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Case Presentation

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Efficient Management on Para-Macular Fixation in a 7.95-Year-Old Male

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Abstract

There is little literature of amblyopia resulted from eccentric fixation, poor prognosis might prevent eye care clinicians from actively providing treating. Literature has indicated that 5 single treatment sessions could be determining whether a fixating site would change. However, in the present case, improvement was not observed until 22nd treatment session. Bleaching retinal areas other than macular/fovea with addition of CAM therapy might be beneficial as the peri-macular areas are still blind temporarily. The methods for evaluating corresponding visual angle and visual acuity, residual amblyopia was relatively objective as compared to traditional methods, though the treating method applied was similar as the old devices designed for eccentric fixation. Past failure experience might be one of the psychological factors toward ceasing the mentioned pleoptic treatment, however, optimal improvement would be observed once the stimulation of macular/foveal sites is guided by the intensive light for sufficient duration and frequency. Quantifying the eccentric amount is crucial so that in the following visits, whether the fixating site is turning closer to macular/foveal can be screened. An efficient flow of procedures shall be established for early diagnosis and better prognosis, appropriate referral stating what would be required to finalize diagnosis shall assist paediatric/eye care specialists for better health care efficiency.

Keywords: Strabismus; Amblyopia; Eccentric fixation; Poor visual acuity

Background

The incidence of Eccentric Fixation (EF) is unknown, to our knowledge, this is a rare condition difficult to treat and the prognosis often is poorer than amblyopia caused by other refractive conditions. Depending on the eccentric amount and various area of fixation, there are 5 to 9 types **[1,2],** mainly composing of erratic, centro-cecal, para-central, para-fovea and para-macular. Byron **[1]** found approximately 1/5 of the non-centric fixation was para-macular fixation. In this present case, the type of EF was categorised as "para-macular". According to the treatment results from the New York Eye and Ear Infirmary, only 2 of 6 patients with "para-macular" fixation showed improvement, which could not be overly optimistic in prognosis. To discover amblyopia in clinical setting, Visual Acuity (VA) check currently is the only very first procedure, however, no regular eye health check for pre-school population might delay the crucial discovery. In addition, following discovery, further investigation should have standard with both qualitative and quantitative assessments, for best structuring treatment plan and optimal prognosis. Red Reflex Test is capable of detecting potential poor visual quality and even confirming amblyopia in a very short time before performing any clinical procedures. With a gross estimation, traditional estimation in EF using ophthalmoscope is neither able to obtain specified distance nor to measure angular discrepancy. Studies **[3,4]** showed the usefulness of Optical Coherence Tomography (OCT) in precisely measuring the distance between fovea and fixating point; by comparison to traditional assessment using ophthalmoscope in defining fixating point on retina not superimposes fovea as "Eccentric Fixation" (EF), a term "fixation shift" is given to OCT EF measurement exclusively **[3].**

The treatment method used in this case was Combination of BIO Light Bleaching and CAM (BLB&CAM). Different from traditional EF treatment using after-image, there is no default black spot and cross to guide fixation; instead, 5-minute intense light of BIO is shined directly onto para-fovea area, followed straight away by 15-minute computer CAM. This treatment avoids difficulty in maintaining steady fixation **[5]** to strong light, and clinicians can actively move intensive light away from fovea.

