ORIGINAL ARTICLE

The Efficacy of Orthokeratology in Controlling Myopia Progression in Primary School Children in Kuala Lumpur

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ABSTRACT

INTRODUCTION: Myopia is a global public health issue. Advanced myopia can lead to potentially serious ocular pathologies such as glaucoma and maculopathy, thus controlling progression of myopia is essential. Orthokeratology (Ortho-K) has been shown to be effective in controlling the progression of myopia in children. However, limited data is available on this from the East Asian populations. This study investigated the efficacy of Ortho -K in controlling the progression of myopia in children in Kuala Lumpur. The results were compared with those for single vision spectacles (SVS). **MATERIALS AND METHODS:** Children aged 8-9 years, with myopia of -0.50 to -4.00D and astigmatism of ≤1.00D, were invited to participate. Cycloplegic refraction at the central and peripheral retina, visual acuity (VA), corneal topography, and axial length (AL) measurements were taken at baseline (BL) and every 6 months over a 1-year period. **RESULTS:** In all, 70 children (35 males and 35 females), with a mean age of 8.31±0.47 years, participated. Forty -five children were fitted with Ortho-K lenses and 25 with SVS. Significant changes in the refraction, corneal curvature, and AL were found over the study period and between the groups ($p<0.05$). Significant myopic shifts in the relative peripheral refraction (RPR) ($p<0.01$) were noted in the Ortho-K wearers, while hyperopic shifts ($p<0.01$) were found in the SVS group. Myopia progression and AL elongation were slowed by around 50% and 44%, respectively. **CONCLUSION:** Wearing the Ortho-K lenses for 12M is effective in controlling myopia progression children and can be recommended when managing myopic children.

Keywords
Myopia, Children, Orthokeratology, Axial length, Refraction

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INTRODUCTION

The prevalence of myopia is increasing worldwide, especially in East Asia regions.[1-3] It has been reported that the prevalence of myopia in East Asian countries to be as high as 90% in young adults.[1] Holden et al.[3] estimates that almost half of the world's population will be myopic by 2050. In addition, myopia now is being diagnosed at a younger age and tends to progress more rapidly to become high myopia.[3] Hence, there are concerns that advanced myopia will become more common in the future.[4] High myopia is associated with sight-threatening eye diseases such as myopic macular degeneration, retinal detachment, and glaucoma, due to axial length elongation.[5]

Several interventions have been shown to be effective in slowing down the progression of myopia, and one of them is orthokeratology (Ortho-K).[6] The Ortho-K is a specialized clinical technique of overnight wear of high-DK gas-permeable rigid contact lenses for the correction of myopia through corneal reshaping.[7] The first clinical study on the Ortho-K was reported in Hong Kong, that involved 35 children aged 7-12 years wearing Ortho-K lenses and 35 children in a single vision spectacles (SVS) control group.[8] The results demonstrated a reduction rate of 46% in the progression of myopia induced by wearing the Ortho-K lenses. Walline et al. fitted 40 children, aged 8 to 11 years with myopia (-0.75D to -4.00D), with the

Ortho-K lenses and measured the axial length (AL) changes annually for 2 years.[9] The subjects were age-matched to soft contact lens wearers from another myopia control study, and the results showed that wearing the Ortho-K lenses reduced 55% of AL elongation over the period of 2 years, with a significantly lower annual rate of change than the control group. In a study, Retardation of Myopia in Ortho-K (ROMIO), Cho and Cheung randomly assigned 102 myopic children aged 6-10 years with myopia of -0.50 to -4.00D to wear the Ortho-K lenses and SVS for a period of 2 years. [10] The authors concluded that children wearing Ortho-K lenses had a slower increase in AL elongation by 43% than the SVS group; and that younger children tended to have faster axial elongation and may benefit from early Ortho-K treatment.

