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Myopia Control Effect of Continuous versus Sinusoidal Photobiomodulation Therapy in Children: A Randomized, Double-Blind, Controlled Clinical Trial

Bingjie Shi
doctorshi0608@163.com

Department of Ophthalmology, Union Hospital, Tongji Medical College, Huazhong University of Science and Technology https://orcid.org/0009-0009-9045-3970

Yamin Mao

Rui Li

Yayan You

Union Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430022, China

Qiming Wang

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Abstract

Objectives

To compare short-term ocular responses to sinusoidal versus continuous light-emitting diode photobiomodulation (LED-PBM) in children with premyopia or low myopia, and assess if lower-average-power modulation elicits early structural changes.

Methods

In this prospective, randomised, double-masked exploratory trial, 61 children aged 6–12 years were screened; 2 were excluded and 59 randomised to 3 months of sinusoidal or continuous LED-PBM. Two sinusoidal-group participants had no follow-up, leaving 57 children (114 eyes: 27 sinusoidal, 30 continuous) for analysis. Both groups used identical 650-nm LED devices with matched peak power (3 minutes twice daily); the sinusoidal regimen delivered ~ 50% average ocular optical input. Axial length (AL), cycloplegic spherical equivalent (SE) and choroidal thickness (ChT) were measured at baseline, 1 and 3 months and analysed via linear mixed-effects models.

Results

At 3 months, adjusted AL increased by 0.071 (0.019) mm in the sinusoidal group and 0.050 (0.018) mm in the continuous group, with no significant between-group difference (difference 0.021 mm, 95% CI − 0.032 to 0.074, P = 0.429). SE remained stable in both groups (P = 0.998). ChT increased from 1 month in both groups; central 1-mm ChT increases were numerically larger in the sinusoidal group, but the 3-month between-group difference was non-significant (5.689 um, 95% CI − 5.60 to 16.98, P = 0.327).

Conclusions

Sinusoidally modulated LED-PBM induces early choroidal thickening despite lower average power, with no significant short-term differences in AL or SE versus continuous LED-PBM. These findings support further optimisation of LED-PBM output profiles but do not establish regimen equivalence.

Introduction

Myopia has become a major global public health challenge, with a rapidly increasing prevalence and a growing number of children at risk of high myopia[1, 2]. Recent systematic estimates project that by 2050, approximately 39.8% of children and adolescents globally will have myopia, affecting over 740 million individuals[1].Progressive myopia is clinically important because excessive axial elongation increases the lifetime risk of vision-threatening complications, including retinal detachment, myopic macular degeneration, glaucoma, and choroidal neovascularization[3, 4]. As axial elongation is the key structural basis of pathological myopia[4], identifying effective and biologically meaningful interventions for childhood myopia control remains an important priority in ophthalmology.

Repeated low-level red-light (RLRL) therapy, a form of photobiomodulation (PBM), has recently emerged as a promising intervention for childhood myopia control[5–7]. Clinical studies have demonstrated that RLRL slows axial elongation and myopic progression, and may even induce short-term axial shortening in some children[8]. However, expanding clinical application has raised concerns regarding retinal safety and treatment optimisation. Radiometric and optical analyses suggest some red-light devices may approach or exceed retinal safety limits under certain exposure conditions, particularly with repeated use, larger pupil sizes or higher delivered power[9, 10]. In addition, case reports of retinal structural abnormalities after repeated red-light exposure, together with divergent findings from AOSLO-based clinical imaging studies regarding cone photoreceptor density after RLRL treatment, further highlight the need to define safer and more appropriate delivery strategies[11–13]. For red-light-based myopia control, the key issue is not only whether PBM is effective, but also how it can be delivered more safely and efficiently[9, 10].

The mechanisms underlying the antimyopic effects of RLRL/PBM remain incompletely understood, but the choroid has emerged as a plausible early responsive tissue. Myopic eyes are commonly characterized by choroidal thinning and impaired perfusion, changes that may drive scleral hypoxia, extracellular matrix remodelling and axial elongation[14, 15]. Consistent with this concept, prior RLRL studies have documented rapid increases in macular choroidal thickness within the first month of treatment[16–19]. More recently, in premyopic children receiving RLRL, 3-month choroidal thickening—particularly in the subfoveal region—was associated with 12-month SE and AL outcomes, suggesting potential value as an early predictor of longer-term treatment response[18]. Paediatric dose-ranging and adult crossover trials further indicate meaningful ocular responses can be achieved with lower mean irradiance, though paediatric clinical evidence remains limited[20, 21]. PBM biological responses are highly parameter-dependent and non-linear, and temporal modulation of light exposure can alter ocular growth responses, suggesting continuous illumination may not be the optimal delivery mode[22–26]. However, whether a lower-average-power, temporally modulated LED-PBM profile can induce early ocular responses comparable to those of continuous illumination in children with premyopia or low myopia remains largely unexplored.