Case Presentation

This 7.9-year-old patient presented on 2022/07/13 in the optometry clinic of the hospital, with a 2-year left eye strabismus and amblyopia history however no improvement had been observed. The carer was going to give up as no hope was seen after the long treatment. Following an ophthalmoscopic examination, it was found that the patient had eccentric fixation [between the 3rd and 4th ring from ophthalmoscopic view (REF11710 Welch Allyn)]. The authors talked them into giving a last try at this age stage. As neither of Haidinger's brush or Maxwell's spot were available upon diagnosis, BIO was used to shine retinal parafovea areas for 5 minutes, followed by 15-minute computer CAM program. The BLB&CAM started from 05th Aug 2022; first VA improvement was observed upon 16th day when 32 treatment sessions were completed. After 57th treatment/ therapy on 29th day (2nd Sep 2022), the VA improved to 0.8+2 for the first time in the patient's life. Three days later on 05th Sep 2022, the VA reached 0.9-1 **(Figure 1a);** in the meantime, a nasal fixation shift of 755 µm (1847 µm-1092.0 µm) was observed by comparison to prior to the treatment **(Figure 1b and c).** The optical coherence instrument used in this study was a SS-OCTA system (VG200D, SVision Imaging, Ltd., Luoyang, Henan, China), works near 1050 nm and features a combination of industry-leading specifications including ultrafast scan speed of 200,000 AScans per second, a widefield of 56 degrees, and an imaging depth of 6.0 mm (in tissue). The default value for axial length is 24.0 mm, visual angle therefore has to be adjusted in accordance.

