CASE REPORT

Bilateral eccentric vision training on pseudovitelliform dystrophy with microperimetry biofeedback

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SUMMARY

Low vision patients with eccentric viewing (EV) use extrafoveal retinal areas to compensate for the loss of central vision. Such retinal loci are known as the preferred retinal locus (PRL). It is known that EV is accompanied by unstable fixation. Microperimetry systems with biofeedback training have been used as a rehabilitation aid to improve fixation stability in EV patients. Normally, only the best or dominant eye is selected for such rehabilitation. This case report describes the rehabilitation on both eyes by means of PRL relocation with MAIA microperimetry (Centervue, Padova, Italy) with biofeedback training technology of a 74-year-old woman diagnosed with adult pseudovitelliform dystrophy. The patient presented binocularly similar anatomical and functional characteristics with the PRL located over the dystrophic area. At the end of the 3 months rehabilitation period, the PRL was successfully relocated inferiorly from the fovea showing relevant visual acuity improvement.

BACKGROUND

Degenerative retinal diseases, such as age-related macular degeneration (AMD) and adult vitelliform, among others, in advanced stages can result in dense central scotoma creating eccentric viewing (EV) with unstable fixation. Unfortunately, to date, apart from recent therapies for neovascular AMD, there are no known treatments for such pathologies.

One EV rehabilitation technique consists of asking patients to move their gaze to different directions and determine the position where they can better perceive a visual target.¹ Using microperimetry biofeedback training (MBFT), vision specialists are able to define a more functional retinal locus to perform oculomotor training sessions, correlating the patient's good retinal sensitivity and fixation characteristics. In such EV training, patients are guided by audio and visual feedback signals to move their gaze to a locus retinal target set inside the microperimetry machine.² MBFT has been demonstrated by several authors to be effective in patients with loss of central vision secondary to macular pathologies, particularly in cases with large and absolute central scotoma such as geographic atrophy secondary to AMD. The patient's best or dominant eye has usually been selected for such rehabilitation.^{3–5}

This case illustrates that MBFT rehabilitation can be performed with important visual acuity improvement, by selecting a correspondent and symmetrical preferred retinal locus (PRL) target (PRT) to rehabilitate patients with similar

anatomic-functional characteristics in both eyes; even in cases where fixation demonstrates to be stable in the baseline examination, according to the classification of fixation stability reported in the literature.⁶

CASE PRESENTATION

A 74-year-old woman diagnosed with adult pseudovitelliform dystrophy was recruited from the Low Vision clinic of the Nottingham University Queen's Medical Centre to perform eccentric vision and fixation rehabilitation with MBFT. Best corrected visual acuity was 1.0 LogMAR on both eyes, and reading speed was 117 words per minute.

INVESTIGATIONS

The microperimetry scanning laser ophthalmoscope (SLO) image showed a hyper-reflective area on the central macula of approximately one-fourth optic disc diameter in both eyes, confirming bilateral central dystrophy. A customised sensitivity grid map was designed around the dystrophy area demonstrating 20.7 and 20.1 dB in OD and OS, respectively. The fixation stability was P1=80% and P2=96% in OD and P1=92% and P2=98% in OS. The classification of fixation was stable in both eyes (P1 and P2>75%); however, the PRL was found to be located over the dystrophic area slightly inferior from the fovea in both eyes as demonstrated in [figure 1A, B](#) corresponding to OD and OS, respectively. The sensitivity over the dystrophic area was lower than 16 dB for both eyes; however, no absolute scotoma was demonstrated.

DIFFERENTIAL DIAGNOSIS

The differential diagnoses considered in this case were similar anatomic-functional characteristics revealed by the microperimetry outcomes in both eyes:

- ▶ Similar bilateral central dystrophy size of approximately one-fourth optic disc diameter in both eyes;
- ▶ PRL located over the central dystrophic area and slightly inferiorly from the fovea in both eyes;
- ▶ Fixation stability was classified as stable with parameter values near to the relatively unstable classification.

TREATMENT

Owing to the bilateral similar anatomical and functional conditions, MBFT was performed in both eyes. The selection of the PRT was symmetrically set inferiorly from the fovea in both eyes as shown in [figure 2A](#) (OD) and [B](#) (OS). Both loci were

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Figure 1 (A) SLO image demonstrating fixation points of the preferred retinal locus (PRL) over the dystrophic area in OD. (B) As well as the right eye, the SLO image demonstrates fixation points of the PRL over the dystrophic area in OS.

correlated with an area of better retinal sensitivity than the one found over the retinal locus involved in the baseline examination. During the training sessions, the patient was asked to move her gaze slightly inferior according to the auditory biofeedback emitted by the microperimetry system. First, the training was performed in the eye with better fixation stability (OS) over 3 weeks, subsequently followed by training in both eyes, starting every session with OS. Every session lasted 10 min per eye and a total of 12 sessions were performed over a total period of 3 months.

