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Case report

Hybrid monovision therapy in a patient with retinitis pigmentosa

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ABSTRACT

A 41-year-old female was diagnosed with retinitis pigmentosa (RP) after bilateral implantation of multifocal intraocular lenses (IOLs). Due to persistent dissatisfaction with her visual performance, she came to our hospital for medical help. We exchanged the multifocal IOL in the dominant eye with a monofocal IOL (hybrid monovision therapy), and the visual inconvenience was alleviated to a large extent. To our knowledge, this is the first case report on the effect of hybrid monovision therapy applied to a patient with RP.

1. Introduction

Multifocal intraocular lens (IOL) implantation is now commonly used because the patient does not need to wear corrective lenses for near and distant vision after a cataract extraction surgery. However, some optical adverse effects, such as decreased visual acuity, halo, and glare, may appear and cause inconvenience in a patients' life. Previous studies showed that the dissatisfaction with bilateral implantation of multifocal IOLs is related to decreased amplitude and extended peak latency in visual evoked potential (VEP).[1]

Retinitis pigmentosa (RP) refers to one group of hereditary diseases, and its prevalence rate is low. The clinical features include loss of visual field, abnormal electroretinography (ERG), and also abnormal VEP occasionally. The initial RP may be asymptomatic and not easy to be diagnosed timely during the examination prior to cataract surgery. Because both multifocal IOL implantation and RP exhibit negative effects on VEP, the synergic effect can lead to more severe photic phenomena if multifocal IOL is implanted in patients with RP.

A recent study proved that hybrid monovision therapy (the multifocal IOL in the dominant eye exchanged with a monofocal IOL) can increase the amplitude and shorten the latency in VEP, improving visual performance.[1] Nevertheless, previous studies reported only those cases in which clear-type IOLs were used in patients with normal fundi. No one has reported the application of this new therapy to patients with abnormal fundi and discussed its effects on visual performance. We herein present the first report on the application of hybrid monovision therapy to a patient with RP.

2. Case report

A 41-year-old female suffered from decreased vision and severe photic phenomena lasting for more than 3 months after bilateral implantations with multifocal IOLs (M-flex 630N, Rayner, Hove, East Sussex, UK). Due to persistent discomfort and inconveniences in daily life, she came to our hospital for medical help. Prior to hybrid monovision therapy (after the patient has received multifocal IOL implantations for both eyes in another hospital), the standard ERG of both eyes revealed a normal amplitude and implicit times of the patient's rod and maximal responses. The average value of central multifocal ERG response of the patient was normal, but that of the peripheral multifocal ERG response was reduced to 35 nV (normal range 71–115 nV). Based on the results of ERG examinations, the patient was diagnosed with an early-stage RP. The spherical equivalent (SE) was −0.50 in the right eye (dominant eye) and −1.00 in the left eye (nondominant eye). Her best-corrected visual acuity was 20/40 in the right eye and 20/40 in the left eye. The degree of photic phenomena was assessed via a modified questionnaire based on the study published by Arnold[2] (Table 1) and visual functions were assessed via a modified questionnaire

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Table 1
Modified questionnaire for photic phenomena evaluation.

1. After your eye surgery, did you notice photic phenomena that you had not noticed prior to surgery?
_ Yes
_ No
If you answered Yes, please answer the following questions.
2. What did your photic phenomena seem the most like? (You may check more than one.)
_ A curved STREAK of light—an arc or a semicircle of light, usually seen in darkness or dim lighting conditions and lasting only for seconds
_ A HALO of light—a circle or a nearly complete circle of light, usually seen in darkness or dim lighting conditions around a point source of light, such as a headlight or a streetlight
_ A FLARE of light—a streak or "tail" of light that proceeds consistently from the same area and goes in the same direction when a point source of light is viewed
_ A FLASH of light—a very brief spot, splash, or streak of light that may move and does not seem to come from a point source of light
_ A GLARE—reduced sharpness of vision in bright lights; may also have halos in association
_ Other symptoms not mentioned above
3. Have these photic phenomena gone away?
_ Yes
_ Almost completely
_ No
4. How severely do these photic phenomena disturb you?
On a scale of 0–4, where 0 is equated with "no daily-life restriction" and 4 with "extreme daily-life restriction" due to photic phenomena

adapted from the National Eye Institute Visual Functioning Questionnaire-25 (NEI VFQ-25)[3] (Table 2).

Considering that the neuroadaptation may take a longer time, we extended the observation period for another 6 months after the patient's first visit to our hospital. During the observation period, complete ophthalmologic examinations were carried out to exclude dry eye, posterior capsular opacity (PCO), or IOL decentration. Six months later, the patient still suffered from severe visual inconveniences even when spectacles or contact lenses were used. The major symptoms were decreased visual acuity and severe photic phenomena, including halo, glare, flare, and double vision. Day- and night-time life functions were strictly limited. In our clinical experiences, the symptoms of this patient were much more severe than other cases with normal fundi.

We applied hybrid monovision therapy and exchanged the IOL in the dominant eye with an UV-light-filtering monofocal foldable lens (aspheric monofocal IOL, ZCB00, AMO, Milpitas, CA, USA). The IOL power was selected for distance visual acuity (0.00 D). Three months after the hybrid monovision therapy, ophthalmologic examinations were performed. No postoperative complication was noted. Spherical equivalent of the dominant eye was 0.05 and its best-corrected visual acuity increased to 20/30. Halo disappeared completely. The glare and flare were improved from a score of 4 to that of 2. The double vision scores improved from 4 to 2.

