos, and starbursts.

Diffractive EDOF IOLs may offer better night vision compared with multifocal IOLs.[1] They do not completely eliminate halos, but they are significantly decreased, especially compared with bifocal IOLs.

We need to achieve a balance. If we reduce aberrations, it maximizes vision quality. However, if we increase multifocality or depth of focus, it decreases vision quality and increases night vision symptoms.

> ***"We need to understand our patients' needs and willingness to compromise."***
> ***- Gerd U. Auffarth, MD, PhD, FEBO***

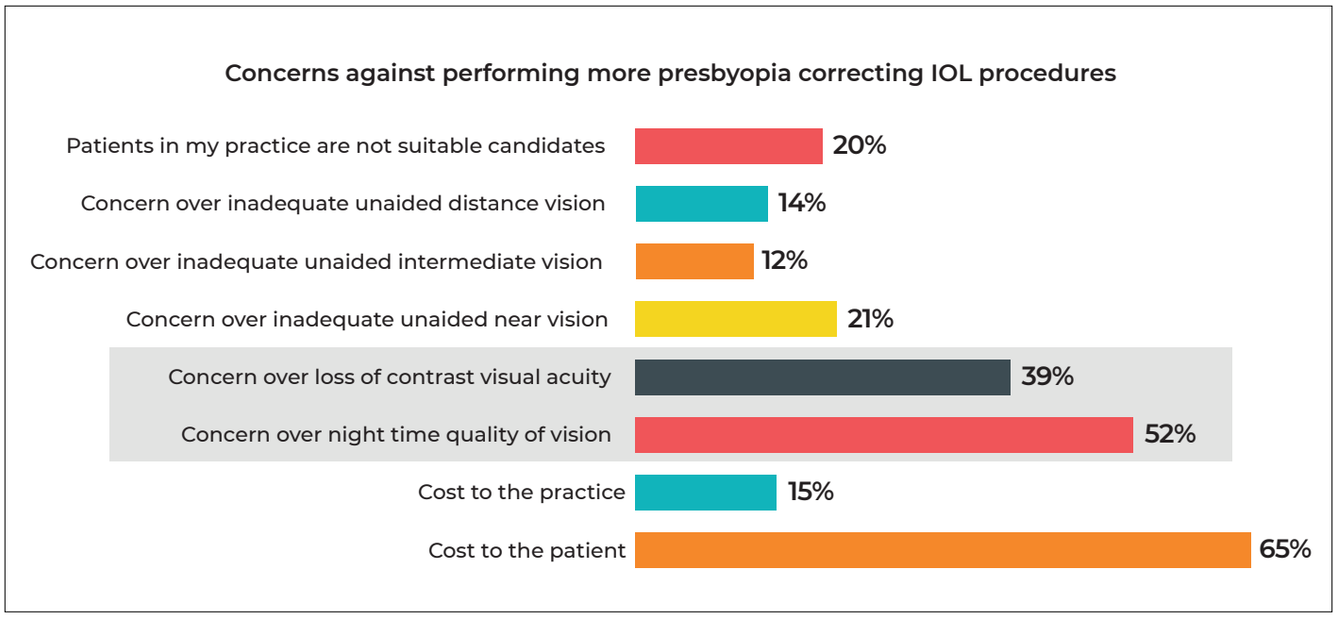


Figure 3. ESCRS 2020 Clinical Trends Survey indicates respondents' top two vision-related concerns regarding PC-IOLs are loss of contrast visual acuity and nighttime quality of vision.

## ENHANCED MONOFOCAL IOLs

Most patients choose monofocal IOLs, which provide high-quality uncorrected distance visual acuity and minimal photic phenomena, but the majority require reading glasses.

Enhanced monofocal IOLs are designed to provide the same vision quality for uncorrected distance acuity with the low dysphotopsia profile of monofocal IOLs. They also are created to slightly improve the depth of focus, increasing intermediate vision. We increase spectacle independence when we achieve these goals.

The ESCRS Clinical Trends Survey showed that patients receiving PC-IOLs are least satisfied with the intermediate performance of their IOLs (Figure 4).

Enhanced monofocal IOLs are progressive in power.[2]

The Tecnis Eyhance (J&J Vision) increased uncorrected intermediate vision by at least one line and extended the defocus curve.[3] There was very little difference in halos, glare, or starbursts compared with the Tecnis monofocal.