This 3-month exploratory randomised study compared short-term ocular responses to two power-output profiles of the same LED-PBM device in children with premyopia or low myopia. We characterised trajectories of AL, SE and ChT at 1 and 3 months, with retinal capillary density and optic nerve-related parameters as ancillary outcomes. The study was not designed or powered to establish equivalence or non-inferiority between regimens, but to generate preliminary evidence for future optimisation of LED-PBM power-output profiles in early myopia management.

Material and methods

Study design

This was a prospective, randomized, double-masked, parallel-group exploratory study conducted at Wuhan Union Hospital between May 2025 and December 2025. A total of 57 children with premyopia or low myopia, comprising 114 eyes, were enrolled and received LED-PBM therapy. The study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Wuhan Union Hospital (approval number: UHCT-IEC-SOP-016-03-03). Written or electronic informed consent was obtained from all participants and their parents or legal guardians before enrollment. All data were anonymized before analysis. All investigators and key personnel involved in this multi-center study received standardized training and obtained certification prior to study initiation. No modifications were made to the study protocol or methodology after the commencement of the trial. This trial was registered with the Chinese Clinical Trial Registry (ChiCTR) under the registration number ChiCTR2500113054 (accessible at http://www.chictr.org.cn/).

Participants

Children aged 6 to 12 years with a cycloplegic SE ranging from -3.00 D to 0.00 D were required to provide written or electronic informed consent. Participants were also required to agree to complete the screening procedures and the 3-month follow-up visits.

The exclusion criteria were as follows: (1) ocular disease that could affect refraction, retinal or optic nerve assessment; (2) strabismus or other clinically relevant binocular vision abnormalities; (3) neurologic disease; (4) photophobia or intolerance of cycloplegic agents; (5) astigmatism greater than 2.00 D; (6) anisometropia greater than 1.50 D; (7) best-corrected visual acuity worse than 0.8 decimal; (8) use of another myopia-control intervention during the preceding month. Participants were instructed not to initiate another myopia-control treatment during follow-up.

LED-PBM exposure and optical correction

All participants used the same LED therapy device (Eagle Eye Vision Therapy Device; Beijing Eagle Eye Technology Co., Ltd., China), which incorporated a 650-nm LED source with a peak output power of 1.39 ± 0.10 mW. Participants were randomly assigned to one of two regimens: a sinusoidally modulated regimen (hereafter, the sinusoidal group) or a continuous-output regimen (hereafter, the continuous group). In the continuous group, output remained constant throughout each session. In the sinusoidal group, output varied over time according to a sinusoidal profile while retaining the same peak output power. The treatment schedule was identical: 3 minutes per session, twice daily, with an interval of at least 4 hours. Treatment was administered at home under parental or guardian supervision.

The average output power, irradiance, and estimated optical power entering a 4-mm pupil were 0.70 ± 0.10 mW, 1.85 mW/cm², and 0.405 mW, respectively, for the sinusoidal regimen and 1.39 ± 0.10 mW, 3.70 mW/cm², and 0.810 mW for the continuous regimen (Supplementary Table 1). According to device testing and relevant safety standards, the LED-PBM parameters used in this study met the Class 1 requirements of IEC 60825-1:2014 for direct ocular exposure under the tested conditions. Children with cycloplegic myopia >0.50 D were prescribed single-vision spectacles according to routine clinical practice.

Ophthalmic Examinations

Examinations were performed at baseline and at 1 and 3 months by trained examiners using standardized procedures. Uncorrected and best-corrected visual acuity were measured at 5 m using the standard logarithmic visual acuity chart. Cycloplegia was induced with compound tropicamide administered four times at 5-minute intervals. Twenty minutes after the final instillation, cycloplegia was considered adequate when pupil diameter was at least 5 mm and the pupillary light reflex was absent. Cycloplegic refraction was measured with an autorefractor (KR-8900; Topcon, Tokyo, Japan); three measurements were accepted when the maximum difference in sphere or cylinder was no greater than 0.25 D. SE was calculated as sphere plus one-half cylinder.

AL was measured using an IOLMaster 700 (Carl Zeiss Meditec, Jena, Germany) prior to cycloplegia, with the final value recorded as the mean of five consecutive measurements, each differing by less than 0.05 mm. Optical coherence tomography (OCT) and OCT angiography (OCTA) imaging were performed before cycloplegia using a TowardPi system, employing a 6 × 6-mm macular scan centered on the fovea. ChT and other retinal/choroidal structural and vascular parameters were automatically segmented and quantified using the built-in software. All acquired images and automated segmentations were subsequently reviewed by an experienced technician. Scans were excluded if they exhibited a quality score below 90, prominent motion artifacts, poor fixation, or unreliable segmentation.

