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Prismatic correction in patients affected by age-related macular degeneration

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Objective: To evaluate by means of a controlled clinical trial the effectiveness and the tolerance of prismatic correction in improving visual function in patients affected by advanced bilateral age-related macular degeneration.

Setting: Department of Ophthalmology, Eye Clinic, University of Trieste.

Subjects and interventions: Each patient underwent an ophthalmologic examination, complete with distance visual acuity measurement using the Standard Early Treatment Diabetic Retinopathy Study chart. Patients were then randomly assigned to the treatment or control group. The treatment group received spectacles lenses with a prismatic correction of low power (5–7 prismatic dioptres) in the better eye.

Main measures: Visual acuity was measured at baseline and 1, 90, 180 and 360 days after prescription in both groups.

Results: The treatment group consisted of 14 patients, while the control group was of 14 patients. The prismatic correction was well tolerated in 85.7% of cases. Visual acuity in the treatment group improved mostly at three-month follow-up, with a slight further improvement at the six- and 12-month follow-ups, showing a statistically significant difference in comparison with the control group. No visual acuity improvement was registered in the control group.

Conclusion: Monolateral prismatic correction may be considered a viable means to improve visual function in patients affected by bilateral age-related macular degeneration at an advanced stage.

Introduction

Age-related macular degeneration (AMD) is a disorder of the macula characterized by progressive loss of central vision. It is currently the leading cause of irreversible blindness in industrialized countries, affecting approximately 1 in 20 people

over the age of 60 years.¹ Visual acuity loss is the result of either geographic atrophy or choroidal neovascularization.^{2–4} In both forms of AMD the end-stage is characterized by severe macular dysfunction, with development of central scotoma of various densities.

In the affected patients the visual system naturally shifts the fixation to one or more eccentric preferred retinal loci immediately adjacent to the fovea, in order to perform foveal visual tasks such as object recognition, reading, and tracking.^{5–8}

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Several methods, including the use of magnifying instruments (microscopes or telescopes), large print materials or computer and video display-based systems, have been employed to compensate loss of foveal vision and enable resolution of objects by preferred retinal loci.^{9–13} Some authors have described the use of prism relocation in patients with macular dysfunction in order to train eccentric viewing areas and thus to improve their visual performance.^{7,13–17}

The aim of our study was to evaluate by means of a controlled clinical trial the effectiveness and the tolerance of prismatic correction in improving visual function in patients affected by advanced bilateral AMD.

Materials and methods

Patients bilaterally affected by advanced AMD referred to the Retina Service of the Eye Clinic from December 1999 to October 2000 were considered for the study. Inclusion criteria were: presence of bilateral exudative AMD at an advanced stage, visual acuity greater than 0.5 logMAR (minimum angle of resolution), stable visual acuity for at least one year, signed informed consent. Exclusion criteria were: presence of any other ocular disease able to impair visual function, presence of disorders causing choroidal neovascularization other than AMD, previous laser photocoagulation.

Patients were then randomly assigned to the treatment or control group, following a computer-generated list using a block randomization scheme.

Each patient underwent an ophthalmological examination, complete with distance acuity measurement using the Standard Early Treatment Diabetic Retinopathy Study (ETDRS) chart. This is a logMAR chart with logarithmic progression of letter sizes allowing accurate and repeatable measurements, particularly for low visual acuity values. Visual acuity was measured by an author (MD) who was unaware of the purpose of the study and the condition of the patient, at baseline and 1, 90, 180 and 360 days after prescription in both groups. The treatment group received spectacles providing prismatic correction. More specifically, a prism of low power (4–7 prismatic dioptres) placed in front

of the better eye was rotated to the position of clearest vision. Low-power prismatic correction was specifically chosen bearing in mind that reading tasks had previously been successfully performed using low-power prisms (<8 prismatic dioptres), whereas a correction with high-power prismatic lenses (≥ 15 prismatic dioptres) was reported to be associated with negative response in up to 47% of cases.⁷

Visual acuity in the control group was assessed in the same way, using the best optical correction (without prismatic correction) that had been prescribed at baseline. Particular attention was paid to the possible negative effects of wearing the prismatic lenses by asking patients if they experienced dizziness, optical distortion of the image, diplopia, difficulty in walking or discomfort owing to the weight of the lens. The variation of visual acuity during the study period was evaluated using the analysis of variance (ANOVA) for repeated measurements. This statistical test evaluated the variations both within the group and between groups. Statistical analysis of the variation of consecutive time point measurements was carried out using Student's *t*-test.

