

Effects of Accommodative Vergence Training With and Without Full Optical Correction on Visual Comfort, Near Point of Convergence and Visual Acuity in Young Patients With Myopic Anisometropia

Mahnoor¹, Dr. Aamir Gul Memon², Prof Dr. Muhammad Naveed Babur³, Tehreem Khalid¹, Asma Rizwan¹, Hassan Hashmi¹, Rabia Riasat¹

¹ MS Rehabilitation Sciences, The Superior University, Lahore, Pakistan

² Associate Professor/Manager CRC, Department of Physical Therapy & Rehabilitation Sciences, Superior University, Lahore, Pakistan

³ Dean, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan

Corresponding Author: Mahnoor

Correspondence: Mahnoorhafeez17@gmail.com

Received: 13 April 2026

Revised: 26 April 2026

Accepted: 13 May 2026

Published: 30 June 2026

ARTICLE INFORMATION	ABSTRACT
Article Type: Original Article How to Cite: Mahnoor, Memon AG, Babur MN, Khalid T, Rizwan A, Hashmi H, Riasat R. Effects of Accommodative Vergence Training With and Without Full Optical Correction on Visual Comfort, Near Point of Convergence and Visual Acuity in Young Patients With Myopic Anisometropia. Journal of Precision Medicine and Health Research. 2026;3(1):1-9. Article ID: 59 DOI: https://doi.org/10.68279/2vgy3n30 Article Link: https://jpmhr.com/index.php/jpmhr/article/view/59 Declarations: See end of article. OPEN ACCESS This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0).	Background: Myopic anisometropia may impair binocular visual function and contribute to visual discomfort, abnormal near point of convergence (NPC), and reduced visual acuity. Accommodative vergence training (AVT) may improve functional binocular performance, although the additional value of full optical correction during training remains uncertain. Objective: To compare the effects of AVT with and without full optical correction on visual comfort, NPC, and visual acuity in young patients with myopic anisometropia. Methods: This randomized controlled trial included 34 participants aged 10–25 years allocated equally to AVT with full optical correction (Group A, n=17) or AVT without full optical correction (Group B, n=17). Training was performed three times weekly for six weeks. Visual comfort, NPC break and recovery, and right- and left-eye visual acuity were assessed before and after treatment. Within-group changes were evaluated using paired-samples t-tests, and between-group comparisons used independent-samples t-tests. Results: Both groups showed reported within-group improvements in all outcomes ($p < 0.001$). At follow-up, visual comfort was 5.59 ± 2.03 versus 5.82 ± 1.63 ($p = 0.718$), NPC break 7.93 ± 1.55 versus 7.92 ± 1.37 cm ($p = 0.983$), and NPC recovery 9.88 ± 1.64 versus 9.25 ± 1.29 cm ($p = 0.222$) in Groups A and B, respectively. Between-group differences in right-eye ($p = 0.135$) and left-eye ($p = 0.260$) visual acuity were also non-significant. Conclusion: AVT under both optical-correction conditions was associated with short-term improvement in visual outcomes, but full optical correction did not demonstrate a statistically significant additional benefit over AVT without full optical correction. Keywords: Accommodative Vergence Training; Myopic Anisometropia; Near Point of Convergence; Visual Acuity; Visual Comfort.

Introduction

Myopic anisometropia is characterized by unequal myopic refractive error between the two eyes and may create an imbalance in the quality and clarity of the retinal images available for binocular integration. Differences in refractive status can influence accommodative and vergence behavior and may interfere with efficient binocular visual function, particularly during sustained near tasks. Previous investigations have demonstrated alterations in accommodative and vergence parameters among individuals with myopia, while increasing degrees of myopic anisometropia have been associated with progressive disturbances in binocular visual function (1,2). In school-age children with myopic anisometropia, abnormalities in binocular function have also been associated with greater visual fatigue, suggesting that the consequences of anisometropia may extend beyond reduced monocular visual acuity to functional difficulties during visually demanding activities (3).

Effective binocular vision depends on the visual system's ability to integrate information from both eyes despite differences in refractive status and retinal image quality. In anisomyopia, interocular differences may disturb binocular balance and reduce the contribution of the more ametropic eye, particularly across different spatial frequencies (4). Optical correction is therefore an important component of the clinical management of anisometropia because improving retinal image clarity may reduce interocular visual imbalance and support more effective binocular visual processing. Evidence from patients with axial anisometropia has shown that optical correction influences aniseikonia and several aspects of visual function, demonstrating the relationship between refractive correction and binocular performance (5). Nevertheless, correction of refractive error alone may not address functional abnormalities of accommodation and vergence that coexist with anisometropia.

