Introduction

In the past decade cataract patients have benefited from dramatic improvements in surgical technique as well as important innovations in IOL design and materials. The benefits include shorter surgery times, less morbidity and more predictable visual outcomes.

The next step in this evolution is to deliver better functional vision than ever before by further reducing rates of posterior capsule opacification, improving IOL designs and materials and producing ever-more sophisticated tools and equipment to enable surgeons to meet patients’ demands.

In a Eurotimes Satellite symposium held during the XXII Congress of the ESCRS in Paris, leading ophthalmic surgeons from both sides of the Atlantic shared their views, clinical data and expertise on topics ranging from PCO prevention and IOL design issues to lens-based refractive procedures, phaco technology and the clinical performance of the new aspheric prolate IOL.

Rupert Menapace MD, Intraocular Lens Service, Department of Ophthalmology, University of Vienna Medical School in Austria, moderated the symposium.

Considerations in IOL standards and design:

The rates of posterior capsule opacification (PCO) following cataract surgery have continued to drop over the last decade, thanks in large part to innovations in intraocular lens (IOL) design and materials, as well as advances in surgical techniques, according to Donald Nixon MD, FRCS.

“As surgeons we need to look at the fact that we are working on a living tissue with a reparative capacity and we need to respond to the healing response of that tissue. Essentially what we do with cataract surgery is to create two defects: the capsulorhexis; and the actual removal of mass. In removing the nucleus, the cortex, we leave a defect there and in fact one of the principal roles of the lens epithelial cells (LECs) is to respond to that defect that we have created,” he said.

Dr Nixon said while this LEC reaction could be classified in simplistic terms as PCO or fibrosis, today its manifestation if not minimised and controlled could also be more precisely considered as a surgical or IOL failure. Although Nd:YAG laser capsulotomy remains the standard means of treating PCO, he stressed that this procedure carries its own risks.

“YAG capsulotomy is not a completely innocuous procedure and has the potential for generating not only corneal abrasions and IOP spikes, but also has well documented risks of cystoid macular edema and retinal detachment,” he said.

Capsular dynamics

Rather than focusing on PCO as an isolated phenomenon, Dr Nixon said that it was more appropriate to think of the entire process with the term ‘capsular dynamics’.

“This is really a way of describing the interaction between the IOL and the epithelial cells, in terms of the way that the cells proliferate, the way they migrate and the way they induce fibrous metaplasia. These phenomena can cause progressive capsular shrinkage, PCO formation and IOL decentration,” he said.

Good surgical technique remains a primary objective in achieving consistently satisfactory results, according to Dr Nixon. In particular he stressed the importance of a central, well-positioned curvilinear capsulorhexis that allows for 360 degree apposition of the posterior surface of the anterior capsule to the anterior surface of the optic, helping to inhibit LEC migration by optimising capsular bend formation. Proper cortical removal and polishing of the posterior capsule only are also important.

Platform lens

In terms of IOL design, Dr Nixon said that the lens manufacturers today need to think in terms of a “platform lens”. He defined this as an IOL that possesses at least three fundamental features for improved performance and long-term in vivo stability. This IOL, once tested, would then be an ideal design to have various optic modifications built onto it, i.e. aspheric, pseudoaccommodative, with a higher level of confidence in achieving the desired outcome.

“First, the IOL needs to have a square posterior edge; second we need to look very carefully at the haptic-optic junction profile and third, we need to start to consider not only the ideal optic, but also the ideal overall IOL size,” he said.

Discussing each of these factors in more detail, Dr Nixon said that by pressing against the posterior capsule, the square-edge component creates a discontinuous capsular bend as the anterior and posterior capsules adhere together. This serves as a barrier to the migration of lens epithelial cells. As a general rule, he noted that the sharper the edge, the stronger the barrier effect.
The positive impact of LECs on lens stability is also an important factor to take into account. Both biomaterial and biomechanical IOL features can actually harness the energy of the LEC to improve outcomes.

