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Innovation in Multifocal IOLs

The experts' standpoint on a new trifocal diffractive lens.

FineVision Multifocal IOL

PhysIOL (Liége, Belgium) recently introduced the FineVision Micro F IOL (Figure 1), a multifocal IOL that combines two diffractive structures, one with a 3.50 D addition for near vision and one with a 1.75 D addition for intermediate vision. The result of this trifocal lens design, developed in cooperation with Damien Gatinel, MD, of Paris, is a significant improvement in intermediate vision while maintaining the far and near visual performance associated with multifocal IOLs. It is compatible with microincision cataract surgery, fitting through a 1.8- to 2.2-mm incision.

This new lens design of the FineVision Micro F boasts other advantages over other multifocal lenses with diffractive designs, including a reduction in the loss of light energy that results from any diffractive system. Such energy gain significantly improves intermediate vision performance without negatively affecting vision performance at far and near. Additionally, the lens' four-point haptic design minimizes decentration; increases the surface of contact; and allows absorption of the capsular contraction forces, preventing transmission to the optic.

The height of the diffractive steps are varied so that the amount of light distributed to the near, intermediate, and distance foci is adjusted according to the pupil aperture. Only a low amount of light is allocated to the near and intermediate foci in mesopic conditions, greatly reducing the incidence of ghost images and halos, and a larger amount of light is allocated for vision at the near and intermediate distances in photopic conditions, thus providing better conditions for precision work. This also enhances the accommodative reflex of pupillary contraction.

Figure 1. The FineVision Micro F.

The preliminary results achieved with the FineVision Micro F IOL include satisfactory visual acuity at all distances as well as an extended range of vision. At 2 months, the average monocular visual acuity using the visual acuity highest values for 50 eyes was J1 for near vision, J2 for intermediate vision, and 0.93 for far vision.

Five surgeons gathered during the ESCRS meeting in Paris to discuss their initial results with the FineVision Micro F. Below is their discussion.

MODERATOR:

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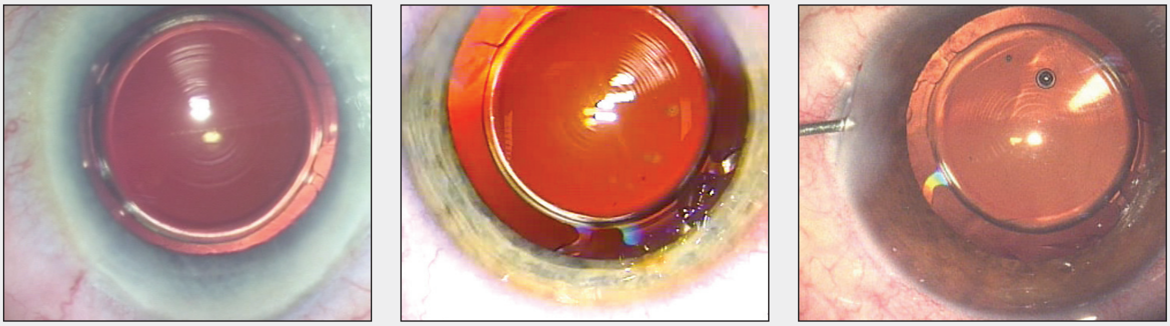
FineVision Micro F IOL Specs



Material: 25% hydrophilic acrylic
Overall diameter: 10.75 mm
Optic diameter: 6.15 mm
Optic: FineVision aspheric trifocal diffractive
Filtration: UV and blue light
Angulation: 5º
Injection system: Single-use MicroSet injector
Incision size: ≥1.8 mm
Power range: 10.00 to 30.00 D in 0.50 D steps

Rozot: We have gathered together in Paris to discuss our preliminary results with the FineVision Micro F IOL from PhysIOL (Liége, Belgium; Figure 1). This new diffractive multifocal lens combines two diffractive optics that work together to provide a significant improvement in intermediate vision and maintain far and near visual performance (Figure 2). This IOL represents the first trifocal diffractive optic available to surgeons.

In terms of background information, historically in the 1990s, multifocal IOLs with refractive designs were popular. However, in the beginning of 2000, many surgeons switched to diffractive multifocal designs. Both refractive and diffractive multifocal IOL designs are still used today, providing multiple approaches to presbyopic correction. For the purposes of this roundtable discussion, we will speak exclusively about diffractive IOL designs and most specifically about the FineVision Micro F. Professor Cochener, what is your overall experience with diffractive lenses?