It is hypothesized that the Ortho-K lenses control the progression myopia by flattening the central cornea and forming a junction wherein the oblate part of the cornea returns to its original curvature, which effectively results in images focusing centrally on the fovea, while the peripheral light focuses anterior to the peripheral retina, thus creating myopic defocus.[11] The simultaneous creation of peripheral myopic defocuses while still providing clear foveal vision has been assumed to be the reason why the Ortho-K lenses have been reported to slow the progression of myopia. Queiros et al measured peripheral refraction along the horizontal meridian of 28 myopic subjects before and after one month of wearing the Ortho-K lenses.[12] Their study reported a hyperopic change in the central refractive error, which indicated the elimination of uncorrected myopia within the central ±20° of retinal eccentricity (a significant myopia reduction at the central 40) and a myopic shift in the peripheral beyond 25°.

To date, there is no published report about the long-term impact of wearing the Ortho-K lenses on refraction and AL elongation in myopic children in Malaysia. Previous reports focused on the short-term impact (1 week and 6M) of wearing the Ortho-K lenses in children and young adults but not on the progression of myopia. [14,15] Given the significant increase in myopia prevalence specifically in the East Asian region and the growing interest in Ortho-K treatment, it is essential for optometrists to have reference data from the Malaysian population specifically on the efficacy of the Ortho-K in controlling progression of myopia. Thus, this study was conducted to investigate changes in the refraction and axial length (AL) elongation in myopic school children after 12 months of wearing the Ortho-K lenses. The results were compared with single vision spectacles (SVS).

MATERIALS AND METHODS

This was a prospective longitudinal clinical study involving myopic school children, aged 8 to 9 years old from Kuala Lumpur. The inclusion criteria were spherical equivalent refractive error (SER) of -0.75<SER<-4D, astigmatism less than ≤1.50D in both eyes and demonstrated myopia progression of at least -0.75D in the 12 months or at least -0.50D in the 6 months prior to enrollment, based on past records. They were further required to have a best corrected visual acuity (VA) 0.0 log of the minimal angle of resolution (logMAR) in each eye, a birth weight of ≥ 2000g, and no history of ocular or systemic disease, myopia treatment, or contact lens use.

Subjects were allocated to either the Ortho-K group or the SVS group based on the decisions of the children and their guardians. They were given a balanced account of the advantages and disadvantages of the two vision correction modalities offered in this study (SVS or Ortho -K lens). Care was taken not to suggest that one modality might perform better than the other or provide better control over the progression of myopia. This study was approved by the Ethics Committee of the Universiti Kebangsaan Malaysia (UKM PPI-800-1/1/5 JEP-2017-422) and was conducted in accordance with the tenets of the Declaration of Helsinki. Written consent was obtained from the parents or guardians of all participants prior to data collection.

Based on the results from previous studies [16], the sample size calculation using the statistical power of 95%, type 1 error probability of 0.05, and the two-tailed paired t test showed that the minimum sample size for the treatment group was estimated to be 8, and it was 6 for the control

group. To account for the possibility of subjects dropping out during the 12 months, as well as the higher accuracy in parametric statistical tests, the minimum sample size was estimated to be at least 20 for each group.

Subjects in the control group were prescribed distance SVS with a spherical design and made of plastic material with a refractive index of 1.56 (Integrated lens technology, ILT, Singapore) having the most plus power with optimum VA, and they were asked to wear the spectacles all the time. The prescription was updated when the monocular aided vision was 0.18 (logMAR) or worse or when the change in SER was -0.50D or greater. Subjects in the Ortho-K group were fitted with Menicon Z night Ortho-K lenses (NKL Contactlenzen, The Netherlands) made of gas-permeable material (Menicon ZÔ) to be worn overnight. The lenses were made of siloxanylstyrene fluoromethacrylate (Tisifilcon A) material (DK 163 ISO, central thickness 0.24mm). The total lens diameter was 10.60 mm with a 6.0mm diameter optic zone. The initial lens parameters were determined using the computer software provided by the manufacturer (Easyfit Software, Menicon Ltd, Nagoya, Japan). Corneal topography and cycloplegic refraction data for both eyes were input into the software, which automatically calculated the specifications of the trial lens to allow the Ortho-K lens fitting. The Ortho-K lenses were ordered and dispensed to subjects approximately 3 weeks after the baseline (BL) examination.