“The second-generation silicone lenses are more effective than acrylic IOLs in stimulating and catalysing metaplasia of the anterior capsule LECs. This induces a tight shrink-wrap effect and collagen deposition at the IOL edge forming a “fibrotic ring” maximising centration, minimising rotation, and leading to long term stability. This is a key factor in “platform lens” design that has any surface modifications including cylinder correction. The problem of photic phenomena associated with square-edge IOLs, particularly in younger patients, has since led to design modifications such as the OptiEdge™ (AMO) with an anteriorly rounded edge that scatters light without losing the benefits of the square posterior edge, pointed out Dr Nixon.

The importance of using a low-profile haptic-optic junction to prevent LEC migration should also be borne in mind, said Dr Nixon. Studies have shown that a bulky haptic-optic junction on some IOLs interferes with proper anterior capsule/posterior capsule closure, thus negating the barrier effect even with a square edge design and providing a staging area and space for cell proliferation.

He noted that the barrier effect, of both hydrophilic as well as hydrophobic lenses, seems to be lost transferring from a three-piece design to the present one-piece designs specifically in the region of the haptic-optic junction.

In terms of optic size, Dr Nixon said this was essentially a balancing act between keeping the volume of the optic small enough for insertion through sub 2.8mm or 3mm incision while also maintaining an effective optical zone under scotopic conditions.

He noted that many researchers now stress the importance of an ideal size relationship between the IOL and the capsule for optimal bending. He also raised the issue of whether there was a tangible benefit to be gained in adjusting overall IOL size according to axial length, bearing in mind that capsular bag diameter correlates negatively with corneal power and positively with axial length. The IOL size and haptic design as it relates to the arc of contact in the equator of the capsular bag can induce capsular striae which can erode the barrier effect of a square edge optic.

“It may well be the case that we need to have different IOL sizes for different IOL powers: Professor Nishi, for instance, has shown that an optic size above 7mm for a one-piece IOL will interfere with the apposition of the posterior and anterior capsule,” he said.

Summing up, Dr Nixon reiterated his belief that the ideal platform for IOLs today needs to adhere to these design standards for long-term success in combating PCO.

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The Slim Junction Important

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Focusing on the factors that can give rise to PCO, Rupert Menapace, MD, PhD, laid down the essential ground rules for IOL design and material and correct surgical technique in minimising the risk of PCO after surgery.

“We are essentially talking about regeneratory after-cataract when we think of visual disturbance and this sort of after-cataract is formed by the population of equatorial lens epithelial cells that reside in the capsular equator and which can migrate into the space between the posterior optic surface and the posterior capsule. And if this space is large, then these cells can form pearls or multi-layers of pearls or huge pearls that interfere with visual acuity,” he said.

There are several strategies to avoid after-cataract formation by targeting these equatorial cells and preventing them from gaining access to the central posterior capsule, pointed out Dr Menapace.

He said that one approach is to try to remove as many of the equatorial LECs as possible through rigorous cortical clean-up. “This is most efficiently done by cortical fibre peeling, directly aspirating the posterior capsule at low vacuum settings together with the rest of the lens fibres resting in the capsular equator and peeling them off.”

**Barrier Effect**

Another approach is to prevent the residual LECs from migrating beneath the central optic. The critical issue is to use the optic edge to create a barrier effect and to optimise the efficacy of this barrier effect, noted Dr Menapace, who then outlined some basic guidelines to ensure this optimisation.

First, it is vital to create a full circumferential capsulorhexis-optic overlap. Dr Menapace said that this was necessary since it is not “the sharp optic edge per se that prevents migration of LECs but rather the capsular bend that is created by the optic edge that does not allow the cells to further migrate.” Such a bend may also be created at a round optic edge due to fibrotic capsular wrapping, he noted.