Cochener: In my hands, as well as in the hands of many other ophthalmologists around the world, diffractive lenses appear to be the best choice for preservation of both far vision and very good near vision. However, diffractive lens designs also have some limitations in terms of results with intermediate vision. Since using the new FineVision IOL, I have noticed an increase in the visual results in my patients for intermediate vision, but this IOL also preserves the great performance at far and near vision that is associated with diffractive lens designs.

I think this lens design establishes a new term for multifocal IOLs, and that is the *trifocal lens*. All other available diffractive design are more like bifocal lenses, with one focus for far vision and one focus for near vision. This lens is different because it has three foci—one for far, one for near, and one for intermediate. With this additional focus, we can expect to improve patients' vision at every distance.

To date, I have implanted 17 patients with the FineVision Micro F. I would like to admit that, in terms of near and far vision, results are the same we have had with other multifocal diffractive models available on the market. I am speaking with no financial interest, but compared with the Restor (Alcon Laboratories, Inc., Fort Worth, Texas) and the Tecnis Multifocal (Abbott Medical Optics Inc., Santa Ana, California), the results with the FineVision lens are more attractive and more convincing for intermediate vision. In these 17 patients, the mean visual acuity for far vision is 20/25 and J2 for near vision; at the same time, the intermediate vision is very good.

I can also provide a comment on patient comfort: With this lens, patients have greatly improved computer vision, which was previously a limitation with other diffractive models.

David: Yes, you are right about patient comfort and intermediate vision. My experience is exactly the same, and I am very impressed with my patients' results in terms of intermediate vision. Using the other multifocal lenses that Professor Cochener mentioned, some of our patients still needed glasses for intermediate vision, especially for computer work. But with this trifocal lens, the FineVision Micro F, none of my patients have complained

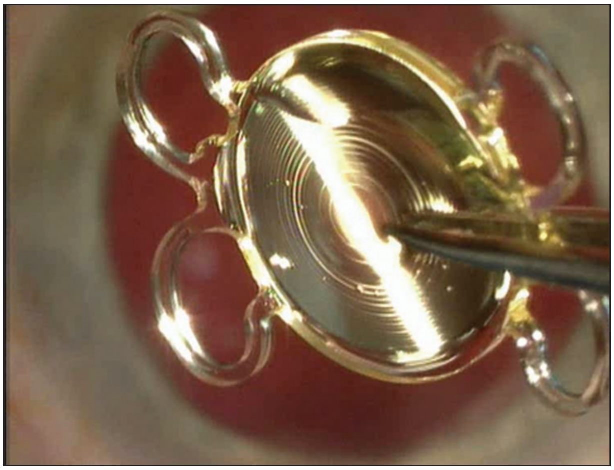


Figure 1. The FineVision Micro F is the first available IOL with a trifocal diffractive optic.

about any kind of trouble reading a computer or other print objects at 50 or 60 cm.

I think the concept of this lens was attractive on paper from the beginning, and now that I have experience with it personally, I know for sure that it is an excellent design. We should all be saying “thank you” to PhysIOL and to Dr. Gatinel for designing the FineVision Micro F.

In the eyes of my patients, simply put, it works. We have exactly the same far vision and the same good near vision that is achieved with other diffractive IOL designs, especially in photopic conditions (Figure 3). But the limitation for intermediate vision has nearly disappeared. At the moment, I have no patient who is in need of glasses for far or near vision, or for intermediate vision. I confirm Professor Cochener’s enthusiasm for this new multifocal model.

Rozot: The major point so far is that these results are possible due to the lens’ trifocal design, rather than the bifocal design that is common with other diffractive multifocal IOLs. With bifocality, you always have very good far vision but either the intermediate or near vision, depending on the lens you use, is compromised. That is why some surgeons perform mix-and-match techniques, because none of these prior lenses achieved both excellent near and far vision with intermediate vision. The trifocality of the FineVision Micro F achieves this acceptable vision at all distances.

DIFFRACTIVE PATTERN

Rozot: Dr. Gatinel, would you be so kind to describe the diffractive pattern of this new lens?

Gatinel: The idea that presided in this lens design was to overcome the problems of intermediate vision. Before we started to work on the lens design, the only lenses that were available on the market were bifocal lenses. But when we say bifocal, it means that only two foci are used to create vision, one for distance and one for near. You can also conceive an IOL to achieve another type of bifocality, which would be for example distance vision and intermediate vision. But in this case, you would be deprived of near vision, which is a problem. So the idea with the FineVision IOL, which was a new concept, was to combine two IOL designs that would result in a true three-foci induction.

Rozot: Do you mean that there are two diffractive patterns in the lens, one for intermediate and the other for far and near?