The ISOPURE (BVI Medical), which has a polynomial complex surface design, has very good image quality and extends the depth of focus similarly to the Eyhance.

Enhanced monofocals may be useful in active patients with a high demand for distance and intermediate vision who desire some spectacle independence.

## EXTENDED RANGE OF VISION

Extended range of vision (ERV) IOLs function like enhanced monofocal IOLs with more near vision. The Vivity IOL (Alcon) creates a continuous extended focal range, providing good intermediate and distance acuity and satisfactory near vision.[4] We can also use mini-monovision to extend the range of vision. We can reduce dysphotopsia in a diffractive technology if we mix and match lenses.

The Finevision Triumf, designed to improve intermediate vision, reduces longitudinal chromatic aberration, which increases quality of vision, resulting in better mesopic vision or less halo and glare.

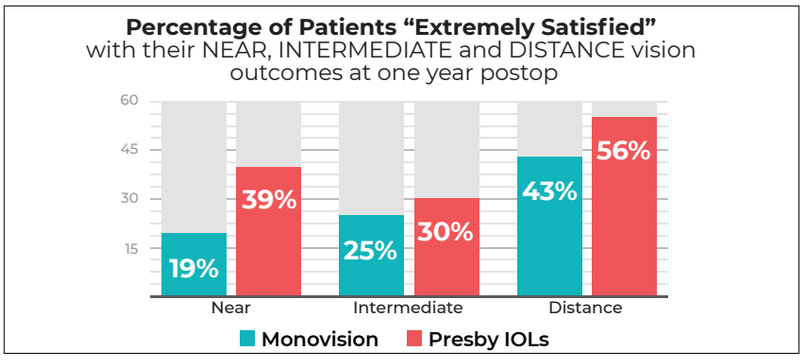


Figure 4. According to the 2020 ESCRS Clinical Trends Survey, patients receiving PC-IOLs are least satisfied with intermediate vision.

## CONCLUSION

Enhanced or monofocal plus IOLs use different optical features to enhance depth of field and substantially reduce dysphotopsia. We need to understand our patients' needs and willingness to compromise.

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# EDOF, ERV, and Multifocal IOLs: Customizing IOL Selection for the Patient's Individual Needs

*Surgeons need to balance benefits, compromises, and variables in lens selection.*
Francesco Carones, MD

With advances in presbyopia-correcting intraocular lens (PC-IOL) technologies, we have many lenses to choose from, but we need to consider the benefits, compromises, and other variables in customizing lens selections to each patient's desires and needs.

Diffractive intraocular lenses (IOLs) have surface discontinuities and split light, whereas nondiffractive IOLs have surface curvature changes to bend light. Increased range of focus (IROF) IOLs include enhanced monofocal IOLs, which provide partial range of vision—distance to intermediate, plus variable useful near vision. They require fewer compromises concerning dysphotopsia and may be diffractive and nondiffractive. Full range of focus (FROF) IOLs provide vision from distance to near, including intermediate, but there are more compromises because of dysphotopsia. All are diffractive IOLs.

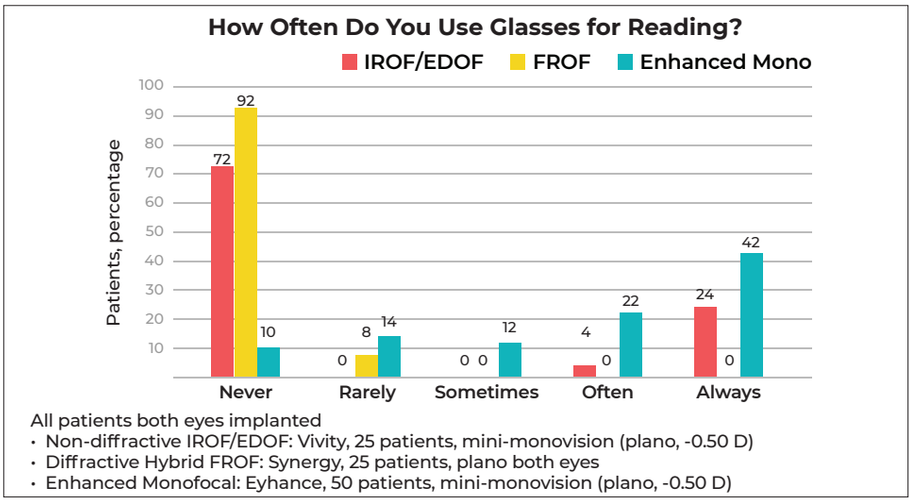


Figure 5. Spectacle comparative differences for how often patient use reading glasses. Source: Francesco Carones, MD