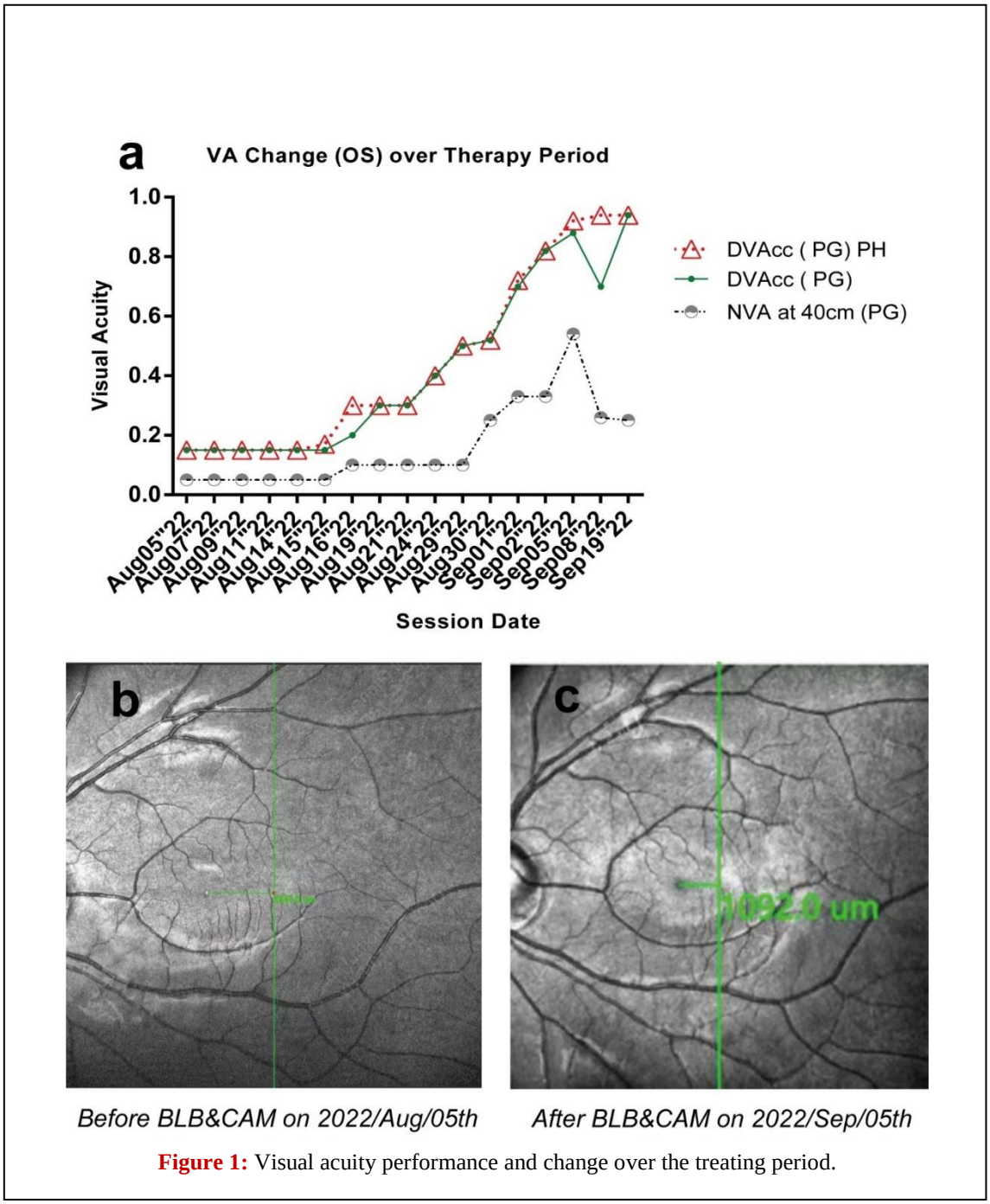

Figure 1: Visual acuity performance and change over the treating period.

Table 1: VEP on 2022/Aug/04th, 2022/Aug/21st, 2022/Sep/05th, and 2022/Sep/20th.

	2022/Aug/05th									
Pattern	VEP 1,0 deg					VEP 15 min				
Channel	N75 (ms)	P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)	N75 (ms)	P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)
OD	65.2	103.9	196.1	12.1	19.9	84.0	116.8	149.1	14.7	7.85
OS	65.2	119.8	150.3	12.5	8.12	94.5	137.4	195.5	11.1	10.9
OD Response				0.31	0.21				0.45	0.24
OS Response				0.23	0.27				0.26	0.19

Ratio (OS/OD)				0.74					0.58	
	2022/Aug/21st									
Pattern	VEP 1,0 deg					VEP 15 min				
Channel	N75 (ms)	P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)	N75 (ms)	P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)
OD	65.2	105.7	191.4	23.1	32.6	84.5	105.7	160.3	21.0	15.8
OS	84.0	111.5	160.9	16.5	15.9	65.8	111.0	145.6	23.4	15.8
OD Response				0.57	0.38				0.99	0.29
OS Response				0.59	0.32				0.51	0.46
Ratio (OS/OD)				1.04					0.52	
	2022/Sep/05th									
Pattern	VEP 1,0 deg					VEP 15 min				
Channel	N75 (ms)	P100 (ms)	N135 (ms)	N75-P100 (µV)	P100-N135 (µV)	N75 (ms)	P100 (ms)	N135 (ms)	N75-P100 (µV)	P100-N135 (µV)
OD	76.3	103.2	202.5	24.85	22.05	85.1	109.8	152.6	29.6	14.1
OS	86	112.4	140.9	16.05	10.5	95.7	122.7	164.4	20.9	10.1
OD Response				0.92	0.22				1.20	0.33
OS Response				0.61	0.37				0.77	0.24
Ratio (OS/OD)				0.66					0.64	
	2022/Sep/20th									
Pattern	VEP 1,0 deg					VEP 15 min				
Channel		P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)	N75 (ms)	P100 (ms)	N135 (ms)	**N75-P100 (µV)**	P100-N135 (µV)
OD	69.9	106.8	197.8	22.30	34.80	84.0	105.1	149.1	21.3	9.28
OS	81.0	111.5	174.4	13.2	7.55	94.5	130.9	179.1	17.6	12.0
OD Response				0.60	0.38				1.01	0.21
OS Response				0.43	0.12				0.48	0.25
Ratio (OS/OD)				0.72					0.48	

Table 2: Comparison on evaluation before and after preoptic treatment.