Results

Overall, 50 patients were considered for the study. Twenty-two out of 50 patients were excluded from the study because of refusal to give informed consent (two patients), visual acuity lower than 0.5 logMAR (10 patients), previous laser photocoagulation (10 patients). The 28 remaining patients eligible for the study according to inclusion and exclusion criteria were randomized to the treatment group (14 patients) and to the control group (14 patients).

Mean age in the treatment group was 72, (range 63–78), with mean visual acuity of 1.06 ± 0.17 logMAR.

In the control group the mean age was 71 (range 65–77) and mean visual acuity 1.06 ± 0.21 logMAR.

Complete results are listed in Table 1. All the treated patients except for two (patients 13 and 14) (85.7%) stated that prismatic correc-

Table 1 Visual acuity (VA) in controls and cases at 1, 90, 180 and 360 days

| Visual acuity (logMAR) | | | | | | | | | | Eye/prismatic dioptr/orientation |
|------------------------|------|---------|------|---------|------|----------|------|----------|------|----------------------------------|
| Baseline | | 1 day | | 90 days | | 180 days | | 360 days | | |
| Control | Case | Control | Case | Control | Case | Control | Case | Control | Case | |
| 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 0.70 | 1.00 | 0.50 | 1.30 | 0.50 | Left/5/130° |
| 1.00 | 1.00 | 1.00 | 0.80 | 1.00 | 0.70 | 1.00 | 0.70 | 1.00 | 0.70 | Right/4/0° |
| 1.00 | 1.00 | 1.00 | 0.80 | 1.00 | 0.70 | 1.00 | 0.70 | 1.00 | 0.50 | Left/5/0° |
| 1.00 | 1.00 | 1.00 | 0.70 | 1.00 | 0.70 | 1.00 | 0.70 | 1.00 | 0.70 | Right/5/180° |
| 1.18 | 0.70 | 1.18 | 0.70 | 1.00 | 0.70 | 1.30 | 0.40 | 1.00 | 0.40 | Right/4/180° |
| 1.30 | 1.30 | 1.30 | 1.00 | 1.30 | 1.00 | 1.30 | 0.50 | 1.00 | 0.50 | Left/4/180° |
| 1.30 | 1.30 | 1.30 | 1.18 | 1.00 | 1.00 | 1.30 | 1.00 | 1.30 | 0.70 | Left/7/130° |
| 1.30 | 1.00 | 1.30 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | Left/5/130° |
| 1.30 | 1.30 | 1.30 | 0.90 | 1.00 | 0.70 | 1.30 | 0.70 | 1.30 | 0.70 | Right/7/70° |
| 1.30 | 1.30 | 1.30 | 0.90 | 1.30 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | Right/5/120° |
| 1.00 | 0.90 | 1.00 | 0.80 | 1.30 | 0.70 | 1.00 | 0.70 | 1.30 | 0.70 | Right/5/0° |
| 0.90 | 1.00 | 0.70 | 0.80 | 1.30 | 0.70 | 1.30 | 0.70 | 1.00 | 0.70 | Left/5/120° |
| 0.80 | 1.18 | 1.00 | 0.80 | 1.30 | | 1.00 | | 1.00 | | Right/5/0° |
| 0.80 | 1.00 | 0.70 | 0.90 | 1.30 | | 1.00 | | 1.00 | | Left/5/180° |

tion was well tolerated. More specifically, the two above-mentioned patients who refused the correction experienced great difficulty in walking and thus suspended the use of the correction within 10 days from the beginning of the follow-up. In any case, it is worth noting that their visual acuity improved respectively from 1.18 to 0.8 and from 1 to 0.9 the day after the application of the prismatic correction.

Mean and standard error of visual acuity for both groups are reported in Figure 1.

Analysing the treatment group (12 patients), mean visual acuity revealed a progressive improvement throughout the follow-up period, showing a statistically significant difference in comparison with the control group. A statistically significant improvement of visual acuity was not found in the control group. Assuming a lens–cornea distance of 13 mm, the image displacement from the fovea, in relation to the position of the prism base, turned out to vary from 0.57 mm to 0.91 mm using prismatic lenses from 4 to 7 prismatic dioptres. Eye