Examination and measurement

Cycloplegic refraction was performed at BL and every 6 months on all subjects, after the commencement of the study. Following the instillation of topical anesthetic (Proxymetacaine hydrochloride 0.5%, Alcaine, Alcon), cycloplegia was induced using two drops of (Cyclopentolate hydrochloride 1%, Cyclogel, Alcon) separated by 5-minute intervals. Objective refraction measurements were taken with the WAM-5500 autorefractor (Grand Seiko Co. Ltd., Hiroshima, Japan) when the pupil size was larger than 5mm and were refined using subjective refraction.

The eye rotation technique was used to obtain the peripheral refraction (PR) in this study. All subjects were instructed to stabilize their heads while facing straight ahead and to rotate their eyes to fixate on high-contrast letter targets with the sizes of 6/12 (20/40, 0.3 logMAR) that were mounted on the wall at 4 m. These targets were separated by 10° intervals over the central ±30° interval across the horizontal eccentricities in the nasal and temporal visual fields (VFs, 30° N, 20° N, 10° N, center 10° T, 20° T, 30° T). As the eye rotated, the axis of the autorefractometer was aligned with the pupil's center and the corneal reflex. When measuring the right eye, the left eye was occluded, and *vice versa*. Five consistent measurements were taken at each point of the target, and the mean was obtained. If an error or fixation loss was found, the reading was discarded and repeated. The results were recorded as visual field (VF) eccentricities, where the nasal VF represented the temporal retina, and the temporal VF represented the nasal retina. Refractive error readings were obtained in the form of sphere (S), cylinder (C), and axis (θ).

The results were then calculated by converting the spherocylindrical refractive error into power vector components—M, J180, and J45—as recommended by Thibos et al below:

$$M = S + C/2,$$
$$J180 = -(C/2)\cos(2\theta),$$
$$J45 = -(C/2)\sin(2\theta),$$

where M represents the mean spherical equivalent, J180 represents the horizontal component, and J45 represents the oblique cross-cylindrical component.[17] However, only M was analyzed in this report.

An ultrasound direct contact A-Scan (PacScan Plus, Sonomed Escalon, NY) was used to measure the AL. One drop of local topical anesthetic (proxymetacaine hydrochloride 0.5%, Alcaine, Alcon, 15mL) was administered to the subject's eye before starting the measurement. When taking the measurements, the transducer hand-held probe was brought into contact

perpendicularly with the cornea to its center, with minimal possible compression. The outcome was calculated by a single continuous beep, which automatically recorded the mean of five measurements with a standard deviation of <0.30 mm. AL evaluation was carried out at the BL and 6 and 12-month follow-ups. Visual acuity (VA) was determined using a logMAR chart at 6 meters. The contact lens fitting and anterior segment health were examined using a slit lamp biomicroscope (Righton MW50D LED, Tokyo, Japan).

Statistical analysis

The data obtained in this study were analyzed using the statistical software Statistical Package for the Social Sciences (SPSS, version 21.0), and only data for the right eye were included in the analysis to avoid the confounding effect from intercorrelation. All data were normally distributed. The paired t test was used to compare the results at BL, 6 months, and 12 months of wearing Ortho-K and SVS. Repeated measures ANOVA was used to compare variables within the same subject at BL, 6 months, and 12 months of wearing Ortho-K and SVS.

RESULTS

In total, 80 children were initially selected to participate, but only 70 of them (45 Ortho-K and 25 SVS) completed the study. Of the five children in the Ortho-K group who did not proceed, one (1) child was unable to control his frequent eye rubbing habit, two children showed poor compliance to contact lens wear, and another two children dropped out due to COVID-19 infection. A total of five children from the SVS group were dismissed due to non-compliance during follow-up visits. There were no statistically significant differences in the BL data between both groups (p>0.05). The demographic and BL data of the participants are described in Table I.

