Poster #37

EVALUATION OF THE EFFECT OF ENERGIE EYERELAX™ VISION THERAPY ON AMBLYOPIC CHINESE SCHOOL CHILDREN

Saadah MA [1], Mutalib HA[1], Chan SP[2]

[1] *Department of Optometry, Universiti Kebangsaan Malaysia, 53000 Kuala Lumpur, Malaysia*

[2] *School of Business, SIM University, 535A Clementi Road, Singapore 599490, Singapore*

12TH INTERNATIONAL MYOPIA CONFERENCE AUSTRALIA 2008

DEPARTMENT OF OPTOMETRY FACULTY OF ALLIED HEALTH SCIENCES UKM

INTRODUCTION

-Amblyopia is a developmental disorder of spatial vision that affects 3% of the population worldwide[1]. It has become an important health hazard if left untreated, especially in children.

- Understanding of visual fields has given better appreciation of the visual neurological function, especially with how specific spectrum, contrast and flickering rate is able to improve the functional visual performance, or sometimes known as "perceptual learning". In a recent study, perceptual learning has been shown as an effective approach to improving visual performance in amblyopic children[2].

- With the use of technology, especially with micro-processors, it is possible to programme perceptual learning sequence automatically. This can either be done on a computer, such as Amblyopia iNet program or with devices such as Energie EyeRelax™ Amblyopia.

-The red, green, blue and yellow colours directly stimulate a stronger reaction from the rods & cones, bipolar cells and ganglion cells of the eye and flickering at different rates with stereo biological images help to increase the spectral receptive area of the eye. These enhance the visual conductivity, stimulate the visual cortex and increase visual sensitivity efficiently. The on-off musical melody accompanying the biological images enhances the receptivity of human's cerebral cortex.

- Various traditional treatments to improve visual acuity in children with amblyopia were very interactive and need regular attendance of a trained therapist. Computer technologies help to reduce the chair time and Energie EyeRelax™ invention has become amongst the useful technology in vision treatment industry.

OBJECTIVE

This study was conducted to evaluate the efficacy of Energie EyeRelax™ vision therapy to improve vision of amblyopic Chinese school children in 90 days.

METHODOLOGY

• Seventeen schoolchildren of age 8 – 11 years old with amblyopia whose unaided visual acuity on either eye was worse than or equal to LogMAR 0.30 (6/12).

• Subjects' participation was on voluntary basis with parents consent.

BATTERY OF TESTS AND PRIMARY OUTCOME MEASURE

• Unaided visual acuity, retinoscopy and subjective refraction were measured at 0th day (baseline), 45th day and 90th day.

•A further 90-day follow-up was also carried out after the treatment was stopped.

• The primary outcome measure was the 90-day change in unaided visual acuity and refractive error.

PROTOCOL

• Subjects were refracted thoroughly and latest prescription was given before Energie EyeRelax™ therapy began.

• Subjects were required to perform the Energie EyeRelax™ therapy twice a day for 90 days.

• Subjects looked into the scope with their amblyopic eye for 10 minutes, with latest prescribed glasses during the therapy.

• Subjects with changes of refractive error more than 0.50 D were prescribed with a new pair of lenses.

STATISTICAL ANALYSIS

• Generalised linear latent and mixed models (GLLAMM) were applied to perform the analysis, while correcting for gender, age, baseline refractive error and unaided visual acuity.

• Data were analysed with Stata 10.0 (Stata Corp, Texas, USA) and all statistical tests were conducted at 5% level of significance.

RESULTS

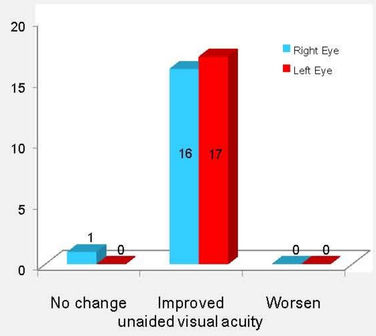

Figure 1 Number of subjects with changes in unaided visual acuity at 90th day

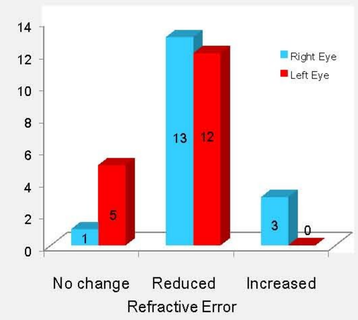

Figure 2 Number of subjects with changes in refractive error at 90th day

Table 1 The unaided visual acuity and refractive error at baseline (0 day) and after 90 days