Second, it is important to use an optic with a sharp posterior edge. Dr Menapace said the hypothesis has been proven from systematic randomised studies carried out at Vienna University Eye Hospital directly comparing lenses with sharp and rounded edges. Moreover, the sharp-edge barrier effect was proven to be effective irrespective of the IOL material used, whether PMMA, silicone or acrylic.

“At 6 months and one year there is already a statistically significant difference in favour of the sharp-edge optic. And this holds for longer follow-up,” he said.

Another study carried out in Vienna further illustrated the efficacy of the sharp edge in preventing LEC migration onto the optic surface, noted Dr Menapace.

“We had a custom-made lens designed with half the circumference with a sharp edge and the other half with a round edge. When we implanted these lenses, it was clear that both the fibrotic and the regeneratory after-cataract were blocked by the sharp edge, whereas along the round-edge circumference both could gain access to the posterior capsule,” he said.
The System makes the difference:

The current range of implant systems and devices to deliver IOLs into the capsular bag were put under the spotlight in a wide-ranging presentation by Ekkehard Fabian MD, who also offered some pearls and tricks for achieving best results using these surgical instruments.

Dr Fabian said that while individual aspects of the implant procedure such as incision width, the type of injector, cartridge and viscoelastic used played an important role in achieving consistently good surgical outcomes, it was the delivery system as a whole that really counted.

“All of these things together, the injector, the cartridge, the ophthalmic viscosurgical device (OVD) and the IOL – that’s the complete system designed to put a lens into the capsular bag and that’s what we should be focusing on,” he said.

Looking at the current range of injectors on the market, Dr Fabian noted that the trend was moving inexorably towards smaller incision widths in the range of 2.75mm to 2.8mm. One-use or disposable injectors were also gaining in popularity, he said.

In a recent clinical trial, Dr Fabian set out to compare the performance of the latest Emerald-Ease Unfolder® (AMO) with two other systems in the range of 2.75mm to 2.8mm. One-use or disposable injectors were also gaining in popularity, he said.

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The key point, according to Dr Fabian, is that significant advances in the sophistication of injector technology mean that surgeons can concentrate more fully on their surgical technique. “This is something very positive. The loaded injector helps the surgeon concentrate on the important details and saves time. Also, the new self-rotating injector of the syringe style facilitates a mono-manual implantation with a high degree of ease,” he said.

**Pearls for better results**

Dr Fabian offered some pearls to help surgeons achieve more consistent outcomes using the Emerald-Ease Unfolder system.

First, he suggested prudent use of viscoelastic. “I would recommend using about two drops of Healon 1% (AMO) to get the balance right for a controlled IOL insertion,” he said. He also advised surgeons to “go vertically with the injector into the incision” using the Emerald-Ease Unfolder, irrespective of whether the procedure is mono- or bimanual.

He then suggested taking a slight pause – about one second – before rotating the IOL clockwise in the capsular bag. “This pause means that the IOL is opening slightly; if you rotate it too early, the haptic will be bent backwards in the capsular bag,” he said.

Summing up the advantages of the Emerald Ease Unfolder, Dr Fabian said the fact that it allowed small incision widths of 2.7mm or 2.8mm was clearly a major plus factor as microincision cataract surgery techniques continue to become more popular. The incision widths were also the same for the phacoemulsification and the IOL injection, he noted.

“We have now implanted hundreds of IOLs using the Unfolder system and have had no problems. Some more work needs to be done on bringing all of these components together into one integrated system but things are clearly moving in the right direction,” he said.
**“I essentially use the forceps to grasp the iris, creating a fold and then I push the haptics over the forceps holding the iris and that works very well.”**

Michael Knorz MD

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**Presbyopic refractive lens exchange (Prelex)** combined with LASIK offers a safe, straightforward and reliable approach to correct myopia and hyperopia as well as presbyopia, according to German ophthalmologist Michael Knorz, MD.

Dr Knorz explained that there are essentially two options for lens-based refractive surgery: phakic IOLs and refractive lens exchange (RLE).