Gatinel: Yes, this lens incorporates two diffractive patterns that are somewhat superimposed, if you like. The main idea at the core of this lens design is that you are combining a bifocal for distance and near and a bifocal for distance and intermediate. Once we achieved this, we needed to not only refine the overall design but also add some features to it. As an example, we decided to reduce the diffractive steps toward the periphery.

Rozot: Thank you, Dr. Gatinel. We will speak of that next. So in summary, you can say that the FineVision Micro F has three focuses, one for far; one for intermediate, which is 1.75 D to provide good vision at 60 centimeters; and one for near, which is 3.50 D.

> The idea with the FineVision IOL was to combine two IOL designs that would result in a true three-foci design.
> – Damien Gatinel, MD, PhD

Gatinel: Technically, the 1.75 D add (at the IOL plane) for intermediate vision provides effective intermediate vision at a range of 60 to 75 centimeters.

Rozot: Great, thank you for the clarification. How did you decide on the addition of 3.50 D? This is a bit less than some diffractive designs and a bit more than others incorporate. I do think 3.50 D is the best choice.

Gatinel: I think the biggest reason, although there are several, is that the addition of 3.50 D makes the plane of reading really comfortable for the average patient.

Rozot: What is that, 35 centimeters?

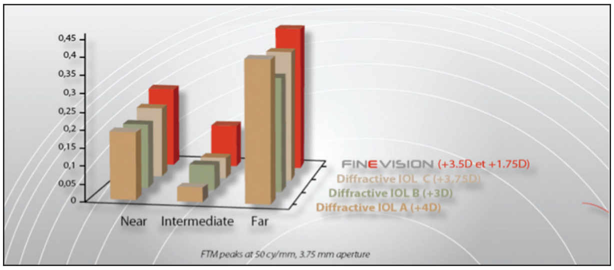


Figure 2. This IOL is designed to improve intermediate vision while maintaining good far and near vision.

Gatinel: A bit more actually; 37 centimeters would be the computation using the near-power add converted at the spectacle plane. But, the reading zone range is in fact extended around that distance, as there is always some natural depth of field in a human eye. The other thing is that, because of the diffraction properties, the multiple foci of a diffractive lens work in a geometrical progression. In other words, if you set the intermediate addition at 1.75 D, a bit of the light diffracted in higher orders will be focused at an addition of 2 x 1.75, or 3.50 D, automatically. So the idea was to optimize both the intermediate and near vision distances, because they are related via some diffraction properties. Doing so, some of the light energy that would disperse in nonuseful diffraction orders with a simple bifocal design can be recuperated to reinforce the near foci. In other words, the performance of this trifocal diffractive lens is slightly better than that of a bifocal one.

Rozot: Let's come to a conclusion about diffraction.

Cochener: In simple words.

Rozot: Yes, in simple words. We have heard of many works that have been done on diffraction.[1] Apodization is the quite recent term that we have all heard of. But, is convolution the same as apodization or is it different?

Gatinel: It is both. You could consider apodization a variety of convolution that covers two aspects; specifically, it is a simple smoothing function that we added to the design of the IOL's optical profile. The reason we did this was that we thought it would really reflect how the lens profile would be after the IOL was created, because we had some industrial constraints that we needed to take into account. When you brand the lens, usually the steps are slightly different (smoother) than they were on the schemes (sharp edges). So on our original lens design, the steps were smoothed, and this smoothing was achieved via the convolution. Additionally, smoothing the diffractive steps is beneficial for the quality of vision because it reduces some of the effects of unwanted diffraction. This is the second reason why we convoluted, or smoothed, the optical profile of this lens.

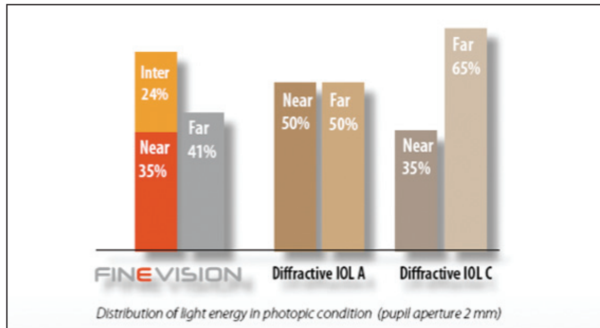


Figure 3. Near and intermediate vision adapted to the reflex of pupil contraction and to lighting conditions during precision activities.

Apodization simply means that you reduce the step toward the periphery, which is also incurred by our convolution method. We wanted the lens to be optically apodized because we thought it would transfer into better mesopic visual quality. That is, when the pupil dilates the apodization brings more light toward distance vision. Therefore, it optimizes vision in these mesopic conditions.