	0th day (Baseline)	90th day	P value
Unaided Visual Acuity (LogMAR)			
Right Eye	0.53 ± 0.23	0.21 ± 0.18	$p < 0.05$
Left Eye	0.50 ± 0.19	0.18 ± 0.22	$p < 0.05$
Refractive Error (D)			
Right Eye	-1.01 ± 1.01	-0.71 ± 0.87	$p < 0.05$
Left Eye	-1.11 ± 0.88	-0.71 ± 0.89	$p < 0.05$

The changes in unaided visual acuity and refractive error remained insignificant after the vision therapy was stopped ($p > 0.05$).

CONCLUSION

There is evidence suggesting that Energie EyeRelax™ therapy is effective in improving vision in amblyopic Chinese school children. Further investigations in other visual functions need to be conducted to support the use of Energie EyeRelax™ therapy.

ACKNOWLEDGEMENT

Authors wish to thank the school children from SJK (C) Pui Ying, Klang for their participation in this study. This study was conducted and funded by Utama Optometrist Group Sdn Bhd (Malaysia) and Energie EyeCare Group, respectively.

REFERENCES

1.Newman DK, East MM. Prevalence of amblyopia among defaulters of preschool vision screening. *Ophthalmic Epidemiol.* 2000;7:67–71.

2.Li RW, Young KG, Hoenig P, Levi DM. Perceptual Learning Improves Visual Performance in Juvenile Amblyopia. *Investigative Ophthalmology & Visual Science*, September 2005, Vol. 46, No. 9.

Disclosure: The authors of this study have no financial arrangement with Energie EyeCare Group and the proprietary rights of its products, such as patent rights, trademark, copyright or licensing agreement.

EVALUATION OF THE EFFECT OF ENERGIE EYERELAX™ VISION THERAPY ON MYOPIC CHINESE SCHOOL CHILDREN

Mutalib HA*, Saadah MA*and Chan SP#
*Department of Optometry, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia
#School of Business, SIM University, 535A Clementi Road, 599490 Singapore
Email: haliza@medic.ukm.my

Poster #38

INTRODUCTION

The global prevalence of refractive errors has been estimated from 800 million to 2.3 billion[1]. In Malaysia, refractive error is one of the most common causes of visual impairment[2]. In a recent study on visual impairment and refractive error among school children in Malaysia, it was noted that prevalence of myopia was 13.9% in Malays, 45.2% in Chinese and 15.4% in Indian children[3].

Various methods of treatment have been used to control progression of myopia. With the advent of the latest technology, an eye therapy device called Energie EyeRelax™ has been invented. The design of the device is based on neuroscience studies. It has been claimed by the manufacturer that Energie EyeRelax™ is able to improve myopia.

Through Energie EyeRelax™ therapy, the subject will be asked to look directly at the computerised biological image. The image comprise of different light spectrum; red, green, blue and yellow.

The flickering effects of the light spectrum accompanied by musical melody stimulates accommodation and decreases fatigue of the ciliary muscles, thus enhancing the visual neuro system.

OBJECTIVE

The main objective of this study was to evaluate the efficacy of Energie EyeRelax™ therapy to improve myopia in Chinese school children in 90 days.

METHODOLOGY

- Study Subjects = 181 Chinese school children
- Myopia criteria = Rx -0.25D to -3.25D
- Single-site, randomised, prospective and single masked study

PROTOCOL

The screening of subjects was done in a Chinese Primary School in Klang whereby the inclusion criteria was no history of ocular surgery, pathology and amblyopia, best corrected vision (minimum VA 6/9), and not on myopia treatment (except wearing spectacles). Subjects' participation was on voluntary basis with parents consent.

1. All subjects were refracted thoroughly before the therapy began and prescribed with the latest prescription.
2. Subjects in the treatment group were required to perform the Energie EyeRelax™ therapy twice a day for 90 days. The therapy was performed on the right eye and left eye monocularly for 5 minutes without the use of spectacles.
3. Subjects were not allowed to do any near visual acuity activity as soon as the therapy was completed for a period of at least 5 minutes.
4. At the end of every 45 days, retinoscopy and subjective refraction were repeated, followed by measurement of habitual VA and unaided VA.
5. Subjects with changes in refractive error of more than 0.50D will be prescribed with a new pair of lenses.
6. A further 90-day follow-up was also carried out after the treatment was stopped.