Accommodation and vergence are closely linked mechanisms required to maintain a clear and single image during near viewing. When these mechanisms are poorly coordinated, patients may experience eye strain, blurred vision, headache, intermittent diplopia, difficulty sustaining focus, and visual fatigue during prolonged near activities. Experimental evidence has demonstrated that altered accommodative responses are related to visual fatigue, supporting the clinical importance of accommodative function in symptomatic individuals performing sustained visual tasks (6). These difficulties may be particularly relevant in children, adolescents, and young adults, whose academic, occupational, and recreational activities increasingly require prolonged near work and sustained visual attention.

Vergence and accommodative therapy has been used to improve functional abnormalities of the binocular visual system by repeatedly stimulating and training accommodative and convergence responses. Such programmes may incorporate convergence exercises, accommodative tasks, and other structured activities designed to improve the coordination and flexibility of the accommodative-vergence system. Clinical evidence in children with symptomatic convergence insufficiency indicates that vergence/accommodative therapy can improve convergence function, including near point of convergence, during treatment (7). Similarly, a randomized pilot trial comparing virtual reality-based vision therapy with office-based vergence/accommodative therapy reported improvements in binocular visual parameters among individuals with convergence insufficiency and accommodative dysfunction (8). The American Academy of

Ophthalmology has also reviewed the evidence for home- and office-based vergence and accommodative therapies in children and young adults with convergence insufficiency, further supporting the potential role of structured therapy in selected binocular vision disorders (9).

Optical correction and vision therapy may therefore address different but related components of visual dysfunction. Optical correction primarily improves the refractive quality and balance of retinal images, whereas accommodative vergence training aims to improve the functional coordination of the binocular motor system. Previous research has shown that combining optical correction with orthoptic training can influence binocular vision parameters in children with convergence insufficiency, although this evidence has been generated in refractive conditions other than myopic anisometropia (10). Furthermore, digital visual training has demonstrated improvements in visual acuity and binocular function in children with anisometropic amblyopia, suggesting that targeted visual training may have therapeutic potential in disorders characterized by interocular visual imbalance (11). However, these findings cannot be directly extrapolated to young patients with myopic anisometropia undergoing accommodative vergence training.

Despite the recognized importance of appropriate refractive correction and the growing evidence supporting accommodative and vergence therapy, limited evidence is available regarding whether accommodative vergence training produces different clinical outcomes when performed with full optical correction compared with training performed without full optical correction in young individuals with myopic anisometropia. In particular, it remains unclear whether the addition of full optical correction during accommodative vergence training provides an additional advantage in terms of visual comfort, near point of convergence, and visual acuity. Clarifying this issue may assist clinicians in determining whether refractive correction should be integrated with vergence-based training when managing functional visual difficulties associated with myopic anisometropia.

Therefore, this randomized controlled trial aimed to compare the effects of accommodative vergence training with and without full optical correction on visual comfort, near point of convergence, and visual acuity in young patients with myopic anisometropia. The study specifically evaluated whether the two intervention approaches differed in their effects on visual comfort, near point of convergence break and recovery, and visual acuity following the intervention.

Materials and Methods

A randomized controlled trial was conducted to compare the effects of accommodative vergence training (AVT) performed with and without full optical correction on visual comfort, near point of convergence (NPC), and visual acuity in young patients with myopic anisometropia. A total of 34 participants aged 10–25 years with a diagnosis of myopic anisometropia were enrolled in the study. Participants were randomly allocated in a 1:1 ratio to two intervention groups, with 17 participants assigned to each group. Group A received accommodative vergence training with full optical correction, whereas Group B received accommodative vergence training without full optical correction. The intervention was administered three times per week for six consecutive weeks.

Participants in both groups underwent accommodative vergence training intended to improve the functional coordination of accommodation and convergence. The principal difference between the intervention groups was the use of full optical correction during the training programme. Participants allocated to Group A performed AVT while using full optical correction, whereas those allocated to Group B performed the same training approach without full optical correction. The intervention period and frequency were maintained consistently across both groups to permit comparison of treatment-related changes in visual function.