With regard to phakic IOLs, Dr Knorz said his own personal experience as well as studies in the published literature caused him to choose not to implant lenses in the posterior chamber.

“I do feel that there are limitations because sizing is very critical; you will see intermittent lens touch with ICLs, simply because the human lens grows as we get older and several studies show that there is some cataract formation, between 0.5% to 10%, of the cases. There is also some pigment dispersal, which may ultimately lead to glaucoma. Those are my reasons not to use ICLs, but this is an individual decision,” he said.

Dr Knorz said he has also opted against using angle-supported PMMA lenses because of issues with pupil ovalization. He said this narrowed the field down to one option: iris-supported lenses, and in particular, the Verisyse™/Artisan IOL (AMO) which has the longest track record and is the first phakic IOL with FDA approval in the United States.

**Forces or needle?**

In terms of surgical technique, Dr Knorz said he prefers to use a forceps rather than a needle for the enclavation. “I essentially use the forceps to grasp the iris, creating a fold and then I push the haptics over the forceps holding the iris and that works very well. It is more controlled and is a more straightforward approach because you really get what you want - direct control of the enclavation procedure,” he said.

Dr Knorz reported data from a series of 243 consecutive eyes of 136 patients implanted with the Verisyse IOL between October 1998 and December 2002. Patients had an average of $-11.4$ D of myopia (range $-5.0$ D to $-27.0$ D). Refractive stability was excellent at three years follow-up. There were no long-term complications, he said, apart from two eyes (0.8%) of one patient that developed nuclear cataract, which may or may not have been lens-related.

Dr Knorz noted that the results for endothelial cell counts were also encouraging. “That is an issue raised frequently and at the three-year follow-up period there was absolutely no indication of a progressive endothelial cell loss. With proper surgical technique there is no movement of this lens so it is very unlikely that it will touch the corneal endothelium resulting in endothelial cell loss,” he said.

In terms of safety, no patient lost lines of vision and most gained one or more lines, said Dr Knorz. Patient satisfaction ratios were extremely high: 99.4% of patients said they were happy with the procedure with just one patient complaining of halos.

**Simultaneous vision**

Moving on to discuss presbyopic refractive lens exchange, Dr Knorz said he used the AMO Array™ Multifocal IOL in his Prelex procedures. He explained that the lens worked on the basis of a concept known as “simultaneous vision”.

“The basic idea is that there are two images formed on the retina at the same time and then our brain selects the image we want to see; so this is a new kind of vision, something we have to adapt to and to learn,” he said.

The disadvantages of such an approach, he noted, was a slight loss in contrast sensitivity and incidence of halos, since each of the images on the retina receives less than 100% of the incoming light.

The major plus, however, is that the Array IOL allows for pseudoaccommodation, essentially meaning an increased depth of focus for the patient, something which is not available in a monofocal IOL.

**Prelex ideal for hyperopes over 40**

Dr Knorz said that Prelex was particularly suitable for hyperopic patients over 40 years-of-age, followed by high myopes over 40 and then presbyopes. Patients with low myopia were generally not suitable for lens exchange, he maintained, as they were used to very good near vision, which might be affected by the procedure.

Addressing the issue of why Prelex wasn’t used more widely, Dr Knorz suggested that it was largely due to the fact that multifocal IOLs are far more sensitive to non-perfect optics than monofocal IOLs.

With this in mind, he offered some tips to ensure best results using a multifocal IOL. Careful patient selection and education are vital. “The patients have to know what to expect and then they can make an informed decision whether this procedure is for them,” he said.

Good surgical technique, with proper in-the-bag placement, capsule overlap and a well-centred IOL, are essential in achieving optimal outcomes. The optics must be perfectly clear, said Dr Knorz.

“For monofocal lenses we know that some slight opacification is accepted but that is not the case with a multifocal lens. This will contribute to an added loss of contrast so the patients will perform poorly, and will complain about poor vision. So perform YAG laser early if necessary and use a large opening,” he advised.