ANALYSIS

In view of the hierarchical data structure, multivariate generalised linear latent and mixed models (GLLAMM) were applied to perform the analysis. Data were analysed with Stata 10.0 (Stata Corp, Texas, USA) and all statistical tests were conducted at 5% level of significance after correcting for gender, age, myopia, baseline refractive error and visual acuity.

RESULTS

Group		Baseline	90-day	180-day
		Spherical Equivalent(D)		
Subjects N = 93	RE	-1.53 ± 0.77	-0.73 ± 0.72	-0.76 ± 0.73
	LE	-1.52 ± 0.81	-0.70 ± 0.70	-0.72 ± 0.70
Control N = 88	RE	-1.56 ± 0.74	-1.66 ± 0.77	-1.71 ± 0.77
	LE	-1.50 ± 0.82	-1.57 ± 0.84	-1.63 ± 0.84

Altogether, 93 subjects (51.4%) were randomised to receive Energie EyeRelax™ therapy. There was no significant difference in baseline characteristics between the Energie EyeRelax™ therapy and control groups. The refractive error of the therapy group was reduced at 90 days for both eyes ($p<0.05$), and remained insignificant after the treatment was stopped. On the other hand, the control group's refractive error deteriorated from baseline to 90 days and further at 180 days for both eyes ($p>0.05$). A similar result was observed in unaided visual acuity.

CONCLUSION

There is evidence suggesting that Energie EyeRelax™ therapy is effective in improving and maintaining myopia in myopic Chinese school children. Further investigations in other visual functions need to be conducted to support the use of Energie EyeRelax™ therapy.

ACKNOWLEDGEMENT

The authors wish to thank the students of SJK (C) Pui Ying School for their participation. This randomized study was conducted and funded by Utama Optometrist Group Sdn Bhd (Malaysia) and Energie EyeCare Group, respectively.

REFERENCES

1. Dunaway D, Berger I. "Worldwide Distribution of Visual Refractive Errors and What to Expect at a Particular Location." Retrieved August 31, 2006.
2. Zainal M et al., Prevalence of Blindeness and Low Vision in Malaysian Population: results fron the National Eye Survey 1996. *Br J Ophthalmol* 2002, **86**: 951-956.
3. "Visual impairment and refractive error among school children in Malaysia" Ophthalmology Department, Hospital Selayang, Batu Caves, Selangor, 68100, Malaysia, 2004

Poster #40

PERIPHERAL EQUIVALENT SPHERICAL REFRACTIONS OF YOUNG COLLEGE MYOPES ARE, ON AVERAGE, MYOPIC RELATIVE TO THEIR FOVEAS

Howard C. Howland, Kenneth Angelino and Christine Yang
Department of Neurobiology and Behavior, Cornell University, Ithaca N.Y.,14853 USA

Abstract

AIM Because it has been shown in primates that peripheral hyperopia can drive the lengthening of the eye[1] and hence progression of myopia, we wished to determine if the peripheral retina is relatively hyperopic or myopic to the fovea in young myopic college students whose myopias were presumably progressing.

METHODS Refractions using a PowerRefractor of the left eyes of 23 myopic and 4 emmetropic freshman and sophomore (18-19 year old) college students were measured at 4 peripheral points (superior, inferior, temporal nasal) 25º from the fovea, and compared with 4 measurements of their foveal refractions.

RESULTS The peripheral refractions of the left eyes of myopic subjects were significantly more myopic than the left foveal refractions (mean difference = -0.28 D $\pm$ 0.14 D, $p \leq 0.05$), but the corresponding relative myopic difference in right eyes was not significant. There was no significant difference between the right eye and left eye values of relative myopia for myopes, nor was there a significant difference between the relative peripheral refractions of myopes and emmetropes. Nine of the 23 myopes exhibited relative hyperopic refractions in one or both eyes that, as a group, differed significantly from zero ($p< 0.006$).

CONCLUSION Because the peripheral retinas of myopic college students are, on average, myopic relative to their foveas, it is unlikely that peripheral hyperopia is driving myopic progression in a majority of these subjects. It remains to be seen if the myopias of those myopes with relative hyperopic peripheral refractions progress more rapidly than those with relative myopic peripheral refractions.

