*Neuro-ophthalmology*, 35(3), 138–143, 2011

ISSN: 0165-8107 print/ 1744-506X online
DOI: 10.3109/01658107.2011.580886

informa
healthcare



CASE REPORT

# Successful Rehabilitation of a Homonymous Hemianopia Patient with Binocular Ground-in Sectorial Prisms: Considerations concerning Prism Power and Location

Fernando J. Palomar-Mascaró,[1] Mª. Virginia Palomar-Mascaró,[2] Genís Cardona,[3] and Lluïsa Quevedo[3]

[1]*Consultorio Oftalmológico Palomar, Barcelona, Spain,* [2]*Centro Oftalmológico Palomar, Barcelona, Spain, and* [3]*Department of Optometry, Universitat Politècnica de Catalunya, Barcelona, Spain*

## ABSTRACT

A case describing the successful rehabilitation of a patient with a right homonymous hemianopia field loss is presented. The patient was fitted with binocular 20-dioptre ground-in sectorial prisms, following a 2-month trial with Fresnel paste-on prisms. Successful fitting of binocular sectorial prisms was achieved through adjustment of prism power and location to ensure smooth transition between both hemifields of view and to avoid diplopia in primary gaze. Prism power was obtained through empirical calculation based on distance and near prism power requirements, as determined with trial lens prisms, which also allowed for determination of the best prism location.

**Keywords:** hemianopia, low vision, prism adaptation, rehabilitation, visual field



Homonymous hemianopia (HH) is a disorder of the visual field with loss of vision in both monocular hemifields, contralateral to the side of brain injury.[1,2] The prevalence of HH is of approximately 0.8% in the general population older than 49 years,[3] with about 2 million stroke survivors in rehabilitation suffering from either HH or hemineglect in the United States annually.[4,5] Homonymous hemianopias from postchiasmatic visual pathway injuries are primarily caused by posterior cerebral artery infarction and, to a lesser extent, by head trauma, tumours, and surgery.[1,2]
Patients diagnosed with HH, even with fair distance and near visual acuity, complain of significant difficulties in their daily activities, including inadequate mobility, frequent collisions with unseen objects, and other limitations in such tasks as shopping, financial management, telephone usage, meal preparation,[6,7] and driving.[8] Reading is particularly affected by the visual loss that accompanies HH, with a reduction in reading speed, an increase in visual omissions and guessing errors, and an alteration in the pattern of ocular movements as the most frequently documented symptoms of hemianopic dyslexia.[2,9] As a consequence of these limitations, some patients adapt to their visual field loss by developing highly specific and task-dependent compensatory eye and head movement strategies, soon after brain injury.[10]
Visual field loss rehabilitation in HH has been approached by training patients to improve their compensatory scanning ocular movements and/or to restore a portion of their hemianopic visual field[11–14] and by employing a variety of optical devices, including mirrors, partially reflecting mirrors, reversed telescopes, and prisms.[15–17] These devices may be classified as providing either relocation or expansion of the field of view of the hemianopic patient.[16]
The following report describes the binocular adaptation of a pair of ground-in sectorial prisms in a young patient with right homonymous hemianopia. Central visual field restoration, which did not require compensatory eye movements, was achieved through careful selection of prism power from a trial set, while precise prism positioning was essential to avoid central diplopia.

## CASE REPORT

A 25-year-old Caucasian healthy female with a history of recurrent cephalalgia reported for neuro-ophthalmological examination after a new episode

Received 30 November 2010; revised 21 February 2011; accepted 14 March 2011

Correspondence: Fernando-J. Palomar-Mascaró, Consultorio Oftalmológico Palomar, Passeig Sant Joan 127, 2-4, E08037 Barcelona, Spain.
E-mail: fpalomar@co-palomar.com, servicios@co-palomar.com

of cephalalgia was accompanied by nausea, vomiting, and sudden visual acuity impairment. A computed axial tomography scan, complemented with magnetic resonance imaging, revealed an expansive process diagnosed as a third ventricle colloid cyst, resulting in block of the foramen of Monro and hydrocephalus (see Figure 1). Surgical removal of the cyst, which followed a transcallosal approach, proved successful, albeit initial right motor deficit and right homonymous hemianopia were observed. Although postoperative recovery was generally satisfactory, HH failed to resolve.