Finally, a perfect cornea is central to a successful outcome. Dr Knorz said it is vital to control the astigmatism during surgery using limbal relaxing incisions and, crucially, to correct any residual ametropia by LASIK or Epi-LASIK.

“Any defocus will further deteriorate the quality of the image, as these patients have two images and if both are blurred, then the resulting image is very poor in quality,” he warned.
New technologies in IOLs: benefits and sacrifices

Physicians today need to embrace a more comprehensive view of functional vision beyond the scope of Snellen charts and to adopt new technologies that best serve their patients in the real world.

That was the view put forward by Jack T. Holladay, MD, MSEE, FACS in a wide-ranging discussion on the importance of quality of vision and the theoretical basis for the Tecnis® (AMO) modified prolate IOL.

Dr Holladay said that Snellen visual acuity alone could not capture all the important information relating to a patient’s quality of vision.

“Visual acuity really determines the ability of our visual system to see a small object at high contrast. In an optical system we call this resolution. It is important but it is not the whole story when it comes to evaluating quality of vision. The other side of vision is to be able to detect a grey truck coming over the hill in a fog, which is something that is more accurately measured by contrast sensitivity,” he said.

Dr Holladay said that new methods of testing contrast sensitivity by M & S Technology using a sinusoidal Bull’s Eye Target allow greater accuracy in testing individual contrast sensitivity to within one-tenth of a log unit (or 1 dB).

**Wavefront & Contrast Sensitivity**

Wavefront analysis is another important measure to help locate any abnormality in the visual system, said Dr Holladay. The raw wavefront data can be converted into the point spread function (PSF), which itself can be transformed by Fourier analysis into the modulation transfer function (MTF). When the problem in the visual system is optical, the area under the MTF should be the same as the area under the CSF curve. When they are not similar, the problem with the visual system is usually sensory (retina, optic nerve or occipital cortex).

“We can see the effect on the MTF as a person ages,” said Dr Holladay. “The 20-year-old has the best MTF, which is about 40% of the diffraction limit of an optical telescope with the same aperture and the same focal length. By the time we are 40 we have lost about 40% of that and by the time we are 60 we have lost 60% and most of this loss is between 3 (20/200) and about 20 (20/30) cycles per degree,” he said.

Dr Holladay explained that this loss in contrast sensitivity is due to increased spherical aberration of the eye brought about by changes in the crystalline lens.

“So when we are driving at night or when we are having problems seeing objects that are quite large, it is because of the loss in contrast sensitivity due mainly to the change in the spherical aberration of the crystalline lens as we get older. The increasing spherical aberration with age is often described as halos around lights, such as head lights. This increases from the time we are born to the time we die, as the crystalline lens becomes progressively more positive in spherical aberration while the cornea remains unchanged,” he said.

Until recently, IOL manufacturers had not taken the spherical aberration of the eye into account in their lens designs. Most current IOLs have spherical surfaces and spherical aberration, which is similar to the 60-year-old crystalline lens, he pointed out.

The Tecnis lens, in contrast, has a modified prolate anterior surface that is designed to compensate for the positive spherical aberration of the cornea. In studies conducted to date, the...
clinical outcome with the lens has correlated closely with those predicted by optical theory. The Tecnis lens has reduced the spherical aberration of the eye to almost zero with in most individuals he said.

Why surgical technique matters
Dr Holladay stressed the importance of good surgical technique if the Tecnis lens is to perform to its optimal potential.

“This means that if the lens is decentred by half a millimetre or placed at a tilt of 7 degrees, you will end up with a performance that is identical to a spherical lens. If you tilt it beyond this point and tilt a spherical lens the same, then it will actually perform slightly worse than a spherical lens,” he said.

Nevertheless, Dr Holladay emphasised that current surgical performance with continuous tear capsulorhexis and viscoelastics is well within these thresholds.