Introduction

Purpose We wished to see if young myopic college students, whose myopia could be expected to progress over the course of their undergraduate years[2,3], exhibited peripheral hyperopia. As a comparison group we used emmetropic students. The study was inspired by the findings that in monkeys peripheral refraction alone is adequate to guide emmetropization[1].

A second, subsidiary purpose of the study was to investigate the off-axis astigmatism of the eye. We distinguish between three types of astigmatism. We call the cylinder of the central refraction "ophthalmic astigmatism", as it can be corrected with a spectacle lens. The cylinder measured in the same manner of a peripheral point of the retina we term "peripheral astigmatism". Lastly by "off-axis astigmatism" we mean that astigmatism that is generated by a symmetrical lens system where the axis of the negative cylinder rotates through 360 degrees and has the same angle as a line perpendicular to that passing from the off axis point to the optical axis of the system (Fig 1).

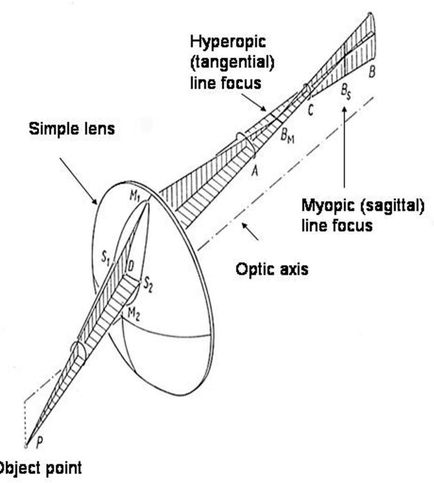

Fig 1. Off axis astigmatism of a simple lens system. The object point is directly below the optic axis. The two line foci are perpendicular to each other. Such a system would image the rim of a wagon wheel in front of its spokes.

Methods

Subjects Freshman and sophomore students (11 males, 21 females) were recruited by posters to date for the study and paid for their participation. Some subjects have attended two visits.

Measurements Central and peripheral refractions were measured with a Power-Refractor (Multi-channel systems, Reutlingen, Germany). The tangent screen was located 1 meter from the subjects corneas and corrections were made for the slightly different working distance of the peripheral targets. Central refractions were also measured with a KR9000 Topcon Wave front analyzer, and these latter measurements were used to asses progression of myopia.

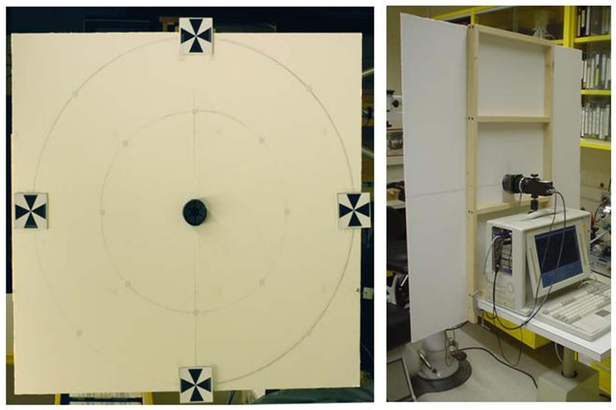

Fig 2.. Tangent screen with peripheral targets and PowerRefractor behind tangent screen

Data analysis Subjects' data were entered into Excel spreadsheets and equivalent spheres of peripheral and central refractions were computed. The differences between central and equivalent spheres were computed for left and right eyes for two visits vectorially and, using a specially written BASIC program, the cylinder of the central refraction was subtracted from the peripheral cylinders of each subject to find the off-axis astigmatism. In this procedure the data of one eye were reversed and combined with the other eye to compute the medial and lateral off-axis astigmatism. Because the magnitude of off-axis astigmatism is known to vary with the square of the distance from the optic axis, best fitting parabolas were fit to the superior-inferior and medial-lateral meridians.