ChT was defined as the perpendicular distance from Bruch membrane to the choroid-sclera interface and summarized within an ETDRS grid as the central 1-mm region, the 1- to 3-mm parafoveal ring, and the 3- to 6-mm perifoveal ring. Ancillary measures included central macular retinal thickness, sectoral peripapillary retinal nerve fiber layer (RNFL) thickness, foveal avascular zone (FAZ) parameters, retinal and choriocapillaris density, choroidal vascularity index (CVI), and optic disc perfusion parameters.

Outcomes and safety assessment

The main outcomes were changes from baseline in AL, cycloplegic SE, and ChT at 1 and 3 months. OCT- and OCTA-derived retinal, optic nerve, and vascular measures were prespecified as ancillary exploratory outcomes. Safety assessment included ocular and systemic adverse events, treatment interruption or discontinuation, visual acuity, slit-lamp and fundus examination, and OCT/OCTA findings. At follow-up visits, participants and caregivers were asked about photophobia, glare, afterimage, eye pain, ocular discomfort, blurred vision, reduced vision, and other visual symptoms.

Statistical Analysis

Statistical analyses were performed using R software, version 4.4.2. Baseline characteristics were summarized according to randomized treatment group. Continuous variables are presented as mean ± standard deviation, and categorical variables as counts and percentages.

Longitudinal changes in ocular outcomes at baseline, 1 month, and 3 months were evaluated using linear mixed-effects models. Time was treated as a categorical variable, and treatment group, time, the group-by-time interaction, age, and sex were included as fixed effects. The models accounted for correlation between fellow eyes and repeated measurements within participants and used all available observations for each outcome. Adjusted between-group differences in change are reported with 95% CIs.

All tests were two-sided, with $P < 0.05$ considered statistically significant. Ancillary structural and vascular analyses were exploratory, and no multiplicity adjustment was applied; isolated nominal P values were therefore interpreted as hypothesis generating.

Results

Study Population and Baseline Characteristics

Of 61 children assessed for eligibility, 2 were excluded because their cycloplegic SE did not meet the eligibility criteria, and 59 were randomized. Two participants in the sinusoidally group had no post-randomization follow-up data. Thus, 57 children (114 eyes) contributed to the primary longitudinal analyses, including 27 children (54 eyes) in the sinusoidally group and 30 children (60 eyes) in the continuous group (Fig. 1). Among them, 55 completed both scheduled follow-up visits, whereas 2 contributed data from only one postbaseline visit. Baseline demographic and ocular characteristics werebalanced between the two groups, including age, sex distribution, AL, SE, and ChT across the examined macular regions ($P > 0.05$; Table 1).

Changes in Axial Length

At 1 month, AL increased from baseline by 0.015 ± 0.019 mm in the sinusoidal group and by 0.007 ± 0.018 mm in the continuous group; neither within-group change reached statistical significance. The adjusted between-group difference in AL change was 0.008 mm, which was not statistically significant ($P = 0.755$) (Table 2; Fig. 2a). At 3 months, AL increased from baseline by 0.071 ± 0.019 mm in the sinusoidal group (within-group $P < 0.001$) and by 0.050 ± 0.018 mm in the continuous group (within-group $P = 0.010$). The adjusted between-group difference in change was 0.021 mm, with no statistically significant difference observed between the two groups ($P = 0.429$) (Table 2; Fig. 2a). Overall, no statistically significant between-group differences in AL change were detected at either 1 or 3 months.

Changes in Spherical Equivalent Refraction

SE remained broadly stable in both groups over the 3-month follow-up. At 1 month, the adjusted changes were −0.073 ± 0.088 D in the sinusoidal group and −0.177 ± 0.085 D in the continuous group; neither within-group change reached statistical significance (Table 2; Fig. 2b). The adjusted between-group difference in change was 0.105 D, which was not statistically significant ($P = 0.394$). At 3 months, the corresponding adjusted changes were −0.001 ± 0.090 D and −0.001 ± 0.085 D, respectively; neither within-group change reached statistical significance (Table 2; Fig. 2b). The adjusted between-group difference in change was 0.0004 D ($P = 0.998$). Overall, no statistically significant between-group differences in SE change were detected at either 1 or 3 months.

Changes in Choroidal Thickness

Early increases in ChT were observed in both groups across all three macular regions (Table 2; Fig. 3).