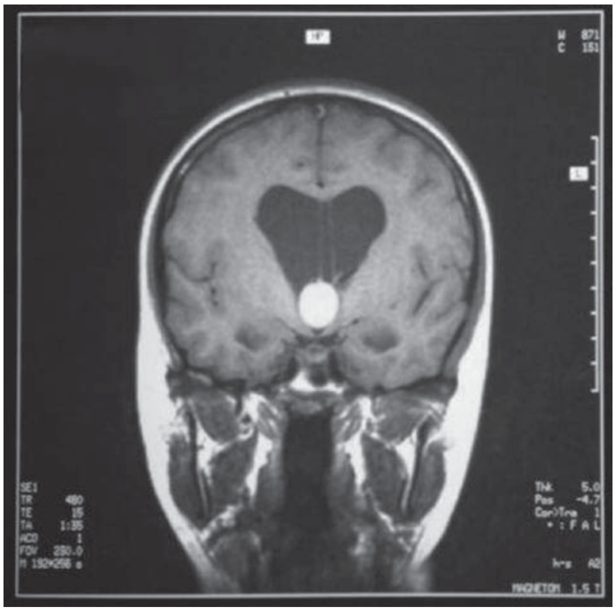

FIGURE 1 CAT scan image displaying an expansive process diagnosed as a third ventricle colloid cyst.

The patient attended our ophthalmology practice complaining of severe limitations in such habitual tasks as house care, reading, shopping, or watching television, associated with a right visual field loss. Spatial orientation and mobility difficulties required constant assistance for walking and all out-of-home activities. A specifically designed questionnaire for HH visual impairment assessment, based on the 14-item visual function index questionnaire (VF-14),[18] was employed to investigate the difficulties in visually dependent daily activities encountered by the patient.

Visual acuity with the patient's spectacle correction (OD: −3.75 D; OS: −3.75 D) was 20/25 in OD, improving to 20/20 after refraction (OD: −4.50 D; OS: −4.75 D). The patient presented with normal extrinsic and intrinsic ocular motility and neither latent nor constant ocular deviations were discovered. Slit-lamp and ophthalmoscope examinations were unremarkable.

Confrontation fields revealed large right hemifield scotomas, with a straight vertical meridian bisecting fixation between the blind from the normal halves of the visual field. This finding was also confirmed by a Bjerrum tangent screen test at 1 m and by automated threshold visual field testing (Dicon 3000 autoperimeter). Figure 2 shows the results from a complete 120-point,