Results

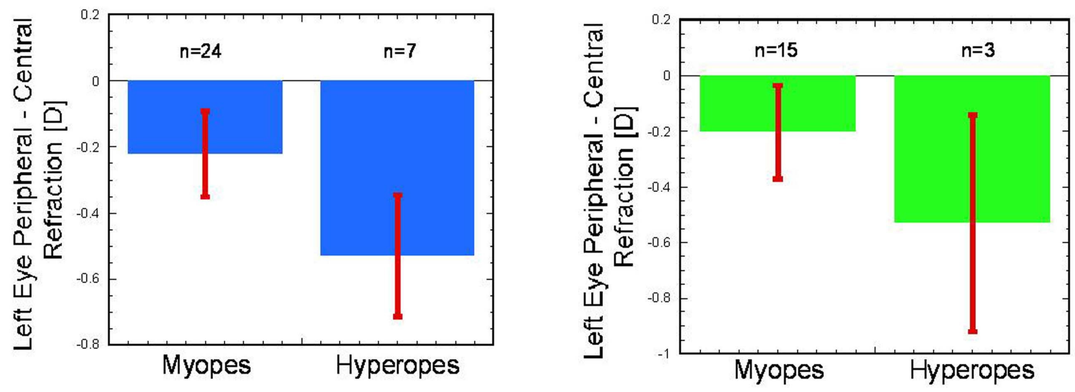

Fig 3. Differences in peripheral minus central (p-c) equivalent spherical refractions for left eyes of myopes and hyperopes in the first two visits of the study as measured by the PowerRefractor. Error bars give $\pm$ one std error.

Peripheral vs. Central Refraction In both the first and second visits subjects were more myopic in their periphery than in fovea (fig 3). However, only the difference between the central and peripheral refractions of hyperopes on the first visit was significant (t-test, $p<0.03$). Sixteen of the 24 myopes exhibited, as a group, significant myopia in the periphery (-0.55 $\pm$0.12D, $p<0.0003$. No differences between males and females were found in central and peripheral refractions. The average time between examinations was 0.325 years. Over this period the mean myopia increased approx 0.1 D ($p>0.05$, Not Significant).

Potential artifact in off-axis refraction of PowerRefractor The power refractor evaluates refraction by calculating the slope of the illumination in the pupil. Thus it is possible that, because the width of the pupil becomes less when viewed at an angle, the refraction of the saggital meridian may be exaggerated by the inverse of the cosine of the angle of view. To correct it one must multiply the cylinder by cos25º, or 0.906. Thus the correct average cylinder (Table 1) is -1.44 D, a difference of 0.15 D. However since the equivalent sphere is the sphere plus one-half the cylinder the correction to the equivalent sphere is 0.075 D, a difference that is negligible.

Off-axis astigmatism The results for off-axis cylinders for 51 Left and 51 right eyes for both visits gave the following table:

Table 1 Off Axis Astigmatism at 25º

Visual Field	Cylinder [D]	SE*	Predicted Axis°	Axis °	SE°
Superior	-2.42	0.18	0	0	2.35
Temporal	-1.88	0.15	90	89	2.53
Inferior	-1.71	0.15	0	-3	3.61
Nasal	-0.36	0.08	90	103	6.15

Using the cylinder values for the temporal and nasal cylinders with their standard errors, and using a Monte Carlo program to find the best fitting parabolas to 10,000 pairs of temporal and nasal cylinders selected at random, we find that the equation for the best fitting parabola describing the off-axis cylinder with error limits is:

$$Y\,[D] = (1.930 * 10^{-3} \pm 1.0*10^{-5}) * (X + 6.2° \pm 0.7°) \quad (1)$$

where Y is the power of the cylinder and X is the angular distance between the fovea and the optic axis.

Discussion

Failure to find relative hyperopic periphery We had expected to find a relatively hyperopic periphery in the eyes of our myopes; however we did not. Thus, if in the future we find that their myopia progresses, it cannot be driven by relative peripheral hyperopia.

Off-Axis Astigmatism In a preliminary study[5] we had reported a larger value of off-axis astigmatism than that of eq. (1) and Fig 4; however we had neglected to consider the bilateral symmetry of the eyes and had used a less accurate method for estimating the central refraction. It will be noted from equation (1) that the mean angle kappa is 6.2º ± 0.7º.