In the central 1-mm region, ChT increased from baseline by 18.792 ± 4.223 μm at 1 month and by 20.054 ± 4.221 μm at 3 months in the sinusoidal group (both within-group $P < 0.001$). In the continuous group, the corresponding increases were 9.121 ± 3.862 μm at 1 month (within-group $P = 0.037$) and 14.365 ± 3.966 μm at 3 months (within-group $P < 0.001$). The adjusted between-group differences were 9.672 μm at 1 month ($P = 0.093$) and 5.689 μm at 3 months ($P = 0.327$) (Table 2; Fig. 3a)

For the 1–3-mm region, ChT increased by 18.109 ± 4.132 μm at 1 month and by 17.972 ± 4.130 μm at 3 months in the sinusoidal group (both within-group $P < 0.001$). In the continuous group, the corresponding increases were 9.703 ± 3.778 μm (within-group $P = 0.021$) and 12.718 ± 3.881 μm (within-group $P = 0.002$). The adjusted between-group differences were 8.406 μm at 1 month ($P = 0.135$) and 5.253 μm at 3 months ($P = 0.355$) (Table 2; Fig. 3b)

For the 3–6-mm region, ChT increased by 13.293 ± 3.731 μm at 1 month and by 15.076 ± 3.729 μm at 3 months in the sinusoidal group (both within-group $P < 0.001$). In the continuous group, the corresponding increases were 6.741 ± 3.433 μm at 1 month and 9.865 ± 3.526 μm at 3 months (within-group $P = 0.011$); the 1-month increase did not reach statistical significance. The adjusted between-group differences were 6.552 μm at 1 month ($P = 0.198$) and 5.211 μm at 3 months ($P = 0.311$) (Table 2; Fig. 3c)

Numerically greater ChT increases were observed in the sinusoidal group across all regions and time points, particularly in the central region at 1 month. However, none of the between-group comparisons reached statistical significance, as reflected by all P values exceeding 0.05.

Ancillary Structural and Vascular Outcomes

The complete LMM results for the ancillary structural and vascular outcomes are presented in Supplementary Table 2. During the 3-month follow-up, central macular retinal thickness, sectoral RNFL thickness, FAZ parameters, optic disc perfusion, choriocapillaris density, and CVI did not show a consistent temporal or between-group pattern.

Nominal statistical differences were observed for several exploratory parameters. For example, at 3 months, choriocapillaris density in the 3–6-mm region showed an adjusted between-group difference in change of −0.504% (P = 0.023). However, these findings arose from multiple exploratory comparisons and were not consistent across time points or macular regions. They should therefore be regarded as hypothesis-generating rather than as definitive evidence of a treatment-related difference.

Safety Outcomes

No severe ocular or systemic adverse event was recorded during the 3-month follow-up, and no participant discontinued treatment because of an adverse event. Best-corrected visual acuity remained stable, and slit-lamp examination, fundus photography, OCT, and OCTA did not reveal a consistent treatment-related pattern of retinal or optic nerve injury.

Discussion

In this exploratory randomized study, we compared two power-output profiles of the same LED-based PBM device in children with premyopia or low myopia. Over the 3-month follow-up, both groups showed mild axial elongation and relatively stable spherical equivalent refraction, with no statistically significant between-group differences in AL or SE changes. ChT increased in both groups as early as 1 month and remained increased at 3 months.These findings provide preliminary evidence that a lower-average-power, temporally modulated LED-PBM regimen may still induce early choroidal structural responses, but they should not be interpreted as evidence of equivalence or non-inferiority between the two regimens.

Our study indicated that, over a 3-month period, mild axial elongation occurred in both LED-PBM groups, notwithstanding the relative stability of the SE. Concurrently, the short-term axial and refractive outcomes did not differ discernibly between the sinusoidal group and the continuous group. Although numerous previous studies using laser-diode RLRL trials have reported reduced axial elongation, refractive progression, and, in selected children, short-term axial shortening[6,7,27–29], a direct comparison between our findings and those RLRL results is inappropriate. The two study types differ substantially in light source, beam coherence and geometry, retinal exposure, baseline refractive status, population, treatment schedule, and follow-up duration. More importantly, both groups in the present study received active LED-PBM, and there was no untreated or single-vision-spectacle-only comparator. The data therefore address differences between two LED output profiles, not efficacy relative to natural progression or standard optical correction.

In contrast to the modest axial and refractive changes, choroidal thickening emerged as a more consistent early response to both LED-PBM regimens, becoming detectable at 1 month and remaining evident at 3 months. Although the sinusoidal group showed consistently greater numerical increases, the between-group differences were not statistically significant. These findings indicate that the sinusoidally modulated regimen can elicit an early choroidal structural response despite its lower average power and estimated ocular light exposure, but they do not establish superiority or equivalence relative to the continuous regimen. This pattern is directionally consistent with previous laser-diode RLRL studies reporting sustained increases in macular ChT and suggesting accompanying changes in choroidal vascular or perfusion-related parameters[16,18,19,30]. In our study, however, exploratory choriocapillaris density and CVI measures showed only small, region-specific changes without a consistent temporal or regional pattern. Therefore, the mechanisms underlying LED-PBM-induced choroidal thickening remain uncertain, and further studies incorporating more comprehensive quantitative vascular and stromal measurements are needed.