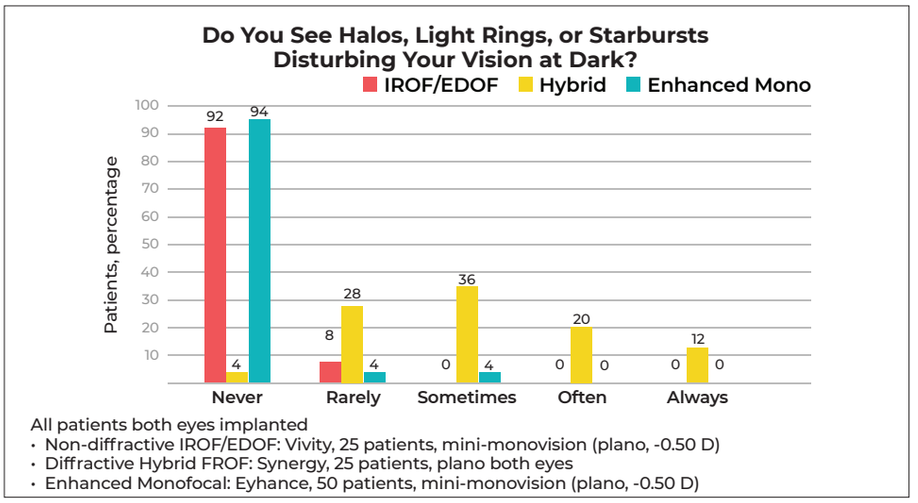


Figure 6. Dysphotopsia profile comparative results. Source: Francesco Carones, MD

## ADDRESSING PATIENTS' NEEDS

Patients have different motivations, expectations, and preferences influencing IOL selection.

In customizing lens selection, we need to consider three factors—the range of vision they provide, dysphotopsia-associated phenomena, and the cost.

We need to balance other considerations: Reduced spectacle dependence is the benefit, reduced quality of vision and additional costs are compromises, and clinical contraindications are uncontrollable variables.

Patients are influenced by the perception they have about the value. From a financial point of view, the value is the benefits over the costs. In our specialty, the value is spectacle independence over the compromises.

We conducted a study of our database of patients to understand some of these variables. FROF IOLs provided greater spectacle independence, but IROF or extended depth of focus (EDOF) IOLs also can perform quite well (Figure 5). This is the benefit of this type of technology

However, the lenses that performed best in terms of spectacle independence delivered less quality of vision in terms of nighttime dysphotopsia (Figure 6).

## DECISION TREE

I implant monofocal IOLs in patients who have no interest in spectacle independence, severe comorbidities, or budgetary concerns. I use enhanced monofocal IOLs in patients with limited interest in spectacle independence, budgetary constraints, and comorbidities. I use IROF/EDOF IOLs in patients with a high interest in spectacle independence, mild comorbidities, and in whom night dysphotopsia would be a major problem. The best candidates for FROF IOLs are patients with a high interest in spectacle independence and no comorbidities and in whom night dysphotopsia may not be a problem.

In the decision tree I built, we consider each patient as a candidate for a FROF IOL, and we downgrade based on variables. With severe clinical contraindications we cannot implant a FROF IOL. We may use a monofocal or enhanced monofocal IOL, if suitable. If contraindications are very mild, we may consider a non-diffractive IROF IOL.

In patients with no contraindications, the second step in my decision tree considers dysphotopsia. If they have no concerns regarding dysphotopsia, they are good candidates for the FROF IOL. If there is some concern of dysphotopsia, we use an IROF. If quality of nighttime vision is a major concern, we do not go beyond the enhanced monofocal.

> ***"All patients deserve a personalized solution to achieve their postoperative goals."***
> ***— Francesco Carones, MD***

Finally, if patients have budget limitations, we cannot advise them to have a high-cost lens such as an FROF or IROF IOL; we downgrade according to the patients' willingness to spend slightly more for the benefit they want.

## CONCLUSION

There is always a suitable solution, but no single IOL fits all situations and cases. All patients deserve a personalized solution to achieve their postoperative goals. We need to consider four main criteria: spectacle independence as a benefit, vision quality and additional cost as compromises, and comorbidities as an uncontrollable variable.