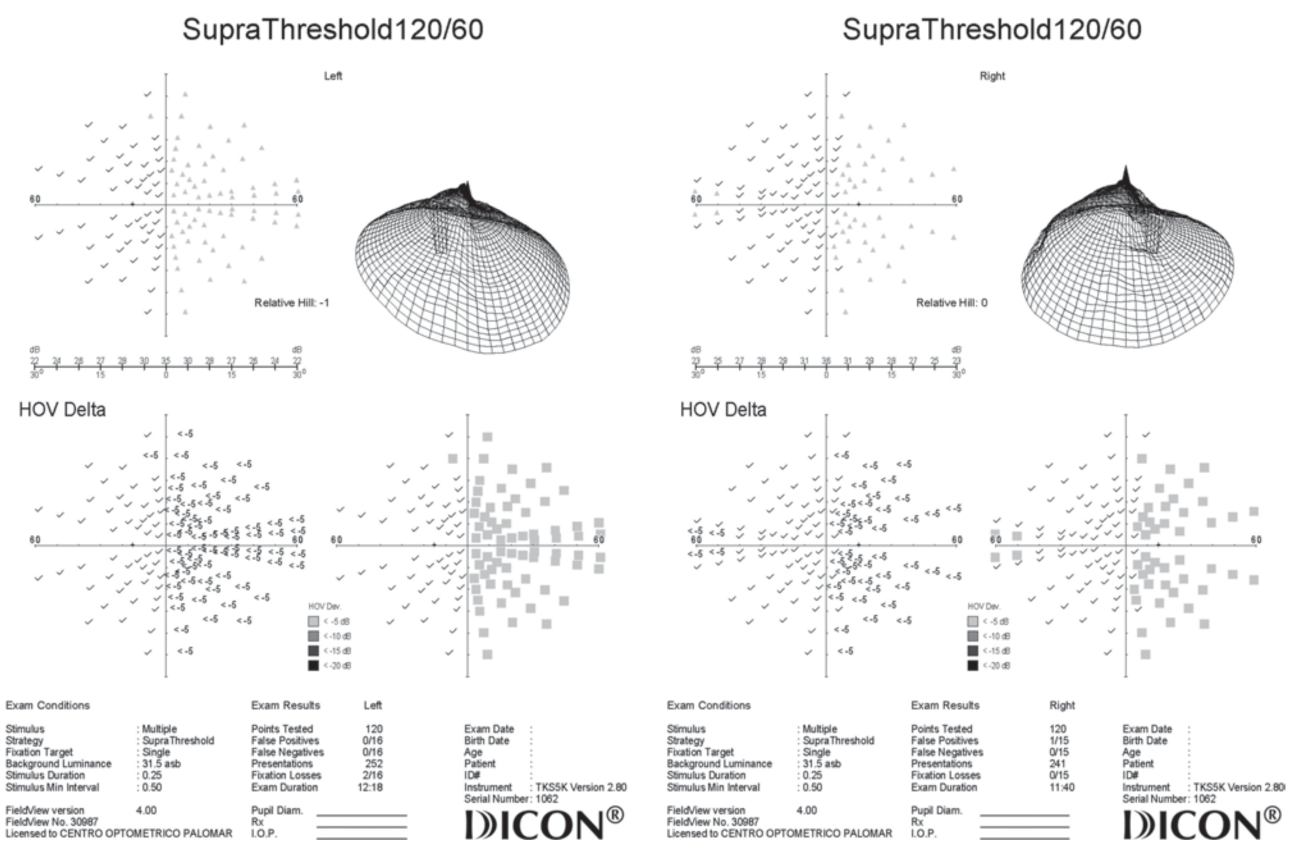


FIGURE 2 Computerized automated threshold 60-degree, 120-point complete visual field evaluation.

60-degree visual field exploration and Figure 3 displays the 48-point, 10-degree central visual field evaluation. The Line Bisection Test[19] determined that the patient had not developed spatial neglect, which is more commonly associated with right hemisphere lesions.[20]

Rehabilitation with ground-in sectorial prisms and training was considered as the best treatment option for this patient. Prismatic lens power was obtained by calculation based on the empirical formula[21]