“Since 1994 every single study that has been done shows that the average decentration is of a range between 0.15mm and 0.30mm and the tilt is around 2.5 degrees. This means that the average surgery exceeds the performance of the lens by about a factor of three in a normal patient with current surgical techniques,” he said.

No scientific rationale for blocking blue light
He also argued that there was no valid scientific reason for an IOL such as the AcrySof Natural IOL, SN60AT (Alcon Laboratories) to filter out 440 nm blue light. Referring to studies by Randall Olson MD and Martin Mainster MD, Ph.D, Dr Holladay said that such IOLs essentially trade scotopic visual performance for no protection against acute UV or blue retinal phototoxicity.

Dr Holladay said that a thorough review of the published literature showed there was no evidence that blocking blue light could help prevent ARMD. Nor was there any evidence that implanting an aspheric prolate lens reduced a patient’s depth of field. On the contrary, he said that patients with low higher order aberration RMS values often end up with a better depth of field and better near vision with the Tecnis lens than spherical IOLs.

He believes that the Tecnis lens provides a significant functional improvement in night time driving and vision similar to a 20-year-old, rather than the 60-year-old with current spherical IOLs. The Tecnis IOL has pointed the way for the future in IOL technology. Dr Holladay predicted that every other IOL manufacturer would follow suit with their own versions of the prolate aspheric lenses and that patients would ultimately benefit from an improved quality of vision as a result.

“When we are driving at night or when we are having problems seeing objects that are quite large, it is because of the loss in contrast sensitivity due mainly to the change in the spherical aberration of the crystalline lens as we get older.”
Functional vision and highway safety with an aspheric IOL:

Improving the functional vision of elderly drivers with the Tecnis lens in less than ideal conditions, such as nighttime, rain, snow, fog and twilight may increase the safety of all drivers and pedestrians on the road, according to Mark Packer MD.

“The ability of the Tecnis lens to improve functional vision sets a new standard in the treatment of cataract patients. Many patients implanted with this aspheric prolate IOL see very well in low light conditions and tell me they feel comfortable driving at night for the first time in years,” he said.

Reviewing the clinical results of the Tecnis Z9000 to date, Dr Packer said that the IOL had more than lived up to expectations in successive trials.

An initial study randomly assigned 21 patients undergoing unilateral cataract surgery to implantation of the Tecnis IOL or the acrylic Sensar OptiEdge AR40e IOL (AMO).

Preoperatively, the two study groups were comparable in terms of photopic and mesopic contrast sensitivity, proportion of dominant eyes to be operated on, and mean patient age. All eyes achieved 20/20 best-corrected visual acuity (BCVA) after surgery, corneal keratometry was relatively unchanged in both groups, and there were no problems with IOL decentration or tilt.

Improved contrast sensitivity

There were, however, differences in contrast sensitivity favouring the Tecnis IOL at 1.5 and 3 cycles/degree under mesopic conditions and at 6, 12, and 18 cycles/degree under photopic conditions. The Tecnis provided a 0.27 log unit (77.9 %) gain in peak contrast sensitivity, noted Dr Packer. Furthermore, the mesopic contrast sensitivity spectrum of the Tecnis IOL was superimposable on the photopic contrast sensitivity spectrum of the control implant.

“This shows that these Tecnis patients were seeing as well with three candles per square metre as the patients with the spherical lens were seeing with 80 candles per square metre – that was a really dramatic difference and indicates that patients with the Tecnis are able to see contrast levels in dim light equivalent to what patients with spherical IOLs can see in bright light,” Dr Packer said.

Another study conducted by Mester et al., randomly assigned 45 patients to receive the Tecnis IOL in one eye and the spherical silicone SI40 lens (AMO) in the fellow eye. Thirty-seven patients were seen at all follow-up visits.