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# Refractive Lens Exchange in Pre-Cataract Presbyopes

*More patients are seeking this procedure to reduce their spectacle dependence.*
*Thomas Kohnen, MD, PhD, FEBO*

With advances in presbyopia-correcting intraocular lenses (IOLs), we are likely to see patients seeking refractive lens exchange before they have cataracts to reduce their dependence on glasses.

The challenge is, when we perform refractive lens exchange (RLE) in pre-cataract presbyopic patients, they have good preoperative distance visual acuity with or without glasses, no or minimal changes in the lens, so we need to consider the optical quality of vision with an IOL versus the natural lens.

> *"With increasing use of digital devices, patients desire good near and intermediate vision." — Thomas Kohnen, MD, PhD, FEBO*

Patients with high myopia are likely to be interested in RLE to reduce the use of glasses or contact lenses. My limit is usually 50-year-old patients. I tend to use a phakic IOL in younger patients. However, there is an increased risk of retinal detachment with RLE in patients with myopia, particularly when surgical complications like posterior capsular rupture occur.[1,2]

Patients with high hyperopia who are 45 and older also pursue RLE. We also know that the lens grows over time.[3] In patients with hyperopia, the anterior chamber becomes shallower. That is a good indication to perform RLE. Some patients who have had LASIK for high hyperopia have had poor results (Figure 7).

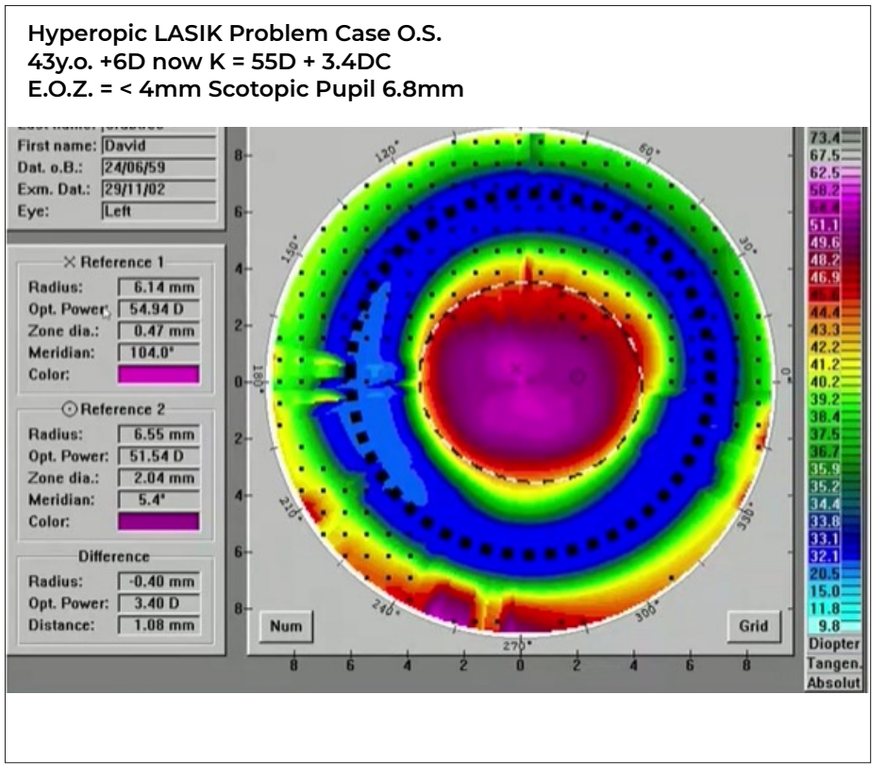


Figure 7. Patient who had hyperopic LASIK for high hyperopia with a small optical zone causing night visual symptoms. Source: Thomas Kohnen, MD, PhD, FEBO

## PRE-CATARACT PATIENTS

Patients are working longer and have more challenging hobbies. With increasing use of digital devices, patients desire good near and intermediate vision.

The ESCRS developed a statement focusing on intermediate vision.[4] Indications for cataract surgery are not based only on visual acuity; the patient's quality of life and visual performance should be considered, and the functionality of the eye should be preserved.

Ideal candidates for trifocal IOLs have no corneal pathology; no severe corneal irregularities on corneal tomography and a bland optical coherence tomography (OCT); and no macular pathology on OCT. Patients also have a high demand for vision at all distances, seeking spectacle independence. Contraindications for trifocal IOLs also include central corneal scars, dry eyes, pseudoexfoliation, glaucoma, and retinal disease.