$P_T = P_D + 2/5\ P_N$,

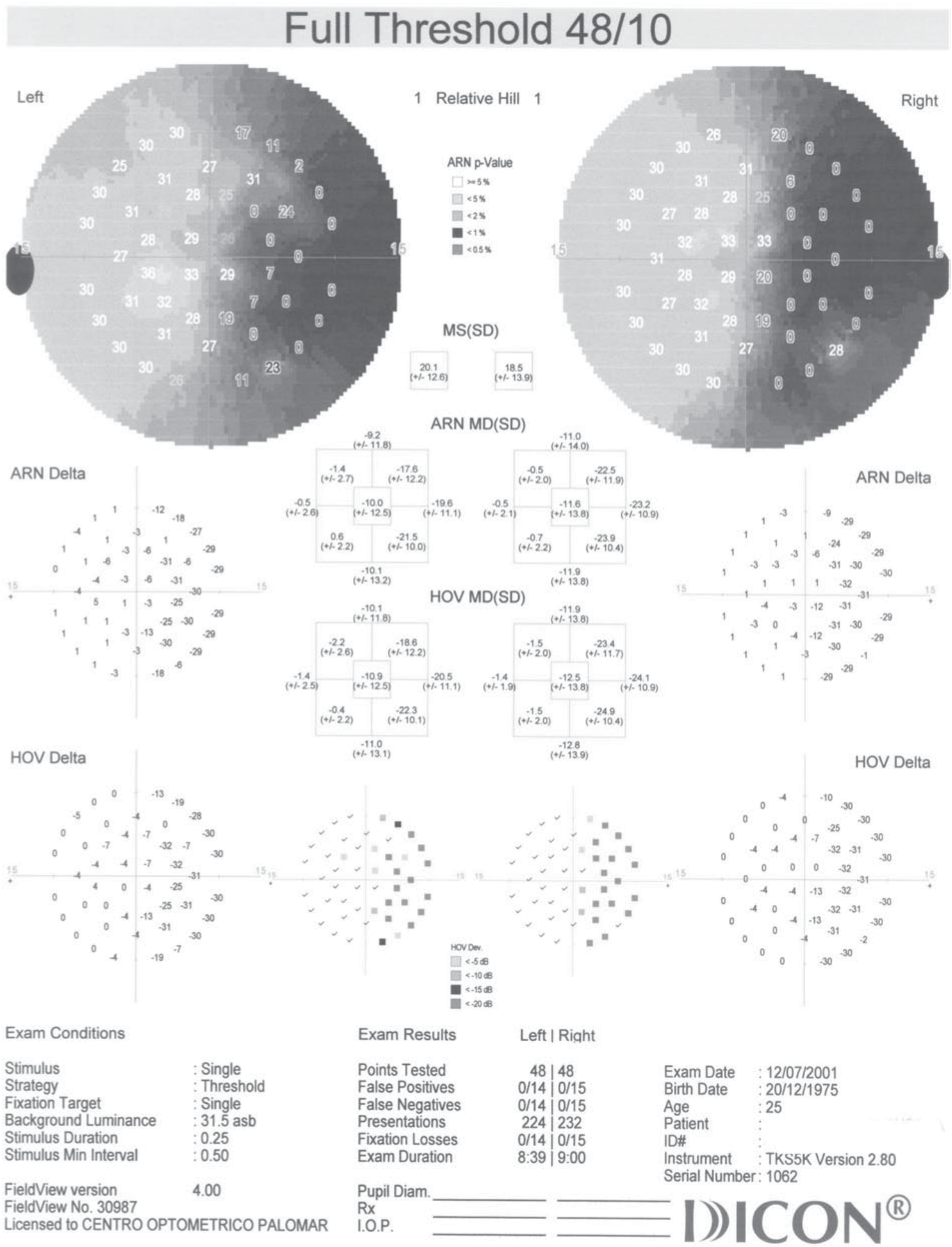


FIGURE 3 Computerized automated threshold 10-degree, 48-point central visual field evaluation.

where $P_T$ is total prism power and $P_D$ and $P_N$ are required prism power for distance and near vision, respectively. Prism power for distance and near vision where determined with the aid of our trial case prisms (Figure 4) and a trial spectacle frame (Figure 5).

Using the formula above, we determined 20 dioptres to be appropriate for this patient, which was provisionally prescribed as a pair of Fresnel plastic paste-on prisms placed on the glasses worn by the patient (OD: −3.75 D; OS: −3.75 D). Prisms were oriented with their base towards the hemianopic side (base out on the temporal half of the right spectacle lens and base in on the nasal half of the left spectacle lens) and the apex of the prism was placed at a distance of 1.5 mm from the centre of the pupil.

The patient was instructed to return to our practice a month later in order to adjust prism power and location. During this time, she was required to follow a program of daily training exercises with the aim of improving her acceptance of the low vision device as "an intrinsic element of her natural navigation strategies".[17] In addition, a walking cane was recommended for outdoor activities, although the patient was encouraged to try and walk without assistance so as to maximise use of prisms for navigation.