> Our preliminary data shows that patients do not complain of poor night vision, which is a very important point because other diffractive lenses that worked well for far vision also decreased the patients' quality of vision.
> – Beatrice Cochener, MD

Rozot: This makes the optic pupil dependent. Do you think, Professor Cochener, that it is necessary for a diffractive lens nowadays to be apodized—to have apodization?

Cochener: Yes. We all know that the ideal multifocal design does not yet exist, because we are still dealing with the loss of some light energy. But with the FineVision Micro F, results are very convincing, and the loss of light energy is less. Although we still do see some dimming with apodization, working in this great new world of accommodation is exciting. The combination of the multifocal profile of the FineVision IOL and having the ability to decrease the loss of energy makes this lens much more efficient in terms of quality of vision.

There is another point I would like to make: When you look at patients' vision in dim light conditions, in terms of halos and glare, this IOL seems to behave very nicely for them (Figure 4). Our preliminary data shows that patients do not complain of poor night vision, which is a very important point because other diffractive lenses that worked well for far vision also decreased the patients' quality of vision. So again, we are preserving some vision that was usually lost with the other diffractive multifocal models.

Rozot: Dr. Gatinel, is it fair to say that, with convolution, the FineVision IOL combines the advantages of two previous lenses, the apodization of the Restor multifocal and the smooth diffractive steps of the AT.LISA (Carl Zeiss Meditec, Jena, Germany)?

Gatinel: Correct, and I would also add that the diffractive pattern of the FineVision appears on the whole surface of the IOL's optic. This apodization strategy does not make the steps disappear at the mid-periphery, but it does progressively reduce the steps toward the outer edge of the optic.

Rozot: Dr. Vryghem, how do you compare the refraction of the FineVision Micro F lens to your previous experience with diffractive lenses?

Vryghem: I also have experience with the AT.LISA, and comparatively I hear less of our patients complaining of halos after FineVision IOL implantation. With the AT.LISA, the disturbances were minimal but patients could still see them. Additionally, the AT.LISA only provided a limited space for reading, compared with the more flexible reading space patients enjoy with the FineVision lens. Patients also have more intermediate vision with the FineVision than they would have with the AT.LISA.

Rozot: As we can see, the convolution of this lens design has allowed better visual conditions for night driving and in other mesopic situations. In our combined experiences, the intensity of halos is quite lower than with the AT.LISA, for instance.

LENS PROPERTIES

Rozot: Now it is time to discuss the other properties of this lens. The FineVision IOL has an aspheric design of the optic, with -0.11 µm of spherical aberration, which represents the most common compromise of spherical aberration in regular lenses, either multifocal or monofocal. Could you say, Dr. Gatinel, that this spherical aberration correction could be applied to other lenses as well, or is it specific to diffractive lenses?

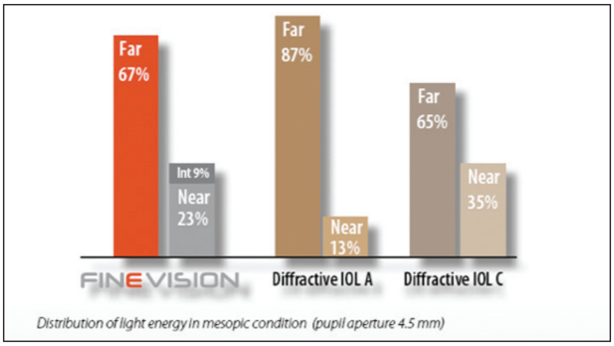


Figure 4. Low level of light energy on the near and intermediate foci in night vision to reduce the possibility of ghost images and halos.

Gatinel: This is a good question. With the FineVision Micro F IOL, the optic's asphericity was calculated exactly like PhysIOL's monofocal lens, the MicroAY. The idea was to compensate for spherical aberration and to account for other realistic errors or imperfections, like the possibility for the lens to be slightly decentered and tilted with the visual axis. The IOL's asphericity was determined, in all calculations, as the best compromise to achieve better mesopic visual quality under these conditions. So we thought it would be logical to transfer the same spherical correction to the diffractive IOL, because it is so important to the visual quality, especially for distance vision.

Rozot: So everybody on this panel thinks that this kind of correction of aberration is the best?

Cochener: Yes, I would say that so far, based on the results we have had, that this would be the best compromise with asphericity. We also need to think about the size of the pupil, for instance. We knew that from the past, even with our picture cameras, that asphericity is one of the best natural models of accommodation. That transfers to our clinical practice, and with all of our experience so far with previous monofocal lenses, this compromise appears to still be the best one.