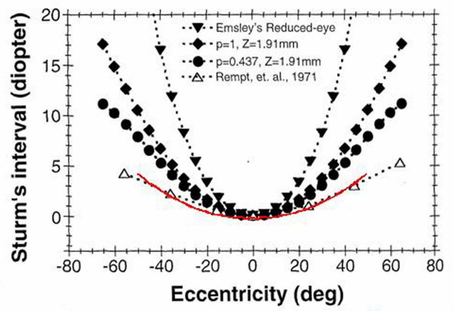

Figure 4. Our off axis astigmatism magnitude (red line) plotted on Wang and Thibos[4] Fig 3. showing various estimates of off-axis astigmatism from human data (Rempt) and Wang and Thibos's schematic eyes. The zero point on the abscissa represents the eye's optic axis

Conclusions

1. The peripheral refractions of 24 college freshmen and sophomores are, on average, myopic, relative to their foveas ($p=0.10$, N.S.). Of these, a group of 16 are significantly myopic (-0.55 $\pm$ 0.12D; $p<0.0003$)

2. The PowerRefractor measurements of off-axis astigmatism do not differ significantly from their predicted axes. They are close to Rempt's data (Fig. 4) in magnitude and predict an angle kappa of 6.2 $\pm$ 0.7°

References

[1]Smith et al. 2005, IOVS 46(11) 3965. [2]Jorg, J. et al 2007,Ophthalmic Physiol Opt **27** (3) 287. [3]Bullimore et al., IOVS 2002, IOVS 43 (7) 2110. [4]Wang, Y. Z. & Thibos, L.N. (1997) Optometry and Vision Science. 74(7): 557–562. [5]Howland & Angelino ARVO 2007

Poster #57

Natural development of macular retinoschisis in pathological myopia The timing for surgical intervention

Tzyy-Chang Ho, Yung-Feng Shih, Pin-Fang Chen, Muh-Shy Chen, Szu-Yuan Lin.
Deparment of Ophthalmology, College of Medicine, National Taiwan University, Taipei, Taiwan

AIM: To investigate the natural development of macular retinoschisis in pathological myopic eyes. **METHODS:** Vision evolution, optical coherence tomographical findings, and associated complications were determined. Surgery was performed only for macular hole retinal detach Twenty eyes of 16 patients were enrolled (mean 53.6 years, average -13.9 diopters). Follow-up period was from 11 months to 11 years. Splitting outer neurosensory retina was found in 100% of the cases. Eight eyes (40%) presented initial BCVA better than LogMAR0.3. During the observation, 13 eyes (65%) maintained stationary vision; whereas, 6 eyes (30%) revealed visual deterioration more than 0.3LogMAR during follow them, 4 eyes showed dramatic visual downhill associated with retinal detachment or macular hole. Two eyes showed dense cataract forma new episode of outer neurosensory layer disruption in macula respectively. Three eyes complicated with MH underwent pars plana v which had led to successful foveal reconstruction. One eye complicated with RD without MH formation resolved spontaneously one y **CONCLUSION:** Dramatic vision downhill (>0.3 LogMAR) may suggest the ensue of retinal detachment or macular hole. Surgical intervention as soon as the macular hole developed prevented advanced vision loss, and will still achieve a satisfying structural and visual success.

Myopia is a highly prevalent condition, especially in the East Asia. Reasonably, these regions contribute the largest portion of patients who suffer from high myopia and associated sight-threatening ocular pathology. A previous study in Taiwan found the prevalence of high myopia (> age of 18 years was 24% in girls and 18% in boys. The associated ocular pathology includes retinal hemorrhage, choroidal neovascularization (CNV), macular hole (MH) with or without retinal detachment (RD), and others. In 1999, Takano and Kishi, using optical coherence tomography (OCT) to present the first examples of" foveal retinoschisis" in highly myopic eyes with staphyloma.[2]

We studied a series of 16 cases, 20 eyes of retinal schisis, presented the characteristics in various profiles, the clinical evolution, and the outcome of surgical intervention in 3 eyes of associated complication during follow-up period.

Design

A retrospective, observational case series

Patients and Methods

Patients were recruited from those kept regular follow-up in Depart. of Ophthalmology, National Taiwan University Hospital. From July, 2005 to April, 2007, twenty eyes of 16 patients (6 males, 10 females) who presented their first image of retinoschisis by OCT were enrolled. We reviewed the charts about the ocular history, grade of myopic retinopathy, and refraction error. Fundus and anterior segment examination were performed with biomicroscopy. Evolution of vision acuity was recorded; cross-sectional image of posterior pole, and macular thickness (MT) were followed by OCT (Zeiss, Stratus OCT®, Model 3000).