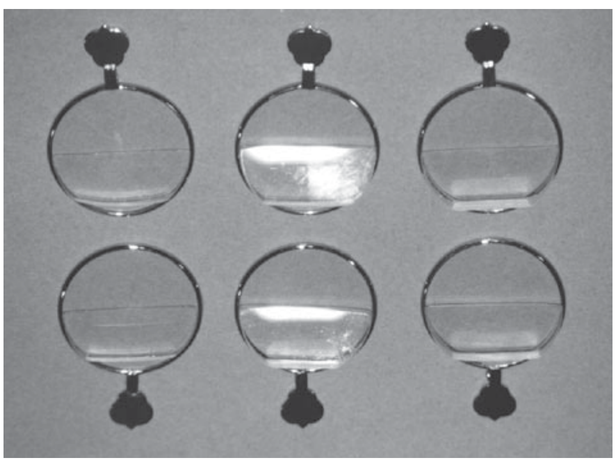

FIGURE 4 Trial case prisms.

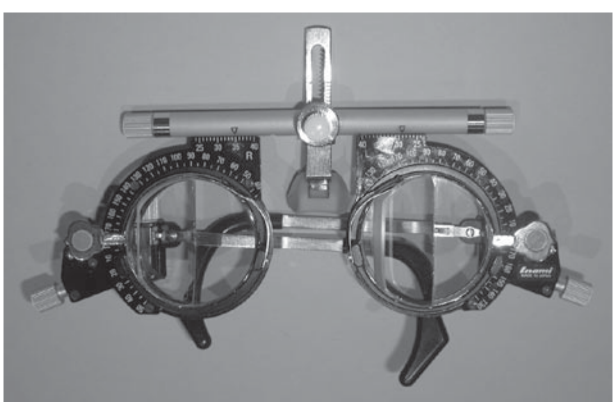

FIGURE 5 Trial frame incorporating a pair of ground-in sectorial prisms for right homonymous hemianopia.

One month later, as the patient returned to our clinical practice, she was walking unaided, although assisted by the walking cane. The patient reported an improvement in her ability to perform daily activities, which was also disclosed in her HH visual impairment assessment questionnaire score. Prism power and location were newly adjusted with the aid of our trial case prisms and trial spectacle frame and a new pair of spectacles, including the most recent prescription (OD: −4.50 D; OS: −4.75 D) and a pair of ground-in 20-dioptre sectorial prisms was ordered, to be delivered 1 month later (Figure 6).

Further improvement in quality of life was described by the patient during the third visit. Indeed, she was walking completely unassisted and she reported being able to watch television and perform near-vision tasks with less difficulty, as well as to successfully interact with various daily life objects. Follow-up visits were scheduled at every 6 months. Three years later, the patient has a relatively satisfactory quality of life with no complications with her visual aid.

A final note regarding our program of daily training exercises may be relevant. Although all patients with HH suffer from difficulties in mobility and manipulation of near objects, our HH visual impairment assessment questionnaire helps to identify particularly distressing situations, such as reading, shaving, etc. In general, however, patients are instructed to follow two 20-minute training sessions each day, consisting of two different types of exercises. During the first exercise, the examiner (or a relative at home) sits in front of the patient with his/her hands placed at different distances and positions with reference to the patient and each other. The patient is then asked to use either his/her right or left hand to touch the examiner's right or left hand. The second exercise requires the patient to successively reach and grasp two objects (e.g., two pens) held by the examiner (or relative) at different distances and positions in front of the patient (see Figure 7). This second exercise involves fine eye-hand coordination, thus being recommended only when the patient does not experience any difficulty with the first exercise. In effect, it is very relevant to prevent patients from feeling frustrated or overwhelmed by not moving forward to more challenging situations until they

FIGURE 6 Spectacle prescription incorporating a pair of ground-in sectorial prisms for right homonymous hemianopia.