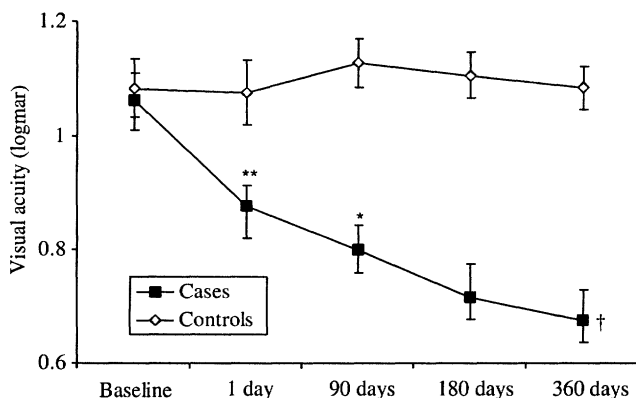


Figure 1 Mean visual acuity (VA) and standard error in controls and cases at baseline and 1, 90, 180 and 360 days (logMAR). † $p < 0.001$, ANOVA test for repeated measurements within group * $p < 0.05$; ** $p < 0.001$, t -test for paired data versus previous time point ANOVA test for repeated measurements between the two groups indicated that the change in the case group was statistically different than that of the control group ($p < 0.001$).

movement to resume the fixation was not noticed in any case after the prismatic correction.

Discussion

Several methods have been proposed to compensate visual loss in patients with macular diseases: magnification with low vision aids, use of larger than normal printed material, training to exploit eccentric viewing.^{9–12} Prism correction, shifting the image from the fovea to eccentric preferred retinal loci, has been reported to be a promising treatment for macular-related low vision. In the same way as ankle-foot orthosis provides a valuable aid in walking when ankle dorsiflexion is impaired in people with hemiplegia,¹⁸ the prisms can be considered a useful tool to overcome an untreatable condition such as advanced AMD.

Studies of prism relocation differ greatly from one another and do not provide clear long-term results. The study by Ramayananda recorded an improvement of near vision, using a prismatic scanning technique in 59 patients with macular lesions.¹³ In a controlled clinical trial, Rosenberg reported a functional improvement in over 90% of patients in whom bilateral prism correction was given for distance, intermediate and near vision, as compared with 60% in the control group.¹⁵ Using high prismatic lenses, Verezen noticed an improvement of visual capacities in 61% of treated patients.⁷ Bertrand reported an improvement of visual acuity of at least one line in 92.86% of patients with bilateral AMD after prismation of both eyes.¹⁴

The importance of the macular perimetry in defining the characteristics of preferred retinal loci by means of scanning laser ophthalmoscope has been brought out in research.^{19–22} Microperimetry allows precise measurement of focal retinal sensitivity and the fixation points. In particular, a tendency for PRL to hug the edge of the scotoma has been highlighted in AMD.²² Unfortunately, scanning laser ophthalmoscopes are not commonly available in a standard clinical practice.

Bearing in mind all these aspects, we decided to carry out a clinical trial in order to evaluate the effectiveness and the tolerance of the prismatic

correction in the better seeing eye of patients bilaterally affected by advanced exudative AMD.

Our approach to prism relocation offers some advantages: it is simple and thus accessible to all clinical practices; it is cheap and does not require expensive instruments; it employs low-power prisms, so is more likely to be tolerated by patients. The results achieved are encouraging. Eighty-seven per cent of treated patients tolerated the prismatic correction well and showed increased visual acuity, whereas none of the patients in the control group revealed an improvement in visual function. The latter finding may be explained by recalling that only patients with visual acuity stability for at least one year were selected. These patients had therefore already achieved a spontaneous visual acuity improvement before entering the study.

Binocular function was not evaluated and this could be a flaw in the study. Nevertheless, most patients did not complain of experiencing any difficulty in their daily activities.

The finding that visual acuity kept on improving up to the 12th month in all but one patient is of considerable significance, suggesting a training effect on preferred retinal loci.

In agreement with previous studies on fixation patterns,^{19,22,23} the prism orientations in our patients may indicate that preferred retinal loci were mainly placed above the central scotoma, even though the preferred retinal loci site to the left or the right of the fixation was also possible.

It has been postulated that prismatic correction, shifting the image toward the eccentric retinal areas, is effective in helping patients use their preferred retinal loci, without any or with reduced eccentric viewing. In particular, it is of interest that even a low prismatic correction determining a small retinal displacement has a significant effect

Clinical message

- A controlled clinical trial shows that monolateral prismatic correction may be considered a viable means to improve visual function in patients affected by bilateral age-related macular degeneration at an advanced stage.

on visual acuity, probably owing to a better visual coordination. The normalization of the position of the eye and head and consequent improved posture might lead to improved integration in the cerebral cortex of images forming in the eccentric retinal areas.^{14,15}

In conclusion, our results show that monolateral prismatic correction may be a viable means to improve visual function in patients affected by advanced bilateral AMD.

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