Wavefront testing demonstrated the Tecnis IOL decreased spherical aberration compared with the SI40 and was associated with significantly better mesopic and photopic contrast sensitivity at all spatial frequencies tested between 1.5 and 18 cycles/degree.

“Ulrich Mester’s work was the first to document the elimination of spherical aberrations with this lens,” said Dr Packer.

“Another important finding of his study was that the only statistically significant difference in higher order aberrations occurred in spherical aberration, which was eliminated by the Tecnis IOL. There was no statistically significant difference in coma, which is another way of showing that with Mester’s standard surgery there was no problem with tilt or decentration with this lens.”

Spherical aberrations virtually eliminated for all age groups

Turning to the more recent FDA study, Dr Packer said that this randomised, double-masked trial included 78 patients implanted with the Tecnis IOL in one eye and the SA60AT IOL (Alcon) in the contralateral eye.

Investigators were somewhat surprised that there was a statistically significant difference for best-corrected ETDRS visual acuity in favour of the Tecnis lens. The data for spherical aberration also showed evidence that Tecnis eliminates spherical aberrations across all age groups, said Dr Packer.

“We effectively eliminated spherical aberrations for all age groups, demonstrating yet again that the changes in spherical aberration are not due to changes in the cornea, but rather due to changes in the crystalline lens,” he said.

Tecnis may mean greater road safety

A subset of patients was randomly selected from all investigational sites to participate in testing in a validated night driving simulator. Patients were tested in four nighttime conditions: normal city, city with glare, normal rural and rural with glare. In each setting, patients were asked to detect and identify targets including white-on-green information highway signs, black-on-yellow warning signs and pedestrian hazards.

They were asked to respond when the sign or the hazard was first detected, and the detection distances were recorded. Patients were then asked to respond when the sign or hazard could first be identified, i.e., what did the sign say, what direction was the pedestrian walking, and the identification distances were recorded.

The Tecnis eyes performed functionally better than the control eyes in 21 of the 24 conditions tested, noted Dr Packer. “This means the Tecnis lens improves both detection and identification distances in both city and rural conditions and different visibility conditions with and without glare compared to the control lens. Tecnis eyes

“The ability of the Tecnis lens to improve functional vision sets a new standard in the treatment of cataract patients.”
performed statistically significantly better than the control eyes in nine of the test conditions,” he said.

Dr Packer concluded that the improvement in functional vision would ultimately end up saving lives. “With the new labelling, the FDA is saying that this difference that we found on the night driving simulation could translate into increased highway safety. It follows that this could make a difference for people with this lens driving at night and could lead to improved highway safety.”

Dr Packer added that the lens may also make a difference in other life situations that were not tested in which people have to function visually under low light conditions. “The elderly person with the Tecnis lens walking down the stairs at night is less likely to fall than a patient who has a spherical lens,” he said.

“With the new labelling, the FDA is saying that this difference that we found on the night driving simulation could translate into increased highway safety.”
WhiteStar: New cold phaco technology:

The latest development in cold ultrasound technology (WhiteStar™, AMO) allows for the efficient removal of all densities of cataracts and is as safe as a pulsed laser microincision phacoemulsification system, according to French ophthalmologist Christophe Baudouin MD, PhD.

A major advantage of the cold ultrasound system is that it dramatically reduces the phacoemulsification time compared with laser phacoemulsification.

"Until recently it seemed to be very difficult to improve phaco techniques and to decrease the width of the incisions. The technique was so well established and so evolved that it seemed almost impossible to go further. However, the advent of new different cold phaco techniques allows for the removal of the cooling irrigation sleeve and cataract surgery through two separate, very small 1.2mm incisions," he said.

One of the principal benefits of WhiteStar technology is the ability to reduce energy levels delivered to the eye without compromising on efficacy, noted Dr Baudouin.

“Today all machines have pulse or burst modes, however, the WhiteStar technology was specifically developed to further reduce energy levels and allow for sleeveless bimanual surgery,” he said.

