

Custom ablation puts the focus on quality of vision

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in Paris**

WAVEFRONT-GUIDED customised ablation is capable of improving both quantity and quality of vision for patients, but surgeons should be aware of its limitations and not consider it a silver bullet solution for all refractive ills.

That was the broad message to emerge from a number of papers presented here at the annual meetings of the French Implant and Refractive Surgery Association (SAFIR) and the French Society of Ophthalmologists (SFO).

"Using customised ablation, the concept is to correct not only sphere and cylinder as with traditional laser refractive procedures but also the higher order aberrations (HOAs) that can really impact on a patient's quality of vision," said Olivier Prisant MD.

Dr Prisant, who works in the Ophthalmology Department of the Foundation Rothschild in Paris, said that it was crucial for surgeons to appreciate that while excellent results were achievable with the latest customised ablation systems, there were limitations to be borne in mind for such procedures.

In particular, he noted that the final ablation could only ever be as accurate as the current measurement systems permitted and that there were certain uncontrollable variables that made it more difficult to consistently achieve the desired refractive outcome.

To illustrate the point, Dr Prisant cited the problem of obtaining repeatable and predictable aberrometric measurements.

"The problem of achieving consistent aberrometry measurements has been well analysed by Larry Thibos who effectively demonstrated that while repeatability is good over the course of the same day, it is less good from one day to the next, and even less so when evaluated from one month to the next," he said.

Another important factor which can play a role in giving variable measurements is accommodation of the eye, noted Dr Prisant, since when the eye accommodates, the lens changes shape which may also induce changes in higher order aberrations.

Similarly, the fact that most aberrometric measurements are taken through dilated pupils after cycloplegia also means that the system is not capturing the eye's HOAs under normal physiological conditions.

Furthermore, pupil size, which can alter as a result of varying conditions of light, dark,

accommodation and convergence, also affects HOAs and makes repeatable measurements all the more problematic to obtain.

The time factor

The ageing process introduces another important variable into the equation, noted Dr Prisant. "At a certain point we can take a profile of HOAs in the eye, but we have to appreciate that over time the ageing process induces changes in the lens and cornea that will significantly alter the aberrometric profile," he said.

Biomechanical factors also have to be taken into account, in particular the condition of the ocular surface and tear film properties. Dr Prisant pointed out that corneal pachymetry tends to change during the course of the day, introducing another potentially crucial variable into the procedure.

Another technological limitation concerns the fact that aberrometers take measurements using monochromatic light, whereas the eye perceives the world using multiple wavelengths. Current wavefront sensors are therefore unable to detect polychromatic aberrations, which might have a role to play in determining a patient's overall quality of vision.

Beyond the limitations imposed by aberrometric measurements and other physiological and biomechanical factors, delivery systems are another vital component in obtaining desired refractive outcomes.

Dr Prisant cited the importance of using a small-spot Gaussian beam laser with advanced eye-tracking technology to ensure pinpoint ablation, proper axis alignment and to minimise the effects of cyclotorsion.

He further noted that the creation of the flap in LASIK procedures may itself be responsible for inducing its own aberrations and that LASEK and PRK may therefore offer superior outcomes in terms of correcting eyes with higher order aberrations.

According to Dr Prisant, the role of neurophthalmology in vision also has to be taken on board by surgeons.

"Even if we achieve what appears to be a perfect optical result, we still have to determine to what extent the brain is actually capable of capturing these perfect images. Perfect optics do not necessarily assure perfect vision," he said.

Despite these limitations, Dr Prisant believed that custom ablation has much to offer in improving the quality of vision of refractive patients.

"As the research of Dr David Williams has demonstrated, a subjective improve-

ment in the patient's quality of vision can be achieved, as well as an improvement in visual acuity and contrast sensitivity," he said.

In a separate presentation, Béatrice Cochener MD, who works at the head of the ophthalmology department at Brest University (France) told delegates that custom ablation marked a clear point of departure from conventional refractive surgery.

"The ability to connect an aberrometer directly to an excimer laser for an integrated system that takes account of both quantitative and qualitative data marks an important technological development for refractive procedures," she said.

Dr Cochener said that as recently as two years ago, customised ablation was an approach that had fallen short of its early promise. "Initial results were less than satisfactory. Procedures were long and costly, the results were not markedly different to conventional ablation, there was a tendency to undercorrect and the fact that we were unable to treat irregular astigmatism were among some of its more obvious limitations," she said.

Marketing outstripping clinical reality She noted that while much had improved in the intervening period, surgeons still needed to be cautious in their deployment of such systems as the marketing was still running ahead of the clinical reality.

She stressed that more randomised, controlled, multi-centre trials were needed to objectively validate the claims of the manufacturers and objectively compare various available systems. Moreover, the fact that the systems used non-standardised methods of measuring and treating aberrations meant that no meaningful direct comparison was possible between different systems.

Like Dr Prisant, she noted the high number of variables that made it difficult to obtain reproducible and predictable aberrometric measurements.

"We know that the physiology of the eye modulates and influences the type and degree of aberrations. It varies from one individual to the next, over the course of a day, depending on pupil size, accommodation, age and other factors. We also have to appreciate the existing natural aberrations of the eye which might in fact be needed for obtaining perfect vision, and we are still not sure which aberrations might be worth keeping to maintain a patient's quality of vision. Definitely, "Super-Vision" appears to be defined in terms of vision quality and not only in terms of best visual acuity increase," she said.

She added that there were certain obsta-

cles that remained to be overcome for wavefront-guided custom ablation to fully deliver on its promise. For example, she pointed out that there was a considerable gap between the aberrations that could be detected by wavefront sensors (up to 18th order and beyond) and those that could actually be treated by the current generation of lasers (up to the 8th order).

Irregular astigmatism also continued to pose an ongoing problem for custom ablation platforms, she said, as it was not possible to take accurate wavefront measurements of corneas that were very irregular. She added that more research was needed on establishing whether certain aberrations stemmed from the retina, the lens or the cornea in certain cases, as this was vital for ensuring predictable outcomes.

"We need wavefront maps which take into account the aberrations of the entire optical system, not just the cornea. We also need to understand more about the role of the brain in vision and how it deals with optical aberrations," she said.

While the current system of Zernike polynomials had served refractive surgery well in categorising higher order aberrations, she felt that more advanced techniques and technology would ultimately expose its limitations and give surgeons new treatment options for their patients.

She emphasised that custom ablation platforms had improved a great deal in recent years and that while there were still obvious limitations on their performance, ongoing upgrades and improvements to the systems brought the promise of 'Super-Vision for all' closer to reality.

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