Apart from choroidal thickening, retinal and optic nerve-related structural and microvascular measures showed no consistent adverse pattern during the 3-month follow-up. Central macular retinal thickness and sectoral RNFL thickness remained broadly stable, while isolated changes in FAZ and optic disc perfusion were not sustained across visits or accompanied by a coherent anatomical pattern. Together with the absence of serious ocular adverse events or treatment discontinuation, these findings provide limited reassurance that no overt short-term retinal or optic nerve safety signal was detected under the LED-PBM parameters evaluated. However, given the small sample size, short follow-up duration, and the lack of adaptive-optics imaging or electrophysiological testing in this study, definitive conclusions regarding subtle, rare, or long-term retinal effects cannot be drawn and warrant further investigation.

Against this safety background, reducing overall ocular light exposure while retaining measurable ocular responses is an important goal of LED-PBM optimization. In the present study, both regimens used the same LED device, wavelength, peak power, and treatment duration. Compared with the continuous regimen, the sinusoidal regimen had approximately half the average power, irradiance, and estimated optical power entering a 4-mm pupil, yet showed changes in AL, SE, and ChT in the same general direction. These observations suggest that temporal power-output profiles and average light exposure warrant further investigation as potentially optimizable parameters of LED-PBM. However, the sinusoidal regimen differed from the continuous regimen not only in temporal power-output profile but also in average delivered power and cumulative exposure. Therefore, the present study cannot disentangle the effects of temporal modulation from those of reduced average light exposure. Previous studies have suggested that PBM biological responses are highly parameter-dependent and often follow a biphasic dose-response pattern[24]. This non-linear response may be partly explained by dose-dependent modulation of mitochondrial activity, ATP production, reactive oxygen species, and nitric oxide signaling; however, the optimal exposure window is likely to be tissue- and disease-specific[22–24]. An RCT reserach by Wang et al. revealed significant power-dependent differences in myopia control efficacy of RLRL therapy among myopia children[21]. Therefore future studies should further evaluate whether different average power levels, irradiance profiles, modulation frequencies, and cumulative exposure doses influence the long-term ocular responses and safety of LED-based PBM.

Several limitations should be acknowledged. First, this was a short-term exploratory study with a relatively small sample size and a follow-up period of only 3 months. The study was not designed or powered to establish equivalence, non-inferiority, or superiority between the two PBM regimens, and the limited observation period precluded assessment of long-term myopia control, durability of treatment effects, rebound after treatment cessation, and rare or delayed ocular safety events. Second, the absence of an untreated or single-vision spectacle-only comparator prevented estimation of the efficacy of LED-PBM relative to natural myopia progression or spectacle correction alone; moreover, the potential influences of outdoor exposure, near-work behavior, and actual

treatment adherence could not be fully accounted for. Third, the two regimens differed not only in temporal power-output profile but also in average power, irradiance, and cumulative light exposure. Consequently, the effects of temporal modulation could not be distinguished from those of reduced average light exposure. Finally, multiple structural and vascular outcomes were evaluated as exploratory measures, and isolated findings should be interpreted cautiously in view of multiple comparisons. In addition, comprehensive choroidal vascular and stromal parameters, such as vessel volume, stromal volume, and blood-flow metrics, were not available, limiting mechanistic interpretation of the observed choroidal thickening.

In conclusion, sinusoidally modulated LED-PBM elicited early choroidal thickening and short-term AL and SE changes in the same direction as continuous LED-PBM, with no statistically detectable between-group differences over 3 months. These data support further investigation of the LED-PBM waveform and dose optimization, but should not be interpreted as evidence of equivalent efficacy or long-term safety. Future trials should independently vary temporal modulation and average power, include a standard-care comparator, document delivered ocular exposure and adherence, and incorporate longer-term multimodal retinal safety monitoring.

Declarations

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Author contributions

YMM: Conceptualization; data curation; formal analysis; methodology; writing – original draft. RL: Conceptualization; data curation; formal analysis; methodology; writing – review & editing. YYY: Conceptualization; investigation; writing – review & editing. QMW: Conceptualization; investigation; supervision; writing – review & editing. BJS: Conceptualization; methodology; project administration; supervision; writing – review and editing. All authors read and approved the submitted version.