The ideal patient for extended depth of focus (EDOF) lenses has a healthy eye and higher visual requirements. Most need low add reading glasses, but they are more forgiving in the outcome.

## WEIGHING LENS OPTIONS

When choosing IOLs for RLE, comorbidities such as regular/irregular astigmatism, corneal diseases, decentered optical zone, and post-LASIK higher-order aberrations all must be considered.

We also must weigh patients' expectations and consider the advantages and disadvantages of available IOL technologies.

We have found that patient satisfaction is high with presbyopia-correcting IOLs. Patients can achieve spectacle independence, but some have optical phenomena, particularly with the trifocal IOL (Figure 8). With the EDOF IOLs, especially the non-diffractive IOLs, they have less optical phenomena but often need reading glasses. Mini-monovision may help here. There is not a single best lens. We need to consider patient preferences in choosing the IOL.

**Trifocal**
- clear cornea
- regular astigmatism
- healthy fundus
- wish for glasses independence
- optical phenomena

**EDOF**
- clear cornea
- regular astigmatism
- healthy fundus
- wish for glasses independence
- **less** optical phenomena (nondiffractive)
- reading glasses needed

Figure 8. Guide to lens choices. Source: Thomas Kohnen, MD, PhD, FEBO.

We are scientifically evaluating methods of measuring visual disturbances.[5]
In addition, a new device (Vivior Monitor) is available in selected markets to determine a patient's individual needs to find out which IOL we would choose for RLE.[6]

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# Best Practices for Preoperative Measurements

*Detailed measurements are necessary to optimize outcomes.*
Filomena Ribeiro, MD, PhD, FEBO

Cataract surgery has become refractive surgery. With the many intraocular lens (IOL) options available, there is always a solution to achieve the best functional vision for our patients.

## PATIENT ASSESSMENT

We need to engage patients in the process of IOL selection, determining their motivations and understanding their personalities. Patients desiring spectacle independence should have a positive perspective and understand compromise.[1] In addition, they must not be totally dependent on night or distance vision.

We also need to set realistic expectations regarding postoperative outcomes.

The patient's refractive history and spectacle dependence are also relevant. For example, a patient with hyperopia who is dependent on progressive glasses and a patient with myopia who does not usually wear near correction are used to near magnification that cannot be achieved with PC-IOLs.

## PERFORMING MEASUREMENTS

We need to diagnose abnormalities that may compromise contrast sensitivity and cause more light dispersion and dysphotopsia, assessing the ocular surface, pupillary issues, and zonulopathy and performing specular biomicroscopy and optical coherence tomography.

We perform several corneal measurements with more than one instrument, selecting high-quality images. We look for discontinuity of Placido rings that may indicate dry eye and necessitate repeated measurements. Untreated dry eye can compromise our corneal measurements and postoperative outcomes.[2]

I always look to the Fourier analysis map and corneal power distribution, which differentiates regular and irregular astigmatism and determines the distribution of astigmatism (Figure 9).

> ***"Cataract surgery has become refractive surgery."***
> ***— Filomena Ribeiro, MD, PhD, FEBO***

Small amounts of postoperative residual astigmatism impact visual acuity and patient satisfaction.[3] When residual astigmatism exceeds 0.5 D, it significantly impacts postoperative outcomes.

We need to assess astigmatism accurately. The principal source of error is the posterior surface of the cornea, so we need to optimize K values when considering only anterior corneal measurements. We