The measurements at BL, 6M, and 12M for both groups are shown in Table 2. The central refraction was reported in spherical equivalent (SE). At BL, the SE in the Ortho-K group was -2.92 ± 1.07D (range -0.75D to -4.59), while the SE in the SVS group was -2.51 ± 1.12D (range -0.75 to -4.41D). No significant differences were shown in the SE between both groups at BL (p=0.127). In the Ortho-K group, the SE decreased significantly from -2.92 ± 1.07D at BL to -0.15 ± 0.13D at 6M and -0.06 ± 0.12D at 12M (p<0.05), respectively. In the SVS group, the SE increased significantly -2.51 ± 1.12D at BL to -3.15 ± 1.08D and 3.77 ± 1.23D at 6 and 12M (p<0.05), respectively.

Table I. Clinical demographics and baseline measurements of both study groups

Parameters		Ortho-K	SVS	p value
Age (y)		8.38 ± 0.49	8.20 ± 0.41	0.110
Male/Female*		21/24	15/10	0.289
Refractive error (D)		-2.92 ± 1.07	-2.51 ± 1.12	0.127
VA (unaided)		1.21 ± 0.65	1.12 ± 0.62	0.577
Axial length (mm)		23.85 ± 0.71	23.49 ± 0.95	0.081
Cornea FK (D)		43.6 ± 1.27	43.12 ± 1.03	0.116
Central corneal thickness (CCT) (um)		537.6 ± 28	528.44 ± 22.1	0.065
Peripheral refraction (D)	N30	-1.92 ± 1.01	-1.89 ± 0.93	0.906
	N20	-2.45 ± 1.06	-2.30 ± 1.16	0.588
	N10	-2.95 ± 1.06	-2.72 ± 1.35	0.44
	C	-3.22 ± 1.11	-3.03 ± 1.35	0.529
	T10	-2.92 ± 1.11	-2.76 ± 1.30	0.592
	T20	-2.50 ± 1.08	-2.47 ± 1.21	0.899
	T30	-2.02 ± 1.11	-1.95 ± 1.18	0.781

Ortho-K= orthokeratology, SVS= single vision spectacles, D= diopter, VA = visual acuity, PR= peripheral refraction, CCT= central corneal thickness, FK= flat keratometry, N= nasal retina, T= temporal retina

Table II. Measurements at baseline and 12 months for both study groups

Parameters	BL		p value	12 months		p value
	SVS	Ortho-K		SVS	Ortho-K	
Refraction (D)	-2.51 ± 1.12	-3.22 ± 1.11	0.529	-3.77 ± 1.23	-0.06 ± 0.12	0.000 *
VA (unaided)	± 0.62	1.21 ± 0.65	0.577	1.73 ± 0.95	-0.03 ± 0.09	0.000 *
Cornea FK (D)	43.12 ± 1.03	43.6 ± 1.27	0.116	43.28 ± 0.96	40.69 ± 2.54	0.000 *
AL (mm)	23.45 ± 0.97	23.85 ± 0.71	0.082	23.97 ± 1.02	23.64 ± 0.75	0.002 *
CCT (um)	537.6 ± 28	528.44 ± 22.1	0.065	538.28 ± 28.22	524.22 ± 22.25	0.018 *

*p<0.05 significant value. Ortho-K= orthokeratology, SVS= single vision spectacles, HCVA = high-contrast visual acuity, LCVA = low-contrast visual acuity, D = diopter, CCT= central corneal thickness, FK= flat keratometry.