David: Just to comment on the asphericity, we all know that, at this time, no fixed aspheric design suits every patient. We have to take into account the asphericity of the cornea and the specific needs of the patient in terms of vision. In terms of compromise, I agree that this seems to be the best one; however, the ideal situation would be to choose the asphericity, matching it to the preoperative data that we collect on the patient's eye and especially with respect to the cornea. I think that would be a great step in refinement and the adjustability of cataract surgery.

Vryghem: Do you think we are going to move to a situation where the average surgeon can choose his lens based on the patient's specific asphericity?

Rozot: Perhaps it will be the future. Just think: Many topographers now calculate the asphericity of the cornea. If you could choose between three asphericity corrections, for instance, to best suit your patient, this is a trend toward customization.

Cochener: I think this will certainly be a consideration for the surgeons of tomorrow. But until then, the -0.11 µm of spherical aberration included in the FineVision Micro F IOL is a nice value, because it represents the mean value of spherical aberration for a normal cornea. The population does not want to go back to a standard lens—neither do the surgeons—and this FineVision lens is changing the way we think about lens choice.

Rozot: This lens, which is made of a hydrophilic acrylic, contains a blue-blocking filter. Do you think it is necessary to have this filter, Dr. David, especially in the sunny areas that you work?

David: [Laughs.] Especially in the sunny areas, yes. We all know about the controversy surrounding blue-blocking lenses. But what is unique about the FineVision lens is that it does not block as much blue light as some of the competitors. Therefore, it really does not affect the color perception.

> The patient's vision is more natural with the FineVision's blue blocker.
> – Thierry David, MD

I have a patient in whom a yellow IOL was implanted in one eye and an IOL with no blue-blocker in the other. He immediately noticed a yellow tint to his vision in the one eye, and he was not satisfied. But this has not happened with the FineVision Micro F lens, which does have a blue blocker. I know this because I used the same mix-and-match strategy, and patients could not tell any difference between their color perception in either eye. So, I would say that the patients' vision is more natural with the FineVision's blue blocker, because it blocks violet light but not as much blue light as other implants. This reduces the amount of change in color perception.

Vryghem: The only IOL with a blue blocker that I have used up to now is the Micro AY. In those patients, I implanted the AY in one eye and a conventional IOL without a blue blocker in the other. Patients did not notice any difference in color perception between eyes.

Rozot: We can imagine, although there is no proof, that incident light is shared for far and near vision when the principle of diffraction is employed in a lens design. Because there is less light for far vision, there may be less toxicity of the light going into the eye—but it is just a theory.

A CONSTANTS

Rozot: Dr. Vryghem, did you find any difficulties with the lens' A constant?

Vryghem: If I remember correctly, the A constant is 118.5 using interferometry and the SRK-T formula.

Rozot: The manufacturer has proposed several A constants depending on the formula that you use. Some surgeons proceed differently, but most always use the same A constant and change the lens power depending on the formula. For instance with emmetropic patients, you know that it is crucial to have emmetropia for far vision, especially with multifocal IOLs. In these patients, you know that the SKR-T is the best formula; but for hyperopic patients, it is best to use the Holladay 2 formula or the Hoffer Q. Dr. David, did you have any refractive errors in your patients?

David: In my experience, the A constant was perfectly adapted, and I used the same formula for every case. I have the IOLMaster (Carl Zeiss Meditec), and I implanted the FineVision IOL with powers up to 28.00 D. I was a bit afraid of the refractive results, but they were impressive in terms of the accuracy of the biometry. These patients I implanted with high-powered lenses had perfect far vision refraction close to 0.00.

Cochener: Did you keep the SKR-T for these high powers?

David: Yes. I know others would have changed the formula to the Holladay but I still used the SKR-T up to 28.00 D. I did not want to end up with residual myopia.

Cochener: What about for hyperopic patients? Did you transition to the Hoffer Q?

David: No, I didn't. I used the SKR-T in every patient. Maybe I was lucky.

Vryghem: Using the SRK-T formula, I'm adding 0.50 D power to any IOL over 26.50 D and 1.00 D to any lens over 28.50 D. In doing this, I am very predictable with the

Micro AY and expect the same with the FineVision. I apply the same strategy to the AT.LISA or the Oculentis Mplus.

Cochener: I think that for smaller axial length, I would recommend the Hoffer Q over the SKR-T, especially for the hyperopic patient. The Hoffer Q has been shown to be more precise in these cases.

Vryghem: I still use the SKR-T, but I have a standard protocol for classical-featured lenses, and that is to add 0.50 D for lens powers over 26.50 D; for lens powers over 28.50 D, I add 1.00 D.