	Before treatment/training (2022/Aug/05th)	**After** treatment/training (2022/Sep/05th)	**Confirmation** (2022/Sep/20th)	Difference	Recovery
BCVA (logMAR)	0.15	0.88	0.94	10 (lines)	100% (interocular)
Stereopsis (arc sec)	< 400	<400	<400	0%	0%
Severity index (interocular	0.77 (0.92-0.15)	0 (0.94-0.94)			100%

difference of BCVA)					
Fixation Shift (μm)	1847.00	869.10	1092.0	977.9	52.90%
Shift of Visual Angle (degree)	6.41 (1847/288)	3.02 (869.1/288)	3.79 (1092.0/288)	3.39	52.89%
Calibrated shift of visual angle (degree) (OS AL: 22.48) factor = 1.0676	6.84	3.22	4.05	3.62	52.92%
Residual amblyopia (standard: 0.8/ 2 line improvement)	100%	0%	0%	100%	100%

Discussion and Conclusion

Our decision in using the mentioned pleoptic was based on the fact other known techniques for EF were not available, and the retinae of amblyopes usually have difficulty maintaining steady fixation **[5]** to intense light for a sufficient period of time to generate proper after-image. In addition, the compliance in using traditional methods such as visuscope or euthyscope could not be ensured as the patient experienced failure in treating amblyopia before presenting in our hospital. Some clinicians claim that no improvement observed within 5 single treatments leads to failure and no further effort should be made. In the observation on 29 patients aged between 7 and 22 **[1],** it was believed that the first five treatments had to make fixating site move and significant VA improvement had to occur within 10 treatments. However, the sign of improvement in this case was only seen after 16 days' continuous treatments (32 sessions), significant VA rise occurred after 40th session. Worth noting and notably, the greater pinhole acuity at each VA check indicated that there would be further improvement, showing the amblyope with EF shares common principles of optical correction as non-EF. It could be assumed that only less fixation shift would assist development of foveal vision.

In comparing the retinal response before and after treatment: The sensitivity of Visual Evoked Potential (VEP) of the left eye skyrocketed rise from 0.26 to 0.77, and 0.23 to 0.61 for the patterns of N75-P100 15 min and N75-P100 1.0 degree **(Table 1),** respectively; noticeably, the response for N75-P100 15 min showed more linear rise, indicating the detailed vision of left eye should have had improvement. The amplitude of multifocal electroretinogram (mfERG) showed 79% (91.28 nV/deg2 to 163.2 nV/deg2) and 73% (36.34 nV/deg2 62.92 nV/deg2) increase for the ring 1 and the ring 2 (see supplementary Figure. ERG change), respectively, indicating visual development before treatment was incompleted. The maximal VA improvement was observed on the 31st day, with response index being 0.61 for VEP 1.0 degree (N75-P100) and 0.77 for VEP 15 min (N75-P100), respectively, these figures were 2.65 and 2.96 times than the ones on the 1st day **(Table 1).** The figures

reduced to 0.43 and 0.48, being 1.87 and 2.96 times than the first day **(Table 1).** While significant VA improvement occurred on the 31st day, the response index decreased from 0.61 to 0.43 without DVA reduction **(Table 1),** implying that VA stability required at least nearly double of the original response index, however for detail VEP might require at least 3 times of the original index to remain stability as the NVA reduced with the response index decreasing from 0.77 to 0.48. The recovery of vision and visual angle is shown in **Table 2.** The explanation for different VA performance at far and near distance of the patient might be twofold. The patients Near Visual Acuity (NVA) were relatively worse than Distance Visual Acuity (DVA) during/at fourth week. One explanation to this is that the left eye had never experienced contracting ciliary muscle due to lack of clue for retinal blur, therefore, instead of binocular level in vision, the visual system only had bi-ocular ability with significantly poorer accommodative function at this stage. On the other hand, as observed the VA under well-illuminated condition (which the ciliary muscle has similar bio-behaviour) was much lower, one study has showed that peri-fovea retina can respond within 14 degrees **[6].** An eccentric fixating retina recognises the original fixating area as its default point, in which this faulty fovea might have had posture of accommodative lag for long, though the function of accommodation was very limited. When the eccentric degree is lower by comparison to earlier, the newly developed "less faulty" fovea required more relaxing power to reach focused image by holding the whole peri-area, however relaxation of ciliary muscles needs more effort as compared to contraction. Further accommodation facility training might be beneficial in improving the patient's NVA. In such poor VA resulted from eccentric fixation, an essential procedure in detecting amblyopia cannot be neglected. Equally important, following that, the amount and type of eccentric fixation has to precisely and objectively be confirmed. For achieving the above qualitative assessment in efficiently detecting amblyopia, fundus red reflex examination has to be performed in the first place, while for quantitative assessment, the appropriate OCT mode has to be applied in justifying the eccentric amount. Blind execution of sound eye occlusion not only would be a waste of time, but also would be very likely to miss the period with maximal effect toward best prognosis. A standard of appropriate flow in the diagnose and assessment of amblyopia should not merely rely on VA, one for EF in paediatric ophthalmology therefore should be established, though such condition is relatively rare. A refractive/eye health examination procedure is recommended for efficient screening and earliest detection. Our suggested flow is shown in **Figure 2.**