The mean difference in the SE at 6 and 12M was significantly lower in the Ortho-K group when compared to the BL. The mean SE reduced to 2.78 ± 1.07D and 2.86 ± 1.11D at 6 and 12M, respectively (p<0.05). In the SVS group, the mean difference in SE progression was significantly higher than that at BL (p<0.05). At 6 and 12M, subjects in the SVS group presented an increase in the mean SE of -0.65 ± 0.54D and -1.26 ± 1.01D. Regarding VA, the unaided VA improved significantly in the Ortho-K group from 1.21 ± 0.65 at BL to -0.03 ± 0.08 at 6M and -0.03 ± 0.09 at 12M post treatment (p<0.05); however, the VA deteriorated significantly from 1.12 ± 0.62 at BL to 1.43 ± 0.78 and 1.73 ± 0.95 at 6 and 12M, respectively (p<0.05), in the SVS group. A significant negative correlation was noted between the

change in the SE and the unaided VA (r=-0.752, p<0.05) in the Ortho-K group.

The AL decreased significantly from 23.85 ± 0.71mm (BL) to 23.75 ± 0.49 (6M) and 23.64 ± 0.59mm (12M) in the Ortho-K group (p<0.05); however, it increased significantly from 23.49 ± 0.95mm (BL) to 23.73 ± 0.54mm (6M) and 23.97 ± 0.59mm (12M) (p<0.05) in the SVS group. When comparing between groups, no significant differences were shown in the AL between both groups during the first 6M, (p>0.05); however, a significant difference was noted at 12M (p<0.05). Regarding the progression of AL, the mean difference in AL progression was significantly lower in the Ortho-K group compared to the SVS group. At 6 and 12M, the subjects in the Ortho-K group showed a reduction in the mean AL to -0.10 ± 0.24mm (6M) (p<0.05) and -0.18 ± 0.38mm(12M) (p<0.05). In the SVS group, the mean difference in the AL progression was significantly higher when compared to the BL. At 6 and 12 M, the subjects in the SVS group showed an increase in the mean AL of 0.24 ± 0.45mm (6M) (p<0.05) and 0.48 ± 0.47mm (12M) (p<0.05). A significant negative correlation was shown between the change in AL and SE within 12M of wearing Ortho-K lenses (r=-0.238, p<0.05).

Wearing the Ortho-K lenses flattens and thins the central cornea. The FK decreased significantly from 43.6 ± 1.27D at BL to 42.17 ± 1.52D at 6M and 40.69 ± 2.54D at 12M after treatment (p<0.05). In the SVS group, the FK increased significantly from 43.12±1.03D at BL to 43.3±1D and 43.47 ± 1.1D at the 6M and 12M follow-ups (p<0.05). The mean difference in FK was significantly lower in the Ortho-K group as compared to BL. At 6 and 12M, the mean FK reduced to -1.43 ± 1.27D and-2.91 ± 2.58D, respectively, both (p<0.05). In the SVS group, the mean difference in FK was statistically significantly higher when compared to the BL. At 6 and 12M, the mean FK in the SVS group increased to 0.18 ± 0.33 and 0.35 ± 0.7mm, respectively.

The CCT in the Ortho-K group decreased from 528.53 ± 22.26 at BL to 526.89 ± 21.81um at 6M and 524.87 ± 23.15 at 12M after treatment (p<0.05). No significant change was noted in the CCT of the SVS group (p>0.05). When comparing between groups, no significant differences were shown in both groups during the first 6M, (p>0.05), but significant differences were noted between both groups at 12M (p<0.05). The mean difference in CCT showed a statistically significant reduction in the Ortho-K when compared to the BL. At 6M and 12M, the subjects in the Ortho-K group showed a reduction in the mean CCT; -1.64 ± 6.08um (p>0.05) and -3.67 ± 11.12um (p<0.05), respectively. No significant difference was noted in the SVS group.

Relative peripheral refraction (RPR)

The M-value from the RPR measurements (N10°, N20°, N30° and T10°, T20° and T30°) at the BL and 12M is shown in Table 3. All subjects in both groups showed hyperopic RPR at the BL, and it did not significantly vary between the Ortho-K and SVS groups (p > 0.05). However, the RPR at all eccentricities in the Ortho-K group was significantly more myopic at 12M than at the BL (p < 0.05) and was evident with a myopia increment beyond 20° of the visual field. By contrast, in the SVS group, the RPR at 12M was significantly more hyperopic than that at the BL, thus increasing the hyperopic defocus (p < 0.05) (Table 3, Figures 1 and 2). The difference in the RPR measurements between the nasal and temporal parts of the retina in both groups was also analyzed and was found to be insignificant (p > 0.05).

