

Case Report

Use of Binocular Prismatic Lens Correction in Glasses of Patients with Central Retinal Impairment – A Case Report

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Most degenerative or dystrophic macular and foveolar diseases cause a decline in central visual acuity and also impair binocular visual functions and fixation stability. We are investigating the possibility of potential vision improvement with the aid of binocular prismatic correction in patients with central macular impairment. Our findings indicate that we can often reach a better visual performance and eliminate a number of accompanying complaints by using prismatic rather than normal “non-prismatic” lens correction.

Keywords: Binocular correction; Age-related macular degeneration; Retinitis pigmentosa; Binocular summation; Visual acuity

Introduction

Given the demographic composition of our society, the number of patients suffering from age-related degenerative retinal changes and hereditary dystrophies in late stage is rising. The majority of these disorders lead to significant and irreversible downgrade of central visual acuity, which is usually unequal between the two eyes. The resulting difference between the two retinal pictures can induce so called binocular inhibition [1], when the binocular visual acuity and contrast sensitivity becomes worse than that of the monocular vision of the better eye [2]. The stability of fixation is significantly reduced because of the damaged foveola, which serves as a referential position for the whole motoric system [3]. These factors naturally weaken the ability of central fusion. The functions of the severely damaged foveola are taken over by the so called “preferred retinal locus” (PRL), which is located on the border of the central scotoma, where the retinal structures are less damaged or intact [3]. The farther the PRL lies, the poorer is the fixation stability of the eye, and this is more noticeable in the worse eye [4]. The question is whether this leads to the redetermination of the directional values of the peripheral retinal areas relative to the new PRLs and to the abandonment of the old link to the destroyed fovea, and if so, how long does this redetermination take. This “reorganization” of retinal relationships could eventually represent itself as kind of fixation disparity or anomalous retinal correspondence. Another result of foveal deterioration could likely be the lesser compensation of latent strabismus, as the significant difference in retinal picture quality between the less and more impaired eye logically decreases the quality of fusion stimuli. The less compensated heterophoria, which could even lead to a noticeable squint, further impacts the quality of vision both in the sense of binocular visual acuity and of spatial vision (e. g. space estimation) and could therefore represent a safety risk and challenges in everyday life.

Heterophorias are quite easily corrected with the aid of prismatic glasses. Our actual study therefore examines the use of prismatic binocular lens correction in glasses, in particular of patients with

central retinal impairment, and verification of its contribution in the process of rehabilitation of retained visual functions.

Methodology

As part of our study we examine refraction in individuals with central retinal impairment diagnosis. For distance vision we use a 15” LCD optotype with Snellen’s characters for monocular vision examination and complete MKH methodology (Mess- und Korrektionsmethodik nach Haase) with separation using a positive polarization for binocular vision examination. The near vision is examined using Optoprox optotype with negative polarization binocular tests. The finest stepping of corrective lenses power is $\pm 0,25D$ or $0,25pD$. Further some supplementary criteria are determined – near point of convergence, freedom of eyeballs motility and occurrence of diplopia in 9 gaze directions (ahead, up, down, rightwards, leftwards and combinations).

Based on the results of the examination two pairs of spectacles are completed: Glasses for near and distant vision with the best tolerated binocular (prismatic) correction (surveyed correction) and identical glasses for near and distant vision only with the sphero-cylindrical correction (comparative correction). The patient’s task was to wear these 2 types of correction, each for a period of one month in succession. On grounds of blinding of the study, patients weren’t informed, which kind of correction they are already wearing. At the time of handover and changing of the glasses and after termination of the second month of wearing the spectacles the visual acuity (monocular / binocular) as well as the mentioned supplementary criteria was controlled. At the conclusion of the study, patients are asked to fill a short questionnaire with subjective estimation of both types of correction (personal appreciation of visual acuity / sharpness, comfort of vision, difficulty of habituation to the correction, stability of vision and the overall satisfaction with correction). It means, we do not follow up only the objective difference in visual performance (visual acuity with and without binocular prismatic correction), but even the personal sensation of the correction which is hardly

Figure 1: Values of visual acuity in the previous 6 years in the Case No. 2.