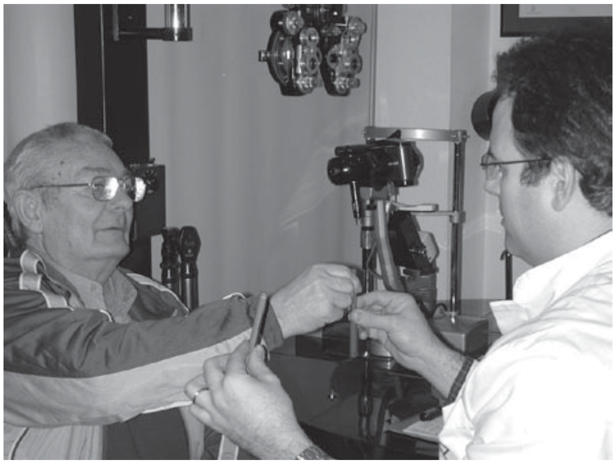

FIGURE 7 Example of a training exercise in which the patient is instructed to successively reach and grasp two objects (in this case two pens) held by the examiner at different distances and positions in front of the patient.

have successfully developed the appropriate set of "coarse" skills.

## DISCUSSION

Different optical devices have been employed to treat HH patients, either providing a shifting (relocation) or an expansion of the field of view. Although field of view expansion is preferred over relocation, binocular ground-in sectorial prisms only provide image relocation for enhanced peripheral awareness.[16] The effect of binocular sector prisms has been described as being limited to instances when the patient is looking through the prism sector of the spectacle lenses, therefore requiring constant scanning movements in order to perceive objects in the hemianopic part of the field. In addition, binocular sector prisms may also lead to central visual field loss, which is associated to the sudden appearance of objects detected through the prism half of the spectacles (known as "jack-in-the-box effect"), often contributing to patient anxiety and resulting in a published long-term success rate of only 24% with this type of prisms.[22] A monocular sector prism, limited to the peripheral field (superior, inferior, or both) and placed across the entire width of the spectacle lens, has been recommended as the best alternative to avoid the complications arising from binocular sector prisms while allowing for the expansion of the field of view and avoiding central diplopia.[16]

The present case describes the successful rehabilitation of a young patient with right HH with binocular ground-in sectorial prisms, achieved through precise adjustment of prism power and location. Indeed, prism power was determined by calculation based on an empirical formula that takes into account distance and near prism requirements. The results from this calculation, which was derived from previous clinical experience with similar cases,[21] were later further refined with the aid of trial case prisms and a trial spectacle frame, which also allowed for accurate determination of prism location. Prism location is critical to avoid diplopia in primary gaze while allowing objects that would normally fall in the hemianopic field to be relocated to the residual field, thus becoming visible in primary gaze.[23] The evaluation of the 10-degree central field is essential to determine the congruency of the hemianopic lesion, that is, whether the homonymous defects in the fields of both eyes are identical,[24] as well as to verify if the lesion follows a straight vertical meridian bisecting fixation between the blind and the normal halves of the visual field. It is relevant to mention that whereas precise prism location ensures the smooth transition between both hemifields of view, patients must still perform scanning movements through the prism half of the spectacles in order to observe objects located at the extreme periphery of the hemianopic fields.

Once prism power and location have been determined, we recommend prescribing them as provisional Fresnel paste-on prism segments, to be worn for a period of 1 or 2 months in order for the patient to become adjusted to the change in peripheral visual field position.[22] During this time, patients are also instructed to follow a program of daily exercises to facilitate their acceptance of the new optical device. For better optical quality and durability, as well as to provide the same clarity of vision in both hemifields of view, Fresnel paste-on prisms are later replaced with permanent ground-in sectorial prisms.