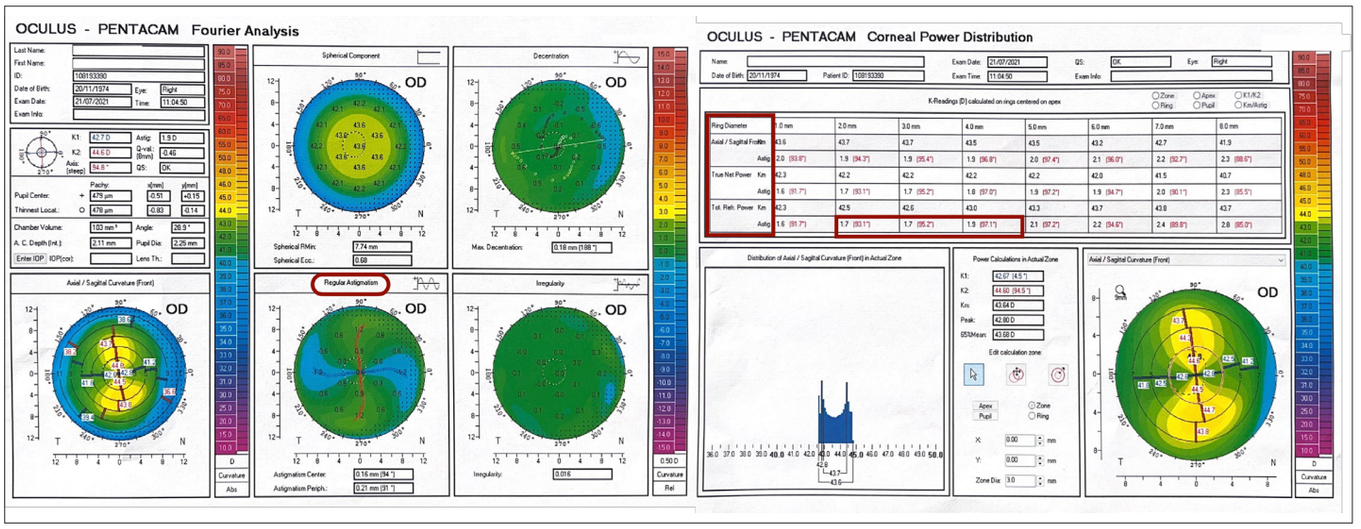


Figure 9. Fourier analysis of the shape of the cornea is broken down into spherical, astigmatism, and its remaining irregular components. The regular astigmatic component shows the difference in axis orientation between the center and the periphery. The information provided on the power distribution also gives an overview of the homogeneity of refractive power over the entire cornea and the difference between considering only the anterior surface or the total corneal power. In this way, these two maps provide cataract surgeons with vital information in planning an IOL implantation. Source: Filomena Ribeiro, MD, PhD, FEBO

have nomograms to correct for total astigmatism of the cornea and can use real values. It appears that the estimate is better than real measurements (Figure 9).[4,5]

Calculations based on predicted total corneal astigmatism (TCA) have been shown to be more accurate with respect to those based on measured TCA. On average, the prediction is good, but we have a large fluctuation in results; only 50 to 78% have a prediction error of the refractive astigmatism within 0.50 D. In our study evaluating differences between high and low levels of astigmatism, in patients with high astigmatism (≥ 1.0 D), if the posterior surface is not considered, there will be a difference of 0.5 D or more in 11% of patients; in patients with low levels of astigmatism (<1.0 D), 40% have a change in axis (Figure 10).[6]

**Difference in Magnitude Between Anterior and Total Corneal Astigmatism**

| | Mean; SD | Maximum value |
|---|---|---|
| WTR | 0.20 ± 0.16 | (MAX 1.19) |
| ATR | 0.27 ± 0.19 | (MAX 0.92) |
| Oblique | 0.19 ± 0.16 | (MAX 1.04) |

D=diopters, WTR=with-the-rule, ATR=against-the-rule

Figure 10. Dr. Ribeiro's group found a difference in magnitude between anterior and total corneal astigmatism in average superior against-the-rule (ATR) astigmatism. For with-the-rule (WTR) and oblique astigmatism, the difference can be more than 1.00 D. Source: Filomena Ribeiro, MD, PhD, FEBO

Different calculators allow us to determine the astigmatism. For example, Barrett calculator allows input of anterior corneal measurements, total cornea measurements, and recently, True K values with the IOL Master 700. In addition, we need to address lens tilt to prevent more induced against-the-rule astigmatism. The Panacea calculator is the only calculator that allows us to include this information.

## CONCLUSION

We need strong patient selection criteria and must assess patients for ocular abnormalities. It is necessary to validate measurements with more than one instrument and always make a spherical and torical IOL calculation to use toric IOLs in patients with clinically significant corneal astigmatism.

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# Everything Is Perfect, But...

*Careful preoperative and postoperative management are essential in achieving patient satisfaction.*
Oliver Findl, MD, MBA, FEBO

Even when we have otherwise "perfect" patients for a presbyopia-correcting intraocular lens (PC-IOL), they may not be satisfied after surgery.