OUTCOME AND FOLLOW-UP

A microperimetry follow-up examination, and visual acuity and reading speed tests were performed at the end of the MBFT sessions to compare the functional outcomes with those from the baseline. Table 1 shows the functional characteristics of both eyes before and after MBFT. The average sensitivity was 24.0 and 24.8 dB on OD and OS, respectively. The fixation stability was P1=100% and P2=100% in OD, and P1=97% and P2=100% for OS. Visual acuity was 0.5 LogMAR for both eyes and the PRL for each eye was located slightly inferior from the dystrophic area as shown in figure 3A (OD) and B (OS). The reading speed was 141 words per minute.

DISCUSSION

Eccentric viewing training (EVT) has been reported to be effective in patients with visual field defects within the central 10° in the dominant eye⁷; however, the effectiveness of such training in patients with small central scotoma has not been considered to be effective due to the controlled reduced amount of gaze

deviation that patients perform to avoid the scotoma area. In consequence, EVT with MBFT has typically been suggested in pathologies with large and absolute central scotoma, such as geographic atrophy secondary to AMD.²

Despite the fact that visual function has been analysed with microperimetry in cases where the PRL of the two eyes is found in corresponding locations, and likewise, when due to the progression of the pathology the PRL is not correspondent to both of the eyes, EVT rehabilitation with MBFT has mostly been performed monocularly.^{2 8–10} Two explanations can be put forward to account for such tendency. On the one hand the present technology is, in itself, monocular, therefore the analysis and rehabilitation of the PRL must be performed on one eye at a time, and on the other hand, pathologies affecting central vision, such as AMD, may progress independently in each eye, resulting in non-corresponding loci of both PRLs. Consequently, vision specialists have mostly opted to perform the rehabilitation in the eye with the best functional prognosis, leaving open the question regarding binocular PRL behaviour and rehabilitation.

This case report suggests that, in cases where both eyes show similar anatomical and functional characteristics with small central scotoma, the position of the new PRL can be easily selected in corresponding loci in both eyes for MBFT rehabilitation to be undertaken. However, further studies are necessary to confirm these findings and to investigate whether EVT can be performed selecting the new PRL in corresponding positions even in cases with large central scotoma and where the PRL of each eye is originally located in non-corresponding loci, which may be the case in most patients who have lost central vision in both eyes.¹¹

Figure 2 (A) Locus target (preferred retinal locus target, PRT) selected inferiorly from the dystrophic area in OD to perform microperimetry biofeedback training. (B) Locus target (PRT) in OS selected in a corresponding location symmetrical to the PRT in OD.

Table 1 Visual function before and after binocular microperimetry biofeedback training

Date	Reading speed (words/min)	Visual acuity (LogMAR)		Average sensitivity (dB)		Fixation index P1 (%)	
		OD	OS	OD	OS	OD	OS
Before MBFT	117	1.0	1.0	20.7	20.1	80	92
After MBFT	141	0.5	0.5	24.0	24.8	100	97

MBFT, microperimetry biofeedback training.

Figure 3 (A) SLO image showing preferred retinal locus (PRL) relocated slightly inferiorly from the fovea after microperimetry biofeedback training (MBFT) in OD. (B) As well as the right eye, the image shows PRL after MBFT in OS, relocated in the corresponding locus symmetrical to OD.

The principal outcome of EVT with MBFT is to improve fixation stability, for this reason patients with unstable fixation are normally considered eligible for the training programme. Microperimetry instruments follow established guidelines to classify fixation in three different conditions: stable, relatively unstable and unstable.⁶ Our results suggest that patients classified as having stable fixation, where their fixation indexes are near the boundaries of relatively unstable fixation, may still have room to improve their fixation stability with good prognosis in visual acuity and reading capabilities. For this reason, future research to explore new classifications of fixation stability related to visual rehabilitation prognosis may be necessary.

Learning points

- ▶ The rehabilitation of eccentric viewing (EV) defining a new preferred retinal locus (PRL) with microperimetry biofeedback training (MBFT) may be attempted in both eyes in cases with analogous binocular anatomic-functional characteristics.
- ▶ The selection of the new PRL shall be defined in correspondent retinal location for both eyes.
- ▶ EV rehabilitation with MBFT may not only be selective in cases with large and absolute central scotoma, but also in patients with small scotoma.
- ▶ The classification of fixation stability used in microperimetry shall not be determinant in the selection of patients undergoing EV rehabilitation with MBFT technique.

Contributors All co-authors have met the following authorship criteria: substantial contribution to the conception or design of this work; drafting this work or revising it critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that

questions related to the accuracy or integrity of any part of this work are appropriately investigated and resolved. All co-authors have had the opportunity to participate in the review, drafting and final approval of this manuscript.

Competing interests MUM has competing interests with the company producer of the instrument used in our study, although the rest of the secondary authors are independent of any commercial funder or sponsor and they all have had full access to all data in the study and take responsibility for the integrity of the data and accuracy of the data analysis.

Patient consent Obtained.

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