Less heat, more impact

He pointed out that WhiteStar technology is based on a special burst modality with rapid on-off power changes that optimise lens extraction without generating heat at the corneal site.

This cool technology contrasts with some phaco devices that utilise a combination of mechanical or acoustical effects to emulsify lens material.

“The mechanical ‘jackhammer’ effect, for instance, works by cracking or chipping the lens, but carries the downside of increased thermal exposure and may cause wound burn especially in more prolonged procedures with hard nuclei,” Dr Baudouin said.

The acoustical effect generated by ultrasound also required careful handling. Different phaco machines achieve cavitation at different power settings, depending on their stroke and tip size.

Microbursts mean reduced power and heat

Dr Baudouin cited the work of Mark E. Schafer PhD, who described two types of cavitation.

Initially, transient cavitation leads to the violent explosive collapse of microbubbles that exist in the fluid in which the cavitation is created. It is that explosive collapse of the bubbles that disintegrates tissue, whether kidney stones or cataractous lenses.

Transient cavitation quickly gives way to stable cavitation, in which there are fewer collapses and less energy released. Most standard phaco machines have pulse lengths of 50, 100 or 150 milliseconds. Transient cavitation lasts only few milliseconds of that time, and the remainder is the less efficient stable cavitation.

The Whitestar technology of the AMO Sovereign® energises the tip for very small intervals, smaller than the pulse mode or burst mode on most machines, and then rests the tip, producing a “microburst” effect. These microbursts accentuate transient cavitation. There is no transition to stable cavitation, Dr. Baudouin said. As a result the system retains the emulsification capability, while reducing phaco power and thermal energy.

In clinical studies on cadaver eyes carried out by Eric Donnenfeld MD, the maximal corneal temperature during phaco was 34°C in a sleeveless on-off cycle mode and there was a minimum endothelial cell loss of about 7% at three months, noted Dr Baudouin.

Straightforward surgical technique

Another advantage of WhiteStar technology is its ability to minimise the impact of ‘acoustical streaming’ that results in lens fragments being pushed away from the tip.

“Because WhiteStar Technology has a much lower energy output compared with other phacoemulsification units, there are less phaco dispersive forces pushing the nuclear fragments away from the tip,” Dr Baudouin said.

He added that the surgical technique for bimanual phaco is very easy to perform. Dr Baudouin uses topical anaesthesia with two clear corneal 1.2mm incisions made using a 20-gauge microvitreoretinal keratome. Capsulorhexis can be performed with a bent needle or with a specific small-incision forceps.

Bimanual nucleofractis is straightforward with this kind of technology, whether using divide-and-conquer, crater divide-and-conquer or chop techniques. He advised, however, that the irrigation handpiece lumen should be large enough to allow satisfactory infusion flow, especially when high aspiration flow rates are used during the procedure. The irrigation bottle should be elevated and Dr Baudouin said he preferred to use two irrigating holes in the event of one of the holes becoming blocked by lens fragments during the procedure.

A cold cold future for phaco

Summing up the benefits of bimanual phaco with WhiteStar technology, Dr Baudouin said it was a clear advance on previous phaco systems.

“There are multiple advantages with this system. It is unlikely to have a corneal burn using this cold, low energy technique; it is a tightly closed system that is safer during surgery, with a very
“There is no induced astigmatism and patients have rapid visual rehabilitation and theoretically, rapid wound healing with less risks of leakage or infection,” he said.

On the debit side, Dr Baudouin said that enhancements could still be made to make the system even better.

“Not everything is perfect right now. For a start, it is much more difficult to manoeuvre through a 1.2mm incision because the two incisions are very tight. The instruments could also be improved and we look forward to better tools to allow surgeons to become more confident with this kind of technique,” he said.

Finally, the stability of small-incision monobloc hydrophilic IOLs is still under debate and further studies are needed to assess small incision IOLs, concluded Dr Baudouin.

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