Table III. Mean RPR (M-value) in both the Ortho-K and SVS groups at the BL and 12 months

	Ortho-K (n=45)			SVS (n=25)		
Eccentricities	BL	12M	p value	BL	12M	p value
RPR-30N	1.3 ± 0.55	-1.38 ± 0.64	0.000*	1.14 ± 0.92	2.58 ± 1.33	0.001*
RPR-20N	0.76 ± 0.45	-0.71 ± 0.54	0.000*	0.72 ± 0.57	1.94 ± 1.06	0.000*
RPR-10N	0.27 ± 0.30	-0.19 ± 0.53	0.000*	0.31 ± 0.33	0.76 ± 0.75	0.013*
RPR-10T	0.3 ± 0.24	-0.20 ± 0.46	0.000*	0.27 ± 0.33	0.72 ± 0.60	0.003*
RPR-20T	0.72 ± 0.42	-0.80 ± 0.44	0.000*	0.56 ± 0.74	1.73 ± 0.99	0.000*
RPR-30T	1.19 ± 0.49	-1.40 ± 0.58	0.000*	1.08 ± 1.02	2.25 ± 0.94	0.000*

*p<0.05 significant value
Ortho-K= orthokeratology, SVS= single vision spectacles, RPR = relative peripheral refraction, N = nasal, T=temporal.

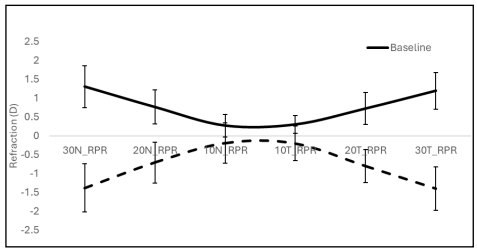

Figure 1. Mean relative peripheral refraction (RPR) at baseline and 12 months in orthokeratology lens wearers.

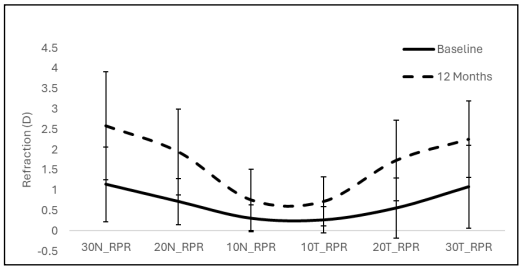

Figure 2. Mean relative peripheral refraction (RPR) at baseline and 12 months in single vision spectacle wearers

DISCUSSION

The efficacy of orthokeratology in reducing the myopic refractive error and thereby providing an improved unaided VA has been well documented by several investigators.[8-10] Nevertheless, to our knowledge this is the first reported study about the efficacy of the Ortho-K lenses in controlling progression of myopia in Malaysian children. Overall, the results of this study demonstrated that wearing the Ortho-K lenses for 12M successfully reduced myopia progression and improved unaided VA in Malaysian children. The unaided VA improvement in this study was consistent with the reduction in the refractive error, where more than 90% of refractive correction was achieved after 6M of wearing the Ortho-K lenses. Chen et al reported that the Ortho-K lenses successfully corrected and reduced myopia from -2.46D at BL to 0.18D at 6M and with no subsequent change at 12M. [18] As for the control group, the amount of myopia increased gradually from -2.04±1.09D to -3.17±1.22D at 12M, which is similar to the findings of this study. In a meta-analysis review study, Lee et al reported that children in the Ortho-K group had a significantly lower trend ($p<0.001$) of refractive error change during the follow-up periods.[19] The authors concluded that wearing overnight of the Ortho-K lens was effective in slowing the progression of myopia and improved unaided VA, over a 12-year follow-up period.[19]