Rozot: In my series, I had 96% of patients between -0.50 to 0.50 D, in terms of spherical equivalence. That shows good predictability.

Vryghem: This is with all multifocal lenses?

Rozot: Just with this lens, the FineVision.

Cochener: That is good, because it means that the lens power was already almost adjusted from the beginning.

Vryghem: And you didn't change anything? Did you use the Holladay 2 or the Hoffer Q?

Rozot: I used either formula whenever I treated a hyperopic patient. From such results, we know that the FineVision Micro F is a very predictable lens.

INCISION SIZE

Rozot: How much does incision size affect our results? What is your incision size with this lens?

Vryghem: 1.9 mm.

Cochener: I have no problem putting this lens design through a small incision. My incision size is 1.8 mm.

David: 1.8 mm.

Gatinel: 2.0 mm.

Rozot: For me, most of my incisions are between 1.8 to 2.0 mm.

Vryghem: I am sure I could put the FineVision through an incision of 1.8 mm, but I feel a little bit more comfortable at 1.9 mm.

Cochener: Yes but we have had the chance to take part in some studies, and this requires you to be at the cutting edge. For us, that is 1.8 mm.

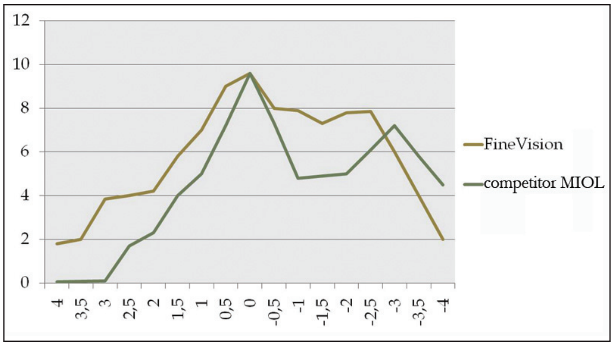


Figure 5. The defocus curve of the FineVision IOL and a diffractive multifocal IOL. Values expressed on this graph are visual acuity (vertical axis) and defocus (horizontal axis), illustrating the difference between bifocal and trifocal diffractive lenses. There is no drop in visual acuity with the FineVision Micro F, wheras there is with the bifocal lens.

Vryghem: In that case, I would like to point out that my blades are trapezoidal, so my surgery is performed through a 1.4-mm incision. Once I insert the IOL, the incision is enlarged to 1.9 mm.

David: Certainly. At the end of the surgery, the incision might be a bit enlarged.

Vryghem: In some cases, I seem to enlarge the incision slightly at the scleral side, because then you have a better docking of the cartridge in the wound.

LENS CENTRATION

Rozot: Were there any problems with centration of this lens?

David: No.

Cochener: I did not notice any either, and I would emphasize that it is because of the design of this lens. The FineVision IOL is close to the design of the Micro AY monofocal IOL, and we were all fascinated that this lens is so well adjusted to the bag. Considering the acrylic material, we should expect more posterior capsular opacification (PCO); however, from the practical point of view, I have been happy with the quality of the posterior capsule. This lens design provides perfect centration as soon as it goes into the bag, and you do not need to do any manipulations intraocularly to rotate or change the center of this lens. It is very easy to implant.

Vryghem: What about when you implant this lens in higher myopic patients, because it could possibly rotate in the capsular bag?

Cochener: But I am already concerned with multifocal lens implantation in high myopic patients. I think that for this kind of very high myopic patient with a very large capsular bag, I would consider the material and of course the design of the lens.

Vryghem: Since the haptic design of the AT.LISA has changed, I have been using this lens in higher myopic patients. It provides an increased chance for stability of the IOL in these patients.

Cochener: I agree, but one day soon we will be able to use the trifocal multifocal lens design of the FineVision IOL for high ametropic patients. The reality is that they will have to deal with some adjustment for asphericity, but we might be able to design a larger lens just to underline the interest of having a wider range of lens options. It would be nice to have a larger design for these high ametropic patients with no amblyopia and no retinal problems, as confirmed by optical coherence tomography.

Rozot: But we must also remember that the diameter of this optic is just a bit larger than other multifocal IOLs, as it is 6.25 mm. Its use is especially pertinent for patients with very large pupils. This lens may be the better option for some patients, because of its larger diameter optic.

Vryghem: Additionally, the haptics reach further.

Rozot: Yes, that is true. The quadruple haptics design of the FineVision provides good stability. Also, this lens has a square-edge design to reduce the amount of PCO. We did not encounter any PCO in our first results, but we might suppose that during the next 2 to 3 years there will be less concealed when the square edge is not there.