***Declaration of interest*:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

## REFERENCES

[1] Zhang X, Kedar S, Lynn MJ, Newman NJ, Biousse V. Homonymous hemianopias: clinical-anatomic correlations in 904 cases. *Neurology* 2006;66:906–910.
[2] Zihl J. Rehabilitation of visual disorders after brain injury. Hove, UK: Psychology Press, 2000.
[3] Gilhotra JS, Mitchell P, Healey PR, Cumming RG, Currie J. Homonymous visual field defects and stroke in an older population. *Stroke* 2002;33:2417–2420.
[4] National Center for Health Statistics, 2008. Cerebrovascular disease or stroke. Available at: http://www.cdc.gov/nchs/fastats/stroke.htm. Accessed 5 August 2010.
[5] Rossi PW, Kheyfets S, Reding MJ. Fresnel prisms improve visual perception in stroke patients with homonymous hemianopia or unilateral visual neglect. *Neurology* 1990;40:1597–1599.
[6] Romano JG. Progress in rehabilitation of hemianopic visual field defects. *Cerebrovasc Dis* 2009;27(Suppl 1):187–190.
[7] Warren M. Pilot study on activities of daily living limitations in adults with hemianopsia. *Am J Occup Ther* 2009;63:626–633.

[8] Szlyk JP, Brigell M, Seiple WH. Effects of age and hemianopic visual field loss on driving. *Optom Vis Sci* 1993;70:1031–1037.
[9] McDonald SA, Spitzyna G, Shillcock R, Wise RJS, Leff AP. Patients with hemianopic alexia adopt an inefficient eye movement strategy when reading text. *Brain* 2006;129:158–167.
[10] Schuett S, Kentridge RW, Zihl J, Heywood CA. Adaptation of eye-movements to simulated hemianopia in reading and visual exploration: transfer or specificity? *Neuropsychologia* 2009;47:1712–1720.
[11] Kerkhoff G, Munssinger U, Haaf E, Eberlestrauss G, Stogerer E. Rehabilitation of homonymous scotomas in patients with postgeniculate damage of the visual system: saccadic compensation training. *Restor Neurol Neurosci* 1992;4:245–254.
[12] Zihl J. Eye movement patterns in hemianopic dyslexia. *Brain* 1995;118:891–912.
[13] Pambakian AL, Kennard C. Can visual function be restored in patients with homonymous hemianopia? *Br J Ophthalmol* 1997;81:324–328.
[14] Kasten E, Wust S, Behrens-Baumann W, Sabel BA. Computer-based training for the treatment of partial blindness. *Nat Med* 1998;4(9):1083–1087.
[15] Weiss NJ. An application of cemented prisms with severe field loss. *Am J Optom Physiol Opt* 1972;49:261–264.
[16] Peli E. Field expansion for homonymous hemianopia by optically induced peripheral exotropia. *Optom Vis Sci* 2000;77:453–464.
[17] Szlyk JP, Seiple W, Stelmack J, McMahon T. Use of prisms for navigation and driving in hemianopic patients. *Ophthalm Physiol Opt* 2005;25:128–135.
[18] Steinberg EP, Tielsch JM, Schein OD, Javitt JC, Sharkey P, Cassard SD, Legro MW, Diener-West M, Bass EB, Damiano AM, Steinwachs DM, Sommer A. The VF-14: an index of functional impairment in patients with cataract. *Arch Ophthalmol* 1994;112:630–638.
[19] Schenkenberg T, Bradford DC, Ajax ET. Line bisection and unilateral visual neglect in patients with neurologic impairment. *Neurology* 1980;30:509–517.
[20] Halligan PW, Marshall JC. The history and clinical presentation of neglect. In: Robertson IH, Marshall JC, editors. *Unilateral Neglect: Clinical and Experimental Studies*. Hove, UK: L. Erlbaum Associates, 1993:3–26.
[21] Palomar Petit F, Palomar Mascaró FJ, Palomar Mascaró Mª,V. *Neurooftalmología. Exploración, pruebas y diagnóstico*. Barcelona, Spain: Elsevier-Masson, 2008.
[22] Giorgi RG, Woods RL, Peli E. Clinical and laboratory evaluation of peripheral prism glasses for hemianopia. *Optom Vis Sci* 2009;86:492–502.
[23] Woo GC, Mandelman T. Fresnel prism therapy for right hemianopia. *Am J Physiol Opt* 1983;60:739–743.
[24] Kedar S, Zhang X, Lynn MJ, Newman NJ, Biousse V. Congruency in homonymous hemianopia. *Am J Ophthalmol* 2007;143:772–780.