PATIENTS WITH SEVERE IMPAIRMENT IN ONE EYE SHOW IMPROVED PERFORMANCE TO DEFOCUS-INDUCED BLUR

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1. INTRODUCTION

It is well known that monocular deprivation early in life results to better spatial visual performance in the non-pathological eye[1]. We have previously shown that patients with severe impairment in one eye exhibit improved contrast sensitivity even at an age after the "critical" period of visual development[2]. The current study investigates whether one-eyed patients show any advantages over binocular vision normals under conditions of defocus blur.

2. METHODS

Sixteen patients (age: 33 ± 8 years) with severe visual impairment in one eye (VA equal or worse than FC at 1m), for a period longer than 2 years (10 ± 8 years), participated in the study. Only patients with an age < 50 years and monocular deprivation onset > 9 years were included (range: 9 to 42 years). Fifteen more participants (age: 28 ± 5) with normal binocular vision served as the control group. The effect of defocus, induced by positive lenses up to 2.50D, on the pattern reversal Visual Evoked Potential (VEP) and on visual acuity (VA) was measured. VEPs were elicited using reversing 10 arcmin checks. The stimulus subtended a circular field of 7 deg with 100% contrast and 30 cd/m^2 mean luminance. VA was measured using ETDRS charts. All measurements were performed at 1m viewing distance with best spectacle correction and natural pupils. Performance of the control group was tested both monocularly (dominant eye) and binocularly. Comparisons between patient and control groups were made by fitting linear growth models using STATA 11 (xtmixed).

3a. RESULTS - VA

In normal subjects VA was always better with binocular than with monocular vision, with the difference being greater for higher levels of retinal blur, in agreement with previous studies[3]. In "one-eyed" patients, average VA, when in-focus, was equal to the monocular values of normal controls. However, VA was less affected by defocus, with a borderline evidence of a difference in slopes: the slope being 0.04 units lower (95% CI -0.09 to 0.00, p=0.06) (fig. 1).

No evidence of a difference in slopes (p=0.270) was found between patients and the binocular values of normal controls: patients have on average 0.08 higher VA (95% CI -0.01 to 0.17, p=0.093).

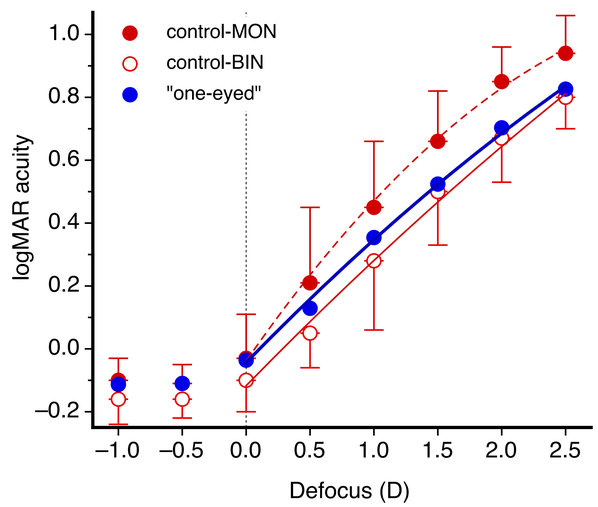

Figure 1: Mean logMAR acuity at 1.0 m as a function of defocus under binocular (red open circles) and monocular (red filled circles) vision for the control and for the one-eyed groups (blue filled circles). The vertical bars indicate characteristic ±1 SD.

3b. RESULTS - VEPs

Average latency of the P100 component of the VEPs was shorter in all cases with binocular than monocular stimulation in normals. The effect of defocus on VEP P100 latency in one-eyed patients (i.e the slope of latency vs. defocus linear fit) was similar to the one exhibited in the control group under binocular viewing conditions, with no evidence of a difference in slopes (p=0.933) (fig. 2).

Note, that pupil diameter was on average larger in patients with one eye (5.5±0.4 mm) compared to the controls [5.1±0.5 mm and 4.5±0.5 mm with monocular and binocular vision, respectively].

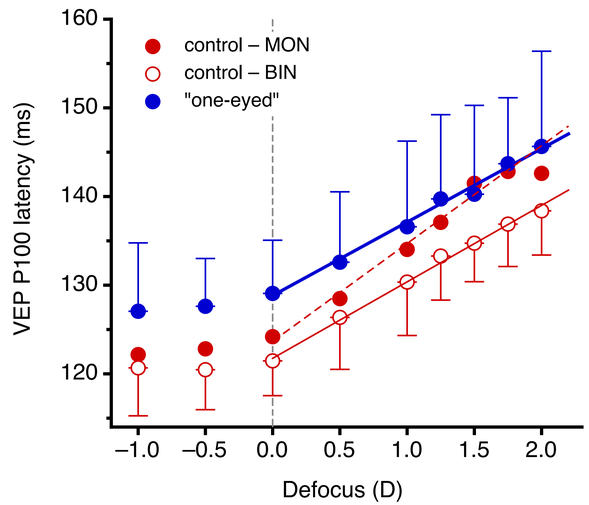

Figure 2: Mean latency of the VEP P100 component as a function of defocus under binocular (red open circles) and monocular (red filled circles) vision for the control and for the one-eyed group (blue filled circles). The slopes are corresponding linear regression lines. The vertical bars indicate characteristic ±1 SD.

4. CONCLUSIONS

Both subjective and electrophysiological data show that patients with severe impairment in one eye may exhibit better performance under conditions of retinal blur compared to the monocular vision of subjects with normal binocular vision, suggesting increased levels of blur tolerance. The long-term improvement in defocus-induced blur in "one-eyed" patients may be due to the activation of larger proportion of neurons compared to normals under monocular vision.

The results are consistent with growing evidence showing that it is possible to reinstate much greater levels of plasticity in the adult visual system than previously suspected.

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