VISUAL RESULTS

Rozot: Let's talk about our visual results. Dr. David, would you like to start?

David: As I said previously, I was rather lucky with the biometry in my small number of patients. But so far, of the 10 patients I have treated, 100% can see 20/20. These patients have perfect far vision, and that was one of my biggest reasons for converting to the FineVision Micro F, because every other diffractive lens had the surgical limitation of low-quality far vision. I would like to emphasize that the special design of the steps really reduces the far vision side effects such as halos and glare. Nearly all of my patients with previous multifocal designs complained of problems with night driving, halos, and glare. But it was really very pleasing to notice that none of my patients complained of night vision problems with this lens. The quality of far vision, for me, is the one of the biggest advantages of this lens compared with others.

> Early visual acuity results are … comparable to results with other multifocal designs. But the point is that the FineVision Micro F provides better UCVA results for intermediate and near vision.
> – Pascal Rozot, MD

Rozot: I think the early visual acuity results are quite good; they are comparable to results with other multifocal designs. But the point is that the FineVision Micro F provides better UCVA results for intermediate and near vision. As we said, this is because of the diffractive pattern of this lens. Did you explore the intermediate vision in your patients, Dr. Gatinel?

Gatinel: We used reading charts that were placed first at reading distance and then at 65 to 75 cm for intermediate vision. In that stage, providing sufficient illumination, my patients could all read print as fine as J3. Some could even reach J2 with no correction.

Rozot: Yes, that is very similar to my experience because no patients complained of poor intermediate vision. This lens provides quite good correction at this distance, especially compared with other multifocal lenses. It also provided good near vision; I will admit that I expected slightly worse results because of the 3.50 D add, but I think the near vision was almost the same as I have seen with the AT.LISA, which has a 3.75 D addition. I was very impressed with the near vision with the FineVision.

Cochener: I have a comment regarding neural adaptation. I found that patients did not need to adjust and find a comfortable distance. Rather, we noticed that patients were seeing not only well but comfortably; they found exact focus at each distance immediately after surgery. So I think that this triple-focus design will help patients make the adjustment much easier than it is with two foci.

Rozot: Our results will have to be confirmed with larger studies, but the defocus curve (Figure 5) for this lens is very promising. I did not perform the defocus curve on a lot of eyes, but for those I did, the behavior of the lens for far, intermediate, and near vision was very high. And what is important is that between -1.00 to -2.00 D, the defocus curve is at same level in comparison to other multifocal lenses, where there is a gap between -1.00 and -2.00 D for bifocal lenses. I think that is what this lens brings for intermediate vision.

Cochener: Dr. Gatinel, I have a question for you about that. We were ready to see some decreased quality of vision and also expected to see three peaks on the defocus curve due to the trifocal design. I was wondering if this is just plain regulation between the two measurements or if it is related to the smoothing of the lens, as if there was some kind of transitional zone between the near and far vision? Alternatively, is it really for one specific vision, according to the cooperation that you described between the foci?

Gatinel: This is may be one explanation. Another is that when we say there are three distinct foci on an optical bench, the eye actually has other sources of multifocality that cause a little bit of depth of focus around each foci. This explains why you may have some overlap between the near and the intermediate vision performance. I would also add that this defocus curve was calculated for an average population, which also contributes to the smoothing of the final vision curve.

Rozot: You are referring to the "through focus" modular transfer function (MTF) of the lens. In your in vitro experience, you do see that trifocal effect. But in the clinical data, you have some differences, and you can smooth these small differences between the three focuses.

Cochener: Let's not forget that they eye works for itself.

Rozot: Yes, exactly.

Cochener: There is some residual accommodation that can play a role in that.

Gatinel: Indeed, but in vitro we checked this using an optical bench, and you can really see on this through focus MTF curve that, in addition to the near and distance ones, there is a third peak for intermediate vision. This does not exist in competitive lenses.

LOW LEVEL OF PATIENT COMPLAINTS

Rozot: Just a few words about patient complaints. We have already said that these patients do not complain about halos, and I haven't had any patients complain about glare. We know that the material has a good refractive index compared with other lenses, and this is probably one reason that patient complaints are low. Additionally, the construction of this lens, with its smooth diffractive steps, provides benefits in terms of patient acceptance. What is everyone else's experience? Did patients complain of some glare?

Cochener: To be frank, in the very early postoperative period they did complain—but you don't know exactly about what. Because of the neural adaptation process, they need to learn what they can consider to be good vision, which includes understanding good light conditions to improve their vision. I would say that for maybe 2 weeks after surgery they complain of functional symptoms, but these disappear over time. Patients are not experiencing neural adaptation for 3 months, which is the case with some other models.