Year	Corrected visual acuity (right eye, far)	Corrected visual acuity (left eye, far)	Corrected visual acuity (binocular, without prism, far)	Corrected visual acuity (binocular, with prism, far)	Corrected visual acuity (right eye, near)	Corrected visual acuity (left eye, near)	Corrected visual acuity without prism (binocular, near)	Corrected visual acuity with prism (binocular, near)
2008	0,80	1,00	1,00	1,00	1,00	1,00	1,00	1,00
2009	0,70	1,00	1,00	1,00	0,80	1,00	1,00	1,00
2010	0,60	1,00	0,90	1,00	0,80	1,00	0,80	1,00
2011	0,60	0,90	0,90	0,90	0,80	0,80	0,80	0,80
2012	0,50	0,80	0,80	0,80	0,80	0,80	0,63	0,80
2013	0,50	0,50	0,40	0,50	0,50	0,50	0,50	0,50

describable by the objective methods, but plays an important rule on acceptance and utility of the correction. On the grounds of minimization of influence of progression of the retinal impairment on the general results in one test cycle, patients were split into two groups according to order of wearing the experimental correction. Availability of patients' past refraction examination results provides us good opportunity to observe the long-term development of binocular refraction.

Case Reports

We'll mention two representative cases from our current research "Binocular refraction in patients with central retinal impairment". Both of them are typical examples of patients with diseases of the macula, in whose cases we utilize prismatic lens correction.

Case report No. 1

A woman (88 years) suffering from bilateral AMD (geographical atrophy on the right eye and ablation of the retinal pigment epithelium (RPE) on the left eye) and incipient corticonuclear cataract. The first examination of refraction was completed by us 6 years ago shortly after the manifestation of AMD. At that time the best visual acuity with correction was 0,7 in the right eye, 0,8 in the left eye and 0,9 binocularly with prismatic correction of the 0,5pD hyperphoria. This vision was subjectively considered as more comfortable and sharper than that without the prismatic correction. With the addition of 2,5D and correction of 0,5pD hyperphoria the visual acuity at near distance (35cm) was 1,0 binocularly. The next examination of refraction was completed by us after 4 years. Because of the AMD progression, the patient's best corrected visual acuity was 0,3 in the right and 0,5 in the left eye. The value of the "latent strabismus" (hyperphoria on the right eye) increased to 4,5pD, of which 3,0pD is compensated by motoric and 1,5pD by sensory fusion. Vision through the prismatic lens correction in the glasses supports stability of the perceived picture, improves assurance in movement and spatial estimation, minimizes line skipping or blending while reading and, in general, is subjectively more comfortable than without the application of prismatic values, although the binocular visual acuity doesn't exceed the monocular visual acuity of the better (left) eye (0,5). Surprisingly, the prismatic values remained the same even for the reading distance of 35cm (with addition 2,5D).

This patient is a typical example of appropriate application of prismatic correction when a central retinal impairment is present. Residual visual acuity still allows the examination of binocular refraction and at the same time achieves a result whereby the subject is able to assess the difference between the vision with prismatic vs. regular correction. The vision with the prismatic correction is appreciated as steadier and more comfortable in general for distance as well as near vision. Although binocular summation doesn't seem to be present in this case in the context of visual acuity, the most important fact (in addition to the subjective feeling) is that the binocular visual acuity isn't worse than the individual visual acuity of the better eye, which isn't always common in individuals with central visual impairment.

Case report No. 2

Based on the findings about binocular functions in AMD patients [1][2][3][4] we decided to verify the effectiveness of prismatic correction in patients with other forms of macular diseases. An example is a woman (78 years) with retinitis pigmentosa diagnosis and symptomatic development from the age of 36. We followed changes in her eyesight refraction during the last 6 years. The patient had bilateral cataract surgery 3 years ago. We observed a slow downgrade of visual acuity (Figures 1 & 2), hemeralopia and photophobia, occasional

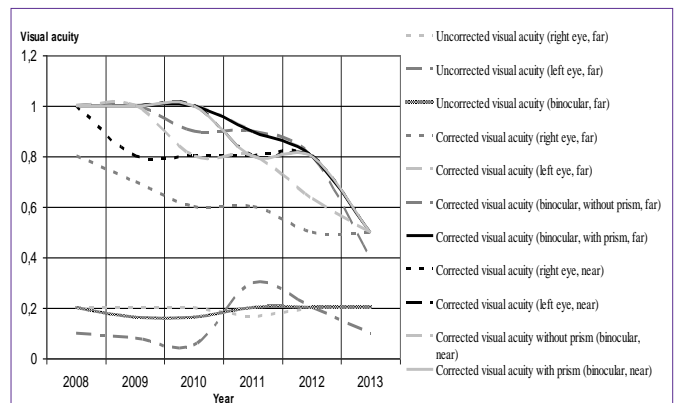


Figure 2: Progression of visual acuity loss during the 6 years in Case No. 2. The growth of the uncorrected visual acuity between 2010 and 2011 was caused due to cataract surgery.