Regarding AL elongation, the results of this study showed that wearing the Ortho-K lenses successfully reduced AL progression by 47% within the period of study. The results are consistent with the outcomes of previous investigations.[8, 10] In the LORIC study in Hong Kong, the authors reported that AL elongation was reduced by 46% after 2 years of wearing the Ortho-K lenses, compared to spectacle-wearing historical controls.[8] In a study conducted in Spain, Santodomingo-Rubido et al reported that the AL in children wearing the Ortho-K lenses was shorter than that in those wearing the SVS lenses (0.22m vs. 0.37mm) over a 12M period.[20] Nevertheless, the results of this study also demonstrated an AL shortening of -0.18±0.38mm after 12M of wearing the Ortho-K lenses. Swarbrick et al revealed a significant shortening of the AL -0.02±0.05mm and -0.04±0.08 at 6 and 12M, respectively, in subjects who were assigned to wear the Ortho-K treatment in their study. [21] Wang et al also reported an AL shortening of -0.08 ± 0.04 mm and -0.28 ± 0.19 at 1 and 20M post Ortho-K lens wear.[22] The authors suggested that the apparent shortening of AL among the Ortho-K lens wearers may reflect the contribution of Ortho-K-induced central corneal thinning, combined with choroidal thickening or recovery due to a reduction or neutralization in the myogenic stimulus to eye growth in these myopic children.[22] The thinning of the CCT was observed among Ortho-K wearers in this study, which may indirectly contribute to the AL shortening. However, choroidal thickness was not measured in this study; therefore, its contribution cannot be confirmed and warrants further investigation.

The results of this study also demonstrated that wearing the Ortho-K lenses for 12M caused significant hyperopic shifts within 20 degrees of central refraction and myopic defocus beyond 30 degrees along the horizontal meridian, which support previous studies. Queiros et al measured the PR along the horizontal meridian of 28 subjects with mean age 24.6±6.3 years and myopia between -0.88 and -5.25D before and after wearing the Ortho-K lenses for 1M.[12] The authors concluded that the Ortho-K lenses invert the pattern of peripheral refraction in SE, creating a treatment area within the central 25 degrees of the visual field and a myopic shift beyond 25 degrees.[2] Yoo et al compared the impact of wearing the Ortho-K lenses and SVS on PR and progression of myopia in a population of South Korean children.[23] Their results also showed peripheral myopia across the horizontal meridian of the retina, at 30T, 20T, 10T, 10N, 20N, and 30N from the fovea. The authors also reported that the central AL elongation in children who wore the Ortho-K lenses was shorter than those who wore SVS after 12M of treatment.[23]

Overall, this study demonstrates that wearing the Ortho-K lenses for 12M alters refraction, creates myopic defocus at the peripheral retina, and reduces AL elongation and progression of myopia in children. It is hypothesized that Ortho-K lenses correct central myopia by flattening the central cornea and increasing the steepness of the mid-peripheral cornea, which indirectly leads to the increase in the myopic defocus and ocular higher-order aberrations on the peripheral retina, which maybe the stimulus for slowing eye growth, thereby reducing the visual feedback for AL elongation. [18, 23] The outcomes of this study concurred with the hypothesis.

Nevertheless, there are several limitations of this study that must be acknowledged. The first is the short follow-up period, which makes it difficult to determine whether the change in PR was the stimulus for AL elongation or the resultant effect of the AL growth. A longer follow-up period is recommended so that the impact of the magnitude of RPR myopic shifts on the progression of myopia can be monitored. Second, the PR on the vertical meridian was not measured in this study. Mutti et al reported that myopic subjects demonstrated myopic defocus in the vertical meridian relative to the fovea. [24]

CONCLUSION

This study concludes that the Ortho-K lenses are effective in controlling the progression of myopia in Malaysian children. More eye care practitioners should consider prescribing Ortho-K lenses when managing myopic children in the local population.

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