Data availability statement

All data supporting the findings of this study are available within the paper and its Supplementary Information.

Competing interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Ethics approval

The study adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Wuhan Union Hospital (approval number: UHCT-IEC-SOP-016-03-01).

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Tables

Table 1 Baseline demographic and ocular characteristics of the sinusoidal and continuous groups

Characteristics	Sinusoidal group (N = 54)	Continuous group (N = 60)	P value
Age (Years)	8.93 ± 1.64	8.97 ± 1.16	0.913
Sex			
Male	18 (66.7%)	16 (53.3%)	0.451
Female	9 (33.3%)	14 (46.7%)	
AL, mm	23.67 ± 0.74	23.79 ± 0.58	0.326
SE, D	-0.61 ± 0.95	-0.51 ± 0.67	0.492
F-ChT (central 1-mm region), μm	269.19 ± 64.40	273.34 ± 46.90	0.702
ParaF-ChT (1–3-mm annulus), μm	262.55 ± 62.30	265.85 ± 44.50	0.751
PeriF-ChT (3–6-mm annulus), μm	245.49 ± 55.98	249.36 ± 39.33	0.680

Data are presented as mean ± standard deviation or number (percentage), as appropriate. AL, axial length; SE, spherical equivalent; D, diopter; ChT, choroidal thickness; F, foveal region; ParaF, parafoveal region; PeriF, perifoveal region.

Table 2 Comparison of ocular parameter changes between sinusoidal and continuous groups at 1-and 3-month follow-up

Indicator	Time_Point	Sinusoidal_Change	Sinusoidal_P	Continuous_Change	Continuous_P	DID_val	P_value
AL, mm	1 Month Change	0.015 ± 0.019	0.629	0.007 ± 0.018	0.881	0.008 (-0.043, 0.059)	0.755
	3 Months Change	0.071 ± 0.019	<0.001	0.050 ± 0.018	0.010	0.021 (-0.031, 0.072)	0.429
SE, D	1 Month Change	-0.073 ± 0.088	0.619	-0.177 ± 0.085	0.071	0.105 (-0.137, 0.346)	0.394
	3 Months Change	-0.001 ± 0.090	0.9996	-0.001 ± 0.085	0.9994	0.0004 (-0.243, 0.243)	0.998
F-ChT, μm	1 Month Change	18.792 ± 4.223	<0.001	9.121 ± 3.862	0.037	9.672 (-1.610, 20.953)	0.093
	3 Months Change	20.054 ± 4.221	<0.001	14.365 ± 3.966	<0.001	5.689 (-5.730, 17.108)	0.327
ParaF-ChT, μm	1 Month Change	18.109 ± 4.132	<0.001	9.703 ± 3.778	0.021	8.406 (-2.632, 19.444)	0.135
	3 Months Change	17.972 ± 4.130	<0.001	12.718 ± 3.881	0.002	5.253 (-5.919, 16.426)	0.355
PeriF-ChT, μm	1 Month Change	13.293 ± 3.731	<0.001	6.741 ± 3.433	0.095	6.552 (-3.444, 16.549)	0.198
	3 Months Change	15.076 ± 3.729	<0.001	9.865 ± 3.526	0.011	5.211 (-4.908, 15.330)	0.311

Data are presented as estimated mean changes from baseline ± standard error. AL, axial length; SE, spherical equivalent; D, diopter; ChT, choroidal thickness; F, foveal region; ParaF, parafoveal region; PeriF, perifoveal region.