The differences in vision prior to and after the hybrid monovision therapy are evaluated more specifically as follows. Prior to the operation, double vision was significant when the distance of the objective was greater than 10 m at day and 5 m at night. After the operation, the symptom was noted only when the distance of the objective was more than 60 m at day and 15 m at night. Prior to the therapy, the results of visual functional evaluations indicated that the patient was able to read only the title of a newspaper in a high-illumination condition. After the therapy, because the power of the monofocal IOL was selected for distance visual acuity, the patient had to wear spectacles to read; however, she could now read small-print texts in newspapers with near-refractive correction. The patient could also recognize objects passing through the space in a dim light condition, which she was not capable of prior to the operation. Therefore, driving at daytime became safe enough after the operation because the patient could now recognize traffic lights and vehicles clearly. However, it was still too dangerous for the patient to drive at night.

Table 2
Modified questionnaire for visual function evaluation.

1. How much difficulty do you have reading ordinary print in newspapers? (0 = none, 4 = extreme)
2. How much difficulty do you have in seeing objects close to you in poor or dim light? (0 = none, 4 = extreme)
3. How much difficulty do you have driving during the daytime? (0 = none, 4 = extreme)
4. How much difficulty do you have driving at night? (0 = none, 4 = extreme)
5. At present, would you say your eyesight using both eyes (with glasses or contact lenses, if you wear them) is excellent, good, fair, poor, or very poor or are you completely blind? (0 = excellent, 4 = very poor)

3. Discussion

Neuroadaptation, which takes usually about 6 months, is a key factor for multifocal IOL implantation.[4] However, visual outcomes after multifocal IOL implantation can be influenced by many factors other than neuroadaptation, such as ametropia, dry eye syndrome, PCO, and retained lens fragments.[5,6] These problems can be resolved by refractive surgery, spectacles, artificial tears, or laser capsulotomy. If the visual inconvenience cannot be improved effectively by these noninvasive or minimal invasive methods, IOL exchange may be considered.

In this case, we believe that the severe visual dissatisfaction was related to the mechanism of a multifocal IOL and the retinal photoreceptors. A multifocal IOL is designed to create near and far foci simultaneously. Multifocal IOLs are primarily of two types: diffractive and refractive types.[7] The diffractive type is near dominant and associated with about 18–20% light transmission loss. Light distribution is approximately 70% at a near distance and 30% at a far distance.[8] The refractive type is distant dominant and has no light transmission loss. Light distribution is 70% at a far distance and 30% at a near distance.[9] In short, for patients undergoing either diffractive- or refractive-type multifocal IOL implantation, light-sensing cells of the retina do not receive 100% light from the subject at any distance.

Second, as mentioned earlier, previous studies have shown that the dissatisfaction after bilateral implantation of a multifocal IOL is related to a decreased amplitude and extended peak latency in VEP.[1] Moreover, if the patient had defective retinal cells, VEP stimulation would be worse than in those with normal cells. The combination of these two factors may have caused serious visual symptoms in this patient.

After the monofocal IOL exchange in the dominant eye, the light converges to one focus and no loss in intensity occurs, causing stronger photostimulation to retinal cells. Furthermore, because of the decrease of complexity in the dominant eye, the photic phenomena were much more improved and the degree of interocular suppression also decreased. These synergic factors brought significant improvement in visual performances. In this case, we measured the P100 amplitude and peak latency in VEP examinations. After the operation, the amplitude in the dominant eye increased from 7.1 μV (preoperation) to 10.9 μV (postoperation) and that in the nondominant eye increased from 6.9 μV to 7.5 μV. The peak latency in the dominant eye improved from 148 ms to 121 ms and that in the nondominant eye improved from 149 ms to 139 ms. The improvement percentage in the P100 amplitude of the dominant eye is six times better than that of the nondominant eye, and that in the peak latency of the dominant eye is almost three times better than that of the nondominant eye.

IOL exchange is a higher-risk method in dealing with the dissatisfaction after multifocal IOL implantation.[10–13] The status of

the posterior capsular bag also plays a critical role in IOL exchange. PCO can disrupt the optical properties of a multifocal IOL and cause light scattering. Therefore, Nd:*YAG* (neodymium-doped yttrium aluminum garnet) capsulotomy is often used to remove opacity from the visual axis. Nevertheless, the broken capsule may increase the intraoperative risk, e.g., vitreous prolapse, in IOL exchange, and in case of such conditions, anterior vitrectomy would become necessary, causing a longer operation time and higher infection rate.[10] Therefore, it is very important to ensure whether PCO is the source of dissatisfaction prior to performing an IOL exchange. Furthermore, if hybrid monovision therapy is to be applied to patients who suffer from discomfort after bilateral implantations of multifocal IOLs, proper evaluations need to be performed to decide which eye should be exchanged to offer more advantages.

In our case, the hybrid monovision therapy was very effective in improving the visual functions of the patient with abnormal fundi. We hope our report can provide useful information to other ophthalmologists.

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