## RESIDUAL ERROR

Residual ametropia and astigmatism are the main reasons for dissatisfaction after implantation of a PC-IOL.[1]

Almost 70% of respondents to the 2020 ESCRS Clinical Survey considered between 0.5 D and 1.0 D the threshold for visually significant postoperative residual cylinder with a PC-IOL (Figure 11).

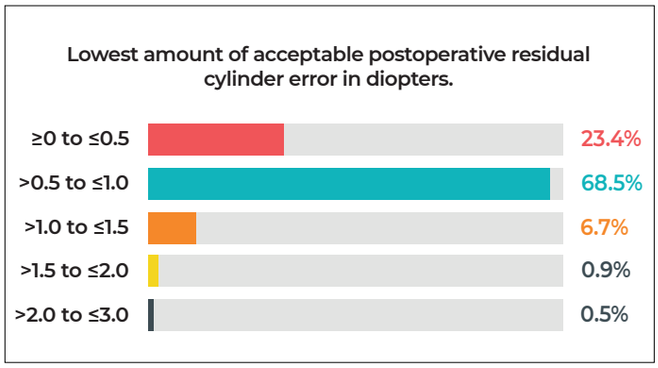


Figure 11. In the 2020 ESCRS Clinical Survey, most respondents considered residual cylinder of > 0.5 to ≤ 1.0 D visually significant after implantation of a PC-IOL.

We can manage residual refractive error with a piggyback IOL, but two lenses may cause more glare. IOL exchange may induce astigmatism because we need a slightly larger incision to explant the lens. Excimer laser is the most accurate, but dry eye may be a problem and all surgeons do not have access to a laser.[2]

In a study of 34,891 eyes, with most having PC-IOLs, dissatisfaction increased significantly, and visual acuity decreased with greater astigmatism.[3]

Extended depth of focus (EDOF) IOLs may be more tolerant of residual refractive error. Cochener 2017 found that residual cylinder as high as 0.75 D after implantation of an EDOF lens had a mild impact on visual acuity.[4]

> ***"Extended depth of focus (EDOF) IOLs may be more tolerant of residual refractive error."***
> ***— Oliver Findl, MD, MBA, FEBO***

## MANAGING OSD PREOPERATIVELY

If we do not diagnose and treat ocular surface disease (OSD) before surgery, it can cause errors in preoperative measurements and worsen visual outcomes.[5]

If treatments significantly improve OSD, with no corneal staining and better tear breakup time and corneal topography regularity, we can proceed with PC-IOLs. If we only have partial improvement, we should probably use an enhanced monofocal IOL or nondiffractive EDOF lens because they may be more forgiving.

## LENS CHOICES

In choosing PC-IOLs for patients with glaucoma, we need to consider disease severity. Patients with only ocular hypertension or very mild glaucoma, a well-controlled intraocular pressure, and full visual fields with no defects may be considered by some surgeons to be suitable candidates for PC-IOLs, but we should avoid diffractive IOLs. I would not use PC-IOLs in patients with visual field deficits, which would result in greater loss of contrast sensitivity. I am hesitant to use PC-IOLs in patients with glaucoma.

I do not use PC-IOLs in patients with age-related macular degeneration.

If patients have corneal pathology such as pterygium, epithelial basement membrane dystrophy, or Salzmann's nodules (Figure 12) that can be treated, theoretically we can create a relatively good surface. We should assess whether the surface is regular and if we can use an EDOF IOL. In some patients without full regularity, I would use an enhanced monofocal or possibly a small-aperture IOL. In patients with a non-treatable pathology, such as keratoconus or post-refractive ectasia, I would not use these lenses.

In some cases, we cannot identify why patients are unhappy. Some of these patients will have fewer symptoms as neuroadaptation occurs.

## CONCLUSION

If we miss the refractive target, it must be addressed postoperatively. In patients with night vision issues, we should wait until neuroadaptation takes place or exchange the lens if necessary.

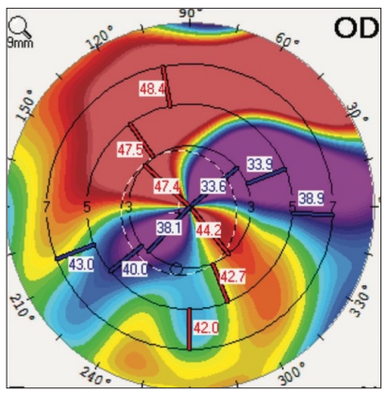


Figure 12. Salzmann's nodules. Source: Oliver Findl, MD, MBA, FEBO.

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