The patients' age ranged from 37 to 79 years (average, 53.6 years). Follow-up period ranged from 11 months to 11 years (average 5.4 years). Duration of OCT follow-up ranged from 1 months to 1 year and 10 months (average, 11.6 months). Best-corrected visual acuity (BCVA) ranged from 20/1000 to 20/22 (average, Log MAR 0.708) in the first examination. Besides, the results of vision acuity were taken and recorded as the standard of Landult' C chart, and was calculated with Log MAR. The selected eyes included 18 phakic, 2 aphakic eyes (NO.14, refraction surgery (NO.18, phakic status, status post LASIK,). The refractive errors of the 18 phakic eyes ranged from -6.5 to -25 diopters (average, -13. diopters) (NO.3, phakic status, which was excluded for failure of the autometry, AXL = 34.1mm).
During the follow-up period, 3 eyes of 3 patients received retinal surgery for macular hole with retinal detachment (NO.1, 16) and macular hole with foveal detachment (NO.13). Because the pre-operative cross-section of patient NO.16 (os) was unavailable in our hospital, we discussed the case by the information of transferring sheet from other hospital. We performed pars plana vitrectomy (PPV), encircling buckle, silicone oil temponade for the former 2 patients; and PPV with ILM peeling for the latter one. Post-operative structural outcome and functional prognosis were recorded.

Results

OCT disclosed the image of retinal splitting in the selected 20 eyes.[Table.1] The distribution of refraction error were listed as following: 4 eyes less then -10 D (20%), others more then -10 D (80%). Splitting level in the outer plexiform was noted in all of the selected eyes (in 6 eyes (30%), in the other words, both outer and inner layer was noted in 30% of them. Traction from epiretinal membrane or posterior hyaloid imaged by OCT was found in 12 eyes (60%), and staphyloma was found in 12 eyes (60%); both factors existing were found in (15%) were free from the both factors above. Besides, posterior hyaloid detachment was noted in Patient NO.10, and 18 (os), imaged by OCT. But the schisis persisted without resolution.

The initial BCVA better than Log MAR 0.3 (including Snellen 20/40) was noted in 8 eyes (40%) of 7 patients. Six eyes revealed retinoschisis in the foveal area only, with macular thickness (MT) ranged from 310 ~ 360 μm ; 1 eye (NO.17) disclosed diffuse, and severe schisis pattern with MT however the BCVA was satisfying of Snellen 20/22. Whereas, the other eye (NO.17) showed poor vision acuity of Snellen 20/66 with MT 580μm, which might be related to the disruption of outer layer of the retina. Cataract surgery was performed in 6 eyes during following period, but none of them showed better vision acuity compared with the initial data. During follow-up, the BCVA decreased from Log MAR 0.708 to LogMAR 0.931 in average. However, improved BCVA (decrease more than 0.3 LogMAR) with mild visual fluctuation was noted in 4 eyes (20%) of the follow-up period was noted in 11 eyes (55%) of 8 patients. Extremely poor vision initially or significant visual downhill was noted in 5 eyes. Four of the 5 eyes were related to the complication of MH with or without RD, 1 of them was mainly due to dense cataract formation.

Patient NO.1 had retinoschisis with foveal detachment in the right eye, imaged by OCT initially. However, complication of RD with MH was noted with significant vision downhill after 7 months. He received PPV and silicone oil temponade, which had leaded to structurally reattached, and regression of retinoschisis just post-operatively. Besides, recovery of foveal depression with mild attenuated signal was found by OCT 4 months later. The vision ever improved from 2/200 to 5/200, but decreased gradually for cataract formation after the surgery. decreased vision, and retinoschisis with MH was diagnosed. She received PPV and internal limiting membrane (ILM) peeling, and the OCT disclosed regressed retinoschisis but central retinal defect after the surgery. The vision acuity remained in the level from 4/200 then decreased to 2/200 with the dense cataract formation. Patient NO.16 complicated as MH with RD, and received PPV, encircling scleral buckle, and silicone oil temponade. The surgical outcome revealed attached retina with central choroidoretinal atrophy. And the vision improved slightly from 2/200 to 10/200. Patient NO.3 had retina detachment without MH, but she refused any surgical intervention. However, spontaneous reattachment, and perfect pattern of foveal depression was imaged by OCT after 1 year. Posterior vitreous detachment at macula area was proved by the cross sectional image. Discouragingly, the vision didn't improve after reattachment, and remained around the level of 6/20. [Table.3]

