New IOLs in search of presbyopia's Holy Grail

Dermot McGrath in Dubai

The latest generation of accommodating intraocular lenses (IOLs) is making steady progress towards achieving the goal of providing variable focus in a pseudophakic eye, according to John A Vukich MD. Addressing delegates attending the IX Congress of the Middle East African Council of Ophthalmology (MEACO) Dr Vukich, associate professor of ophthalmology at the University of Wisconsin, said he believed that current technology is inching ever closer towards finding a solution to one of ophthalmology’s most intractable problems: how to restore accommodation in the pseudophakic presbyopic eye.

“We are continuing to see improvements in IOLs not only in terms of asphericity and proper optical correction, but also in the ability of the lens to provide not only a single plane of focus but a more natural focus.”

While acknowledging the impressive progress made in multifocal IOL designs in recent years, Dr Vukich suggested that the real breakthrough, in his view, would be to develop an IOL that effectively mimics the natural accommodative effect of the eye.

“What I would like to suggest is that if we could come up with a lens that would provide four dipters of peak accommodation and two dipters of sustained accommodation, then it would revolutionise the way we think about IOLs and would become the standard of care for our patients because ultimately that is what we are looking for,” he said.

Dr Vukich explained that there are two primary means of achieving some level of accommodative effect with IOLs. Firstly, there is the approach such as that used by the Crystalens (Eyeonics) where a single optic moves in a backwards and forwards motion along the axis of the eye in response to pressure changes that result from relaxation and contraction of the ciliary muscle.

The second approach, exemplified in the design of the Synchrony Dual Optic IOL (Visiogen), is to combine a high plus anterior optic with a negative posterior optic that move in apposition to one another. For distance vision, the two optics rest close together. When the patient focuses on a near target, forward movement of the front optic causes an increase in effective IOL power. As the ciliary body relaxes, capsular bag tension brings the front optic back to the resting state, thus restoring emmetropic distance focus.

Turning to the single optic approach, Dr Vukich said that he has been involved with early clinical trials of the Kellan Tetraflex IOL (Lenstec), a posterior chamber polyHEMA accommodating IOL with a 5.75mm optic which works on the basis of Helmholtz’s theory of accommodation.

While the exact mechanism of physiological movement in the process of accommodation is still not fully understood, Dr Vukich said that the basic idea is that movement in the ciliary body translates into a hydraulic effect that allows the lens to move, usually anteriorly, as a result of contraction or attempted accommodation.

In relation to the amplitude of accommodation available using this approach, Dr Vukich noted that this has traditionally been one of the sticking points of this type of IOL technology.

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“We know that there is going to be a theoretical limit in terms of how much accommodation we can get based on the power of the lens. If we assume that the lens can move 1mm as a result of accommodative effort, the amplitude of accommodation that you will get varies between 0.6 D and 2.1 D,” he said.

First-generation hinged IOLs were frequently criticised because of the unpredictable nature of their accommodative effect, which in some cases was actually found to cause negative movement of the IOL, as well as problems with posterior capsule opacification.

Dr Vukich noted, however, that the Tetraflex’s anterior angle orientation, with 5-degree contoured haptics and optic are designed to move as a unit without any hinge action. The haptic design allows the lens to move with the entire capsular bag and it does not require postoperative cyclopses.

In studies carried out by Sunil Shah MD, from the Midland Eye Institute, Solihull, UK, the subjective amplitude of accommodation for 100 patients at one month after Tetraflex implantation was 3.1 D (±1.5 D), with a range of 1 D to 6.4 D, and 1.7 D (±2.2 D) with a range of 1 to 6 D after six months. An objective study of 50 patients found objective amplitude of accommodation of 0.4 D (±0.6 D), with a range of 0 to 2.3 D after six months.

Dr Vukich noted that the effect of the lens clearly depends on more than just movement based on the accommodative effect.

“This is what keeps this field of research interesting and challenging. It is not only about the lens movement but also pupil size and depth of focus. So if you have implanted one of these single-optic lenses that are designed to move, whatever movement you get is going to be in addition to the depth of field that already exists. And we have formulas that help us to predict that,” he said.

Initial results from ongoing clinical trials of the Tetraflex lens in the US are encouraging, said Dr Vukich, but some issues remain in terms of delivering consistently high levels of spectacle independence.

“This IOL is a step in the right direction but it is not the definitive answer for the moment. One of the major issues of the single optic accommodating lenses is that they don’t always work and have been somewhat unpredictable,” he said.

In terms of the Synchrony Dual Optic accommodating IOL (Visiogen) currently in phase III clinical trials in the US, Dr Vukich said that the phase II results of the lens were very encouraging.

“The Synchrony lens seems to provide good functional vision at near, intermediate and distance ranges without any loss of contrast sensitivity. The good thing about this IOL is that it does seem to deliver some sort of accommodative effect and the dual optic concept works as it is supposed to,” he said.

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