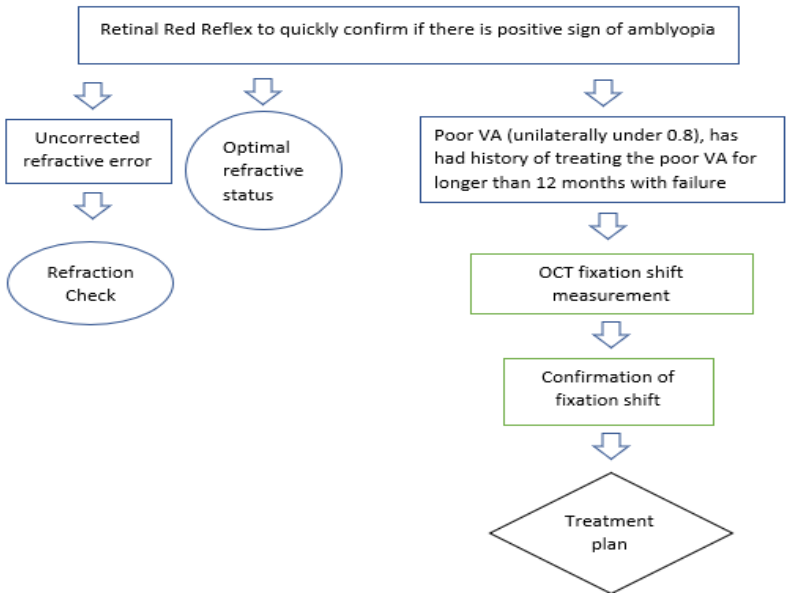

Figure 2: Standard ocular examination with high efficiency in detecting refractive errors, strabismus, and potential amblyope.

In summary, with the advance of medical technology, it might have turned simpler in detecting eccentric fixation, however most children missed or are missing a correct diagnosis as the availability of modern ophthalmic device does not necessarily bring optimal diagnosis/prognosis to patients. It still largely relies on clinicians' initial objective evaluation and tentative decision and strategy, in order to avoid leaving such condition untreated. In addition, two factors toward ideal prognosis from the patient's perspective would be motivation and patience, considering the early period of treatment one might not observe any noticeable improvement.

References

1. Byron HM. Results of pleoptics in the management of amblyopia with eccentric fixation. Arch Ophthalmol. 1960;63:675-81.
2. Malik SR, Gupta AK, Choudhry S. Classification of eccentric fixation. Br J Ophthalmol. 1969;53(3):188-91.
3. Jin J, Apple A, Friess A, Lehman S, Salvin J, Hendricks D, et al. Using OCT Fixation Shift to Assess Eccentric Fixation in Childrn With Residual Amblyopia. Transl Vis Sci Technol. 2020;9(12):30.
4. Nakamoto Y, Takada R, Tanaka M, Matsumoto F, Aomatsu K, Tachibana K, et al. Quantification of Eccentric Fixation Using Spectral-Domain Optical Coherence Tomography. Ophthalmic Res. 2018;60(4):231-7.
5. Wick B. A home pleoptic method. Am J Optom Physiol Opt. 1976;53(2):81-4.
6. Labhishetty V, Cholewiak SA, Banks MS. Contributions of foveal and non-foveal retina to the human eye's focusing response. J Vis. 2019;19(12):18.

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