Discussion

Retinoschisis of the posterior pole in highly myopic eyes was recently described by OCT. Because of the severe tessellated eye ground, or the poor contrast under variant grade of myopic retinopathy, it's difficult for the ophthalmologists to recognize the associated findings such as cart appearance of radial folds in macula. In our series, only one eye of patient NO.17 disclosed the radial folds. Without the cross-sectional image by OCT, this pathological change was probably misinterpreted clinically as shallow RD, macular edema or macular hole.
In several case series, all the myopic-associated retinoschisis (MRS) were highly myopic (> -6D), and mostly with staphyloma, [Table.2] [1] [2] [4] which was corresponding to our case series. As mentioned in previous studies, staphyloma and tangential force by posterior hy might contribute to the pathophysiology of myopic-retinoschisis. There was 85% of eyes in our study presented either of the factors; whereas, we still found 15% of them free from either of the risk factors. In fact, a portion of the fellow eyes of our enrolled patients possessed same their schisis eyes but no retinoschisis was found. This findings may support the hypothesis that retinoschisis in highly myopic eyes involves a degenerative process of the posterior retina. Therefore, we proposed that there should be multi-factors which alter the formation of retinoschisis. Besides, the affected portion of neurosensory retina was more in outer layer than in inner layer (4:1), we proposed that the cellular junction of outer layer might be more affective by MRS.
It is hard to figure out the relationship between vision acuity and macular thickness in schisis eyes, because of the different lens condition, and variant severity of choroidoretinal atrophy individually. Some study proposed that MRS patients had progressively decreasing vision acuity with macular thickening.[1] However, 13 eyes (65%) exhibited slight fluctuation or stable vision acuity with mild change of macular thickness in our study. Corresponding to the study by Benhamou N. et al, there was no definite relationship between macula thickness and vision acuity individually or per Though the averaged Log MAR showed decreased vision acuity during follow-up period, we should take aging factors such as cataract formation into consideration. Our case NO.17 exhibited another interesting example of same splitting pattern of retinoschisis with different vision acuity. BCVA in the right eye was 20/22, whereas 20/66 in the left eye, because of the disruption of outer layer of the neurosensory retina in the left eye.
Dramatic vision downhill was noted in 4 eyes in our study for the macula hole, or retinal detachment. Three of them received appropriate surgical intervention. Despite all the patients had their retina reattached, and all the schisis regressed, the central retinal defect was proved by OCT and improvement of vision was discouraging (2 remained same level as pre-OP, only patient NO.16 gained slightly improvement). The other eye without surgical intervention showed spontaneous resolution after posterior hyaloid detachment (PVD) in macular area, which have never been reported in Medline searching; however, the vision didn't improve with the structural recovery. Surgical outcome of MH associated with MRS was studied by Ikuno Y. et al, and the results were published in the year of 2006. They managed such 8 eyes with PPV, ILM peeling and pneumatic retinopexy and only 25% of them had MH closed, and 37.5% had improved BCVA by more than 2 lines, 37.5% remained unchanged, and 25% even went worsen. [5] Ikuno Y. et al managed 6 eyes of MRS with localized foveal detachment, without MH. Surgical interventions included PPV, ILM peeling, and pneumatic retinopexy. Structural resolution was found in 5 eyes (83%), and vision improvement more than 2 lines was noted in 6 eyes (100%). [6] We had similar outcome as study by Ikuno et al published in 2006.

Conclusion

Macular retinoschisis (MRS) is not rare in the highly myopic eyes. Staphyloma, tangential force from posterior hyaloid / epiretinal membrane, and other factors contribute to the formation of MRS interactively. We proposed that, half of the MRS eyes remained stably functional and structural condition, and the other half might present slow and mild deterioration.
Dramatic visual downhill may suggest the complication of MH or RD, which is emergent and sight-threatening. And OCT is an appropriate tool which disclosed detailed cross-sectional image of those tessellated and whit-mosaic fundus in highly myopic eyes.
Although no significant visual improvement after the surgery, it is beneficial for preventing further vision loss and keeping the detached retina structurally reattached. Spontaneous reattachment might occur after PVD; however no visual improvement was noted in our single case. Different from the previous studies, our high-resolution OCT provided detailed cross-section of posterior pole of the highly myopic eyes, and help ophthalmologists follow the risky patients in a more precise way.