Figures

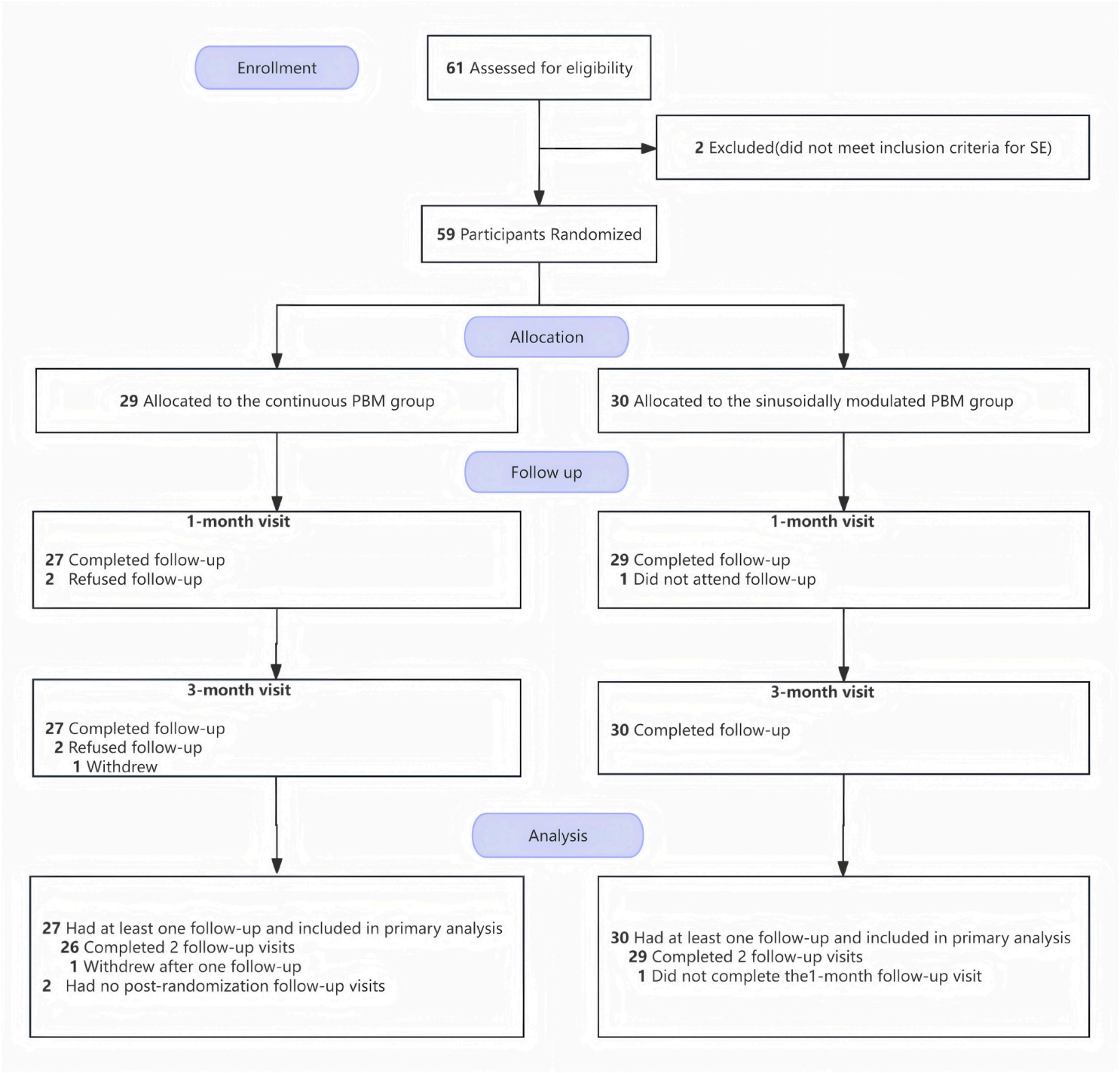

Figure 1

Flowchart of the study

SE,spherical equivalent.

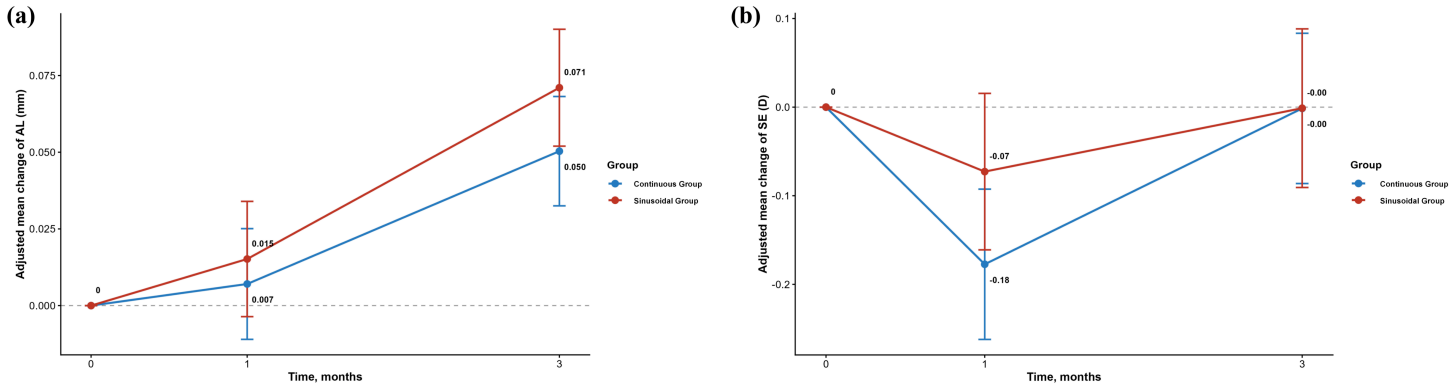

Figure 2

Adjusted mean changes in AL and SE over 3 months in the sinusoidal and continuous groups

Adjusted mean changes from baseline in **(a)**AL and **(b)** SE at 1 and 3 months in the sinusoidally group and the continuous group. Baseline changes were set to 0 for visualization. Points represent adjusted mean changes estimated using linear mixed-effects models, and error bars represent standard errors. AL, axial length; D, diopter; SE, spherical equivalent.