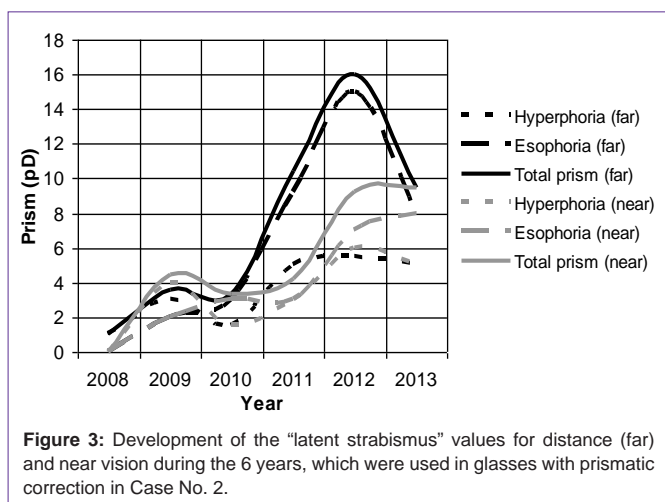


Figure 4: Prismatic values of the glasses for near and distance vision in the previous 6 years in Case No. 2.

Year	Prism (right eye, far)	Basis (right eye, far)	Prism (left eye, far)	Basis (left eye, far)	Prism (right eye, near)	Basis (right eye, near)	Prism (left eye, near)	Basis (left eye, near)
2008	0,50	270	0,50	90	0,00		0,00	
2009	1,80	236	1,80	56	2,24	243	2,24	63
2010	1,68	206	1,68	26	1,68	206	1,68	26
2011	5,23	208	5,23	28	2,12	225	2,12	45
2012	8,00	200	8,00	20	4,60	221	4,60	41
2013	4,72	212	4,72	32	4,72	212	4,72	32

diplopia and instability of text lines, projection of characters between two lines, etc. Prismatic values of binocular correction were changing continually (combination of vertical and horizontal deviations) with a tendency of slow growth (Figure 3 & 4), while the visual acuity was degrading in both eyes (Figures 1 & 2). Because of the gradual changes, a correction was adjusted at least once a year, with prismatic correction always favored over "normal" correction. At the end of the period under consideration a significant decline of the visual acuity of the left eye to 0,16 was observed because of the development of a choroidal neovascularization (CNV) and, as a result, the visual acuity became too poor to allow a reliable examination of binocular refraction using standard methods.

We didn't record any undesirable side-effects such as changes in spatial perception, picture distortion etc., associated with the use of prismatic lens correction by this patient. On the other hand, in the questionnaire she reported feeling of better stability, sureness while reading, "Clearer" and relaxed vision and lower sensitivity to glare. It is obvious in this case that the amplitude of changes of prismatic values in the correction is comparatively higher than in majority of healthy population. This could be an impact of changes on fundus in relation to destruction and creation of new fixation spots, deforming and lifting up the retinal layers after hemorrhages, edemas and formation of drusen.

Conclusion

Binocular visual functions can be worsened due to impairment of central retinal areas. Some symptoms (diplopia, asthenopia, deteriorated stereopsis) can be moderated or eliminated using appropriate prismatic glasses in combination with correction of the basic refractive error and presbyopia. When we are able to compare the results of examination of binocular refraction over a long period of time, we can usually find gradual increase of prismatic corrective values in horizontal as well as vertical direction, which could be related to the progression of the macular disease. The lens correction using prisms is usually well tolerated by patients, but it is recommended to regularly check potential changes in binocular refraction, which are quite common and more prevalent than in a healthy population.

The limiting factors to the use of prismatic lens correction in glasses of patients with central retinal impairment are primarily the central

visual acuity of the worse eye (binocular vision examination becomes virtually impossible when visual acuity decreases to values from 0, 3 to 0,1) and technological and optical possibilities of manufacturing of corrective components (impossibility of correction of cyclophorias). Despite this, based on our experience, we recommend examinations of binocular vision and its correction not only in individuals with healthy eyesight, but also in patients with central retinal impairment, where it can help improve not only the subjective comfort of vision, but also the objective visual enhancement. We are now undertaking a larger study of these problems and expect to publish the results in the near future.

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