Rozot: That's right. We all know that it is better to see the patient once or twice after surgery. They should be told that results are better after both eyes are operated on, and of course they need to understand that the postoperative performance of the lens improves with time. Some patients do not know that they will have to relearn their vision—it is not natural vision—and that the brain requires time to adapt to this new multifocal vision. Sometimes patients complain of blurred vision, and sometimes they have difficulty separating what is happening from what will happen when the neural adaptation process is complete.

Another point I would like to make is that you should not minimize the effects of dry eye in some of these patients. It is quite important to hydrate the cornea postoperatively, because NSAIDs can affect the corneal surface. It is quite important to walk patients through this part of the treatment. They may experience some more floaters because of the presence of the IOL's multifocal optic. If the patient is aware of this, they will be more accepting. I think it is important to observe the patient until he or she has obtained good vision postoperatively. Are there any comments concerning this?

Cochener: All of our remarks certainly indicate just how precious follow-up is after any kind of multifocal implantation. When performing modern cataract surgery with a refractive purpose, all these considerations need to be taken into account. This procedure affects the quality of life of our patients, and therefore it is very important that we walk them through the entire process, especially for all of us who love the cornea and the ocular surface.

Gatinel: And you should always keep in mind that when we do cataract surgery on a patient, his or her vision is altered prior to cataract removal and lens insertion. When you implant the FineVision IOL after removing an opaque crystalline lens, even if the patient may have some drawbacks with contrast sensitivity because you had to optimize three foci instead of one or two, there is still a dramatic visual improvement compared with the preoperative situation. The second thing I would like to emphasize is that I have been exposed to questions like, "Will the third foci be too complicated for the patient's brain?" I think this is a misconception. This logic applies to monovision, because in the latter the right and left eye do not have the same vision. On the contrary, when we deal with multifocality, there is no image for the brain to choose from; when the patient gazes at the specific distance, the IOL will provide the sharpest image that it can. The patient's satisfaction will mainly derive from the achieved visual quality for the distance, near, and intermediate visions.

CONCLUSION

Rozot: So in conclusion, we can say that this is a third-generation multifocal diffractive lens. The first diffractive design was the old 3M lens, and the second-generation diffractive designs included the AT.LISA and the Restor. Now we have arrived at the third-generation design, the FineVision Micro F, which provides more potential for fine intermediate vision. Just in way of a final question, I would like to ask if any of you use the lens for clear lens extraction, independent of cataract?

Vryghem: Up to now, I have not. But after seeing the results, I wouldn't be afraid to use it for refractive lens exchange if there is a clear indication for it.

Rozot: Dr. David, would you use this lens in cases of clear lens extraction?

David: Yes, and I have already done so in one patient with high hyperopia who had the slight beginnings of cataract. This was a very demanding patient, and both she and I were impressed with the results. I was a little cautious when proceeding with refractive lens exchange, especially because of the patient's good far vision with high magnification glasses, but so far the results are excellent.

I would say, in conclusion, that there are really two big advances with this lens. First and foremost is the quality

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> – Jérôme C. Vryghem, MD

of intermediate vision. Second, compared with other multifocal diffractive lenses that I have implanted, I would say that this lens produces fewer side effects, especially in terms of far vision and night driving problems. These are the two main qualities that I like with this lens compared with other diffractive lenses that I have tried before.

Cochener: I think that although we only have short-term experience with the FineVision IOL, this lens deserves a place next to the competition for the challenge of correcting presbyopia. I would use it for refractive lens exchange.

Rozot: So everyone here believes in this lens.

Vryghem: I think so. There is no other diffractive lens that provides such good intermediate vision. It is a promising lens design.

David: We have said that many times today. One of the other advantages is the lens material, because you can use truly neutral incisions on patients who have no corneal astigmatism. This gives you the confidence that you are not going to induce any astigmatism in these patients.

Vryghem: It truly is pleasant that you can use a microincision. You have the best of both worlds.

Rozot: We have accomplished a lot in this roundtable. We have talked about this lens' aspects of multifocality, its optical principles, the early clinical results, and the reduction in patient complaints. We have also established the advantages of the FineVision Micro F IOL over other multifocal diffractive models. I would like to thank the panel for participating. ■

1. Kohnen T, Allen D, Boureau C, Dublineau P, Hartmann C, Mehdorn E, Rozot P, Tassinari G. European multicenter study of the AcrySof ReSTOR apodized diffractive intraocular lens *Ophthalmology.* 2006;113(4):584.

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