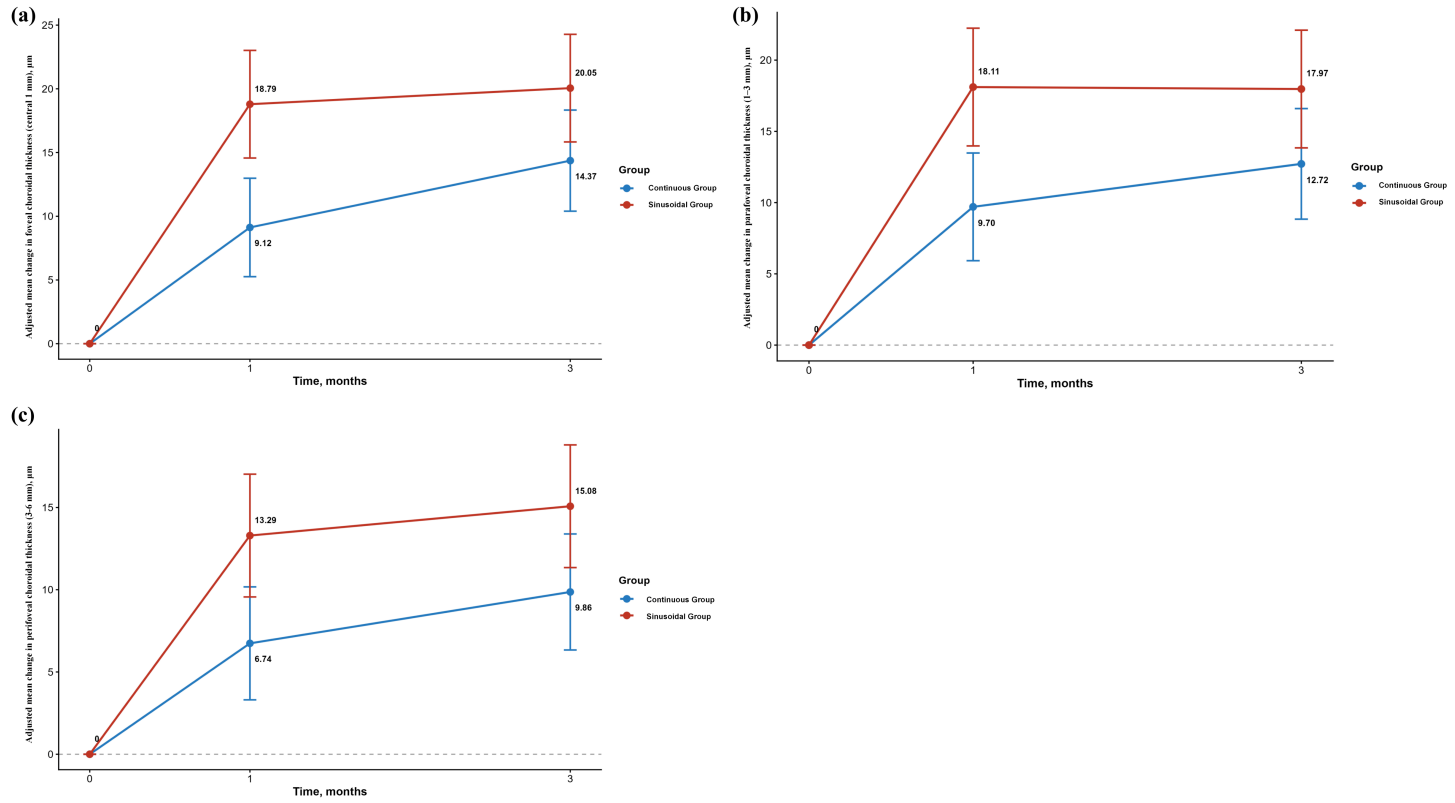

Figure 3

Adjusted mean changes in regional ChT over 3 months in the sinusoidal and continuous groups

(a) Adjusted mean change in foveal ChT (central 1-mm region), (b) adjusted mean change in parafoveal ChT (1–3-mm annulus), and (c) adjusted mean change in perifoveal ChT (3–6-mm annulus) in the sinusoidally and continuous groups at baseline, 1 month, and 3 months. Baseline changes were set to 0 for visualization. Points represent adjusted mean changes estimated using linear mixed-effects models, and error bars represent standard errors. ChT, choroidal thickness

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTable1andTable2.docx