MINI REVIEW

Bifocal intraocular lenses

The paper on quality of vision through diffractive bifocal intraocular lenses by Jay, Chakrabarti, and Morrison offers a careful and detailed study which will be of value to implant-lens surgeons who are or who are considering implanting bifocal intraocular lenses (IOLs). It may well fill in the physiological data gap of some of the more subjective papers on the topic. Good science with careful inbuilt checking for error has been used to assess depth of focus and contrast sensitivity.

The paper also raises questions of relevance to all types of bifocal intraocular lenses – the 'centre drop' design as well as the diffractive types. Both require careful centration, though the diffraction type less so, because both distance and near diffraction rulings are present in almost all zones of the lens.[1] The latter may, however, reduce light transmission slightly because of the machined or moulded-in diffraction ruling structure, and this has been shown to cause problems of reduced near vision in dim light. It may also introduce diffraction grating spectral effects, though these do not figure prominently in the literature.[1] On the other hand the diffractive type retains a balance between luminosity of the near and distance images for all pupil sizes.[2] This balance can be severely disturbed for the centre drop type, even to almost total extinction of the distance image in bright light miosis. Equally decentration by 2 to 3 mm can obscure much of the central near vision zone.

One must ask the question, is the simultaneous perception of both near and distance images in the same retinal focal plane a physiological state? While a blurred image of either distance or near in one scene containing both planes may well be physiological, superimposition of both these sharp images in the focal plane may reduce contrast sensitivity by wave interference at the photoreceptors.[3] Superimposition of two sharply focused near and distance images only rarely occurs physiologically by increased depth of focus at very bright luminance and with small pupil sizes.

There is also debate whether the diffractive type, with its inherently poorer optical quality and reduced resolution, can compare with the discrete bifocal 'centre drop' lenticle type.[4] The latter also have disadvantages with a miotic pupil, so that distance images are inevitably out of focus through the near vision centre lenticle at bright ambient luminance due to near total iris masking of the distance vision annulus.

In spite of these constraints many implanters of bifocal IOLs comment subjectively on their happy patients' response to these lenses,[4,5] though one reports a 14% negative response,[6] and another that only 50% are tolerated.[7] The truth probably lies between these views. Some people do well with bifocal spectacles and adapt rapidly while others never do. It would be a brave surgeon who would implant a bifocal IOL in a non-tolerator of bifocal glasses. Similarly bifocal contact lenses of the annular or the lower segment type are often poorly tolerated and rarely worn in the long term. Furthermore, the Diffrox type contact lenses raise much the same debate regarding contrast sensitivity and visual transfer function.

Some doubts are now being raised by experienced implanters of bifocal lenses.[8] Percival comments on both poor optical quality and tolerance.[6] Kasten-Aker and Kaufmann go further and express the increased risk of error and the possibility that the lens may have to be removed or replaced later with all its attendant surgical problems and hazards – a task few implanters approach lightly.[7] Though endocapsular or 'in the bag' implants may be easier to remove, severe disturbance to the eye can occur with trapped and fibrosed haptic loops, amputated loop remnants left in the eye, and disturbance of the iris or ciliary sulcus by haptic-uvea or ciliary sulcus tunnel adhesions. Even severe disturbance or loss of vitreous with its attendant risk of cystoid macular oedema can occur.

Kasten-Aker and Kaufmann cite 10 to 20% of patients unhappy enough to insist on removal of the IOL, especially when they cannot sort out the two images.[7] They state, 'Thus we create a permanent problem that cannot be fixed by spectacles', whereas monofocal IOLs almost invariably can be balanced or focused by spectacles, and the non-tolerant prescription for bifocal spectacles can easily be remedied by separate pairs of glasses.

This debate is of course incomplete and no one would wish to stifle innovation and development. The bifocal intraocular lens is undoubtedly a valuable innovation well within the ability and technique of the average implant surgeon. The future may lie with accommodating intraocular lenses, potentially a more physiological status. Some extraordinary devices are appearing.[9] There is even the suggestion of a molecular polymer transistor lens which might change refractive index, or shape, by altering cross linkages, and all this under the influence of the small electric potentials on the nearby ciliary muscle.[10] This sounds far fetched, but to some extent the future in science is arriving faster than we can anticipate, and nowhere faster than in intraocular lens surgery and technology. More probable are accommodating IOLs of very pure methacrylate polymers in the liquid glass phase inserted in super flexible envelopes in the posterior chamber or injected into the closed capsular bag itself, and there subject to zonular forces.[11] As Kelman has said, 'Our aim for the turn of the century must be to return our patients' sight after cataract surgery to that state of quality and accommodation that they had enjoyed at 28 years of age.'[12] While reduced retinal performance in age may well curtail this target, it is nevertheless a praiseworthy destination for the millenium.

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