Outcome assessment was performed before initiation of the intervention and again after completion of the six-week treatment period. The outcomes included visual comfort, NPC break, NPC recovery, and visual acuity of the right and left eyes. Visual comfort was assessed using a structured symptom questionnaire addressing visual complaints associated with near work, including eye strain, blurred vision, headache, diplopia, and difficulty performing sustained near activities. The resulting score was used to quantify changes in visual symptoms from baseline to post-intervention assessment.

Near point of convergence was evaluated using an accommodative fixation target that was gradually moved toward the participant's nose while clear and single binocular fixation was maintained. NPC break was identified at the point at which the participant reported diplopia or an outward deviation of one eye was observed. The recovery component of NPC was also recorded as part of the outcome assessment. Measurements were expressed in centimeters, with lower post-treatment values representing a closer nearer point of convergence.

Visual acuity was assessed separately for the right and left eyes using the Log MAR scale. Measurements were obtained at baseline and following completion of the intervention to determine changes within each treatment group and differences between the two intervention groups. The right eye was recorded as OD and the left eye as OS. All principal outcomes were therefore assessed at the same two study time points to permit consistent pre- to post-intervention comparisons.

Data were analyzed using IBM SPSS Statistics version 27.0. Continuous variables were summarized as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. The distribution of continuous variables was assessed for normality and was considered suitable for parametric analysis. Baseline demographic characteristics were summarized for each intervention group. Paired-samples t-tests were used to evaluate pre- to post-intervention changes within each group, while independent-samples t-tests were used for comparisons between Group A and Group B. Statistical significance was determined using a two-sided p-value of <0.05 .

Results

A total of 34 participants were included, with 17 participants in each intervention group. The mean age was 20.76 ± 3.21 years in Group A and 19.82 ± 3.59 years in Group B, with a mean between-group difference of 0.94 years (95% CI -1.44 to 3.32 ; $p=0.427$). Group A included 5 females (29.4%) and 12 males (70.6%), whereas Group B included 8 females (47.1%) and 9 males (52.9%). The sex distribution did not differ significantly between groups (Fisher's exact $p=0.481$).

Visual comfort scores decreased from 7.12 ± 1.90 to 5.59 ± 2.03 in Group A and from 7.47 ± 1.63 to 5.82 ± 1.63 in Group B. The reported within-group changes were statistically significant in both groups ($p<0.001$). However, the post-intervention difference between Group A and Group B was small and not statistically significant (mean difference -0.23 , 95% CI -1.52 to 1.06 ; $p=0.718$; Hedges $g=-0.12$). The corresponding mean changes were -1.53 and -1.65 points, respectively.

NPC break decreased from 9.98 ± 1.38 cm to 7.93 ± 1.55 cm in Group A and from 9.37 ± 1.43 cm to 7.92 ± 1.37 cm in Group B. Although both groups had reported within-group p-values <0.001 , their post-intervention means were nearly identical. The between-group difference at follow-up was 0.01 cm (95% CI -1.01 to 1.03 ; $p=0.983$; Hedges $g=0.01$). The mean changes were -2.05 cm in Group A and -1.45 cm in Group B.

Table 1. Baseline demographic characteristics of participants

Variable	Group A (n=17)	Group B (n=17)	Between-group difference	95% CI	p-value
Age, years, mean $\pm$ SD	20.76 $\pm$ 3.21	19.82 $\pm$ 3.59	0.94	-1.44 to 3.32	0.427
Female, n (%)	5 (29.4)	8 (47.1)	—	—	0.481
Male, n (%)	12 (70.6)	9 (52.9)	—	—	—

CI, confidence interval; SD, standard deviation. The age comparison was calculated using an independent-samples t-test. Sex distribution was compared using Fisher's exact test.

Table 2. Within-group changes and between-group comparisons for visual comfort and near point of convergence

Outcome	Time point	Group A (n=17), mean $\pm$ SD	Group B (n=17), mean $\pm$ SD	Groups Difference	95% CI	p-value	Hedges g
Visual comfort score	Baseline	7.12 $\pm$ 1.90	7.47 $\pm$ 1.63	-0.35	-1.59 to 0.89	0.568	-0.19
	Post-intervention	5.59 $\pm$ 2.03	5.82 $\pm$ 1.63	-0.23	-1.52 to 1.06	0.718	-0.12
	Change	—	—	0.12	—	—	—
	Within-group p-value	—	—	—	—	—	—
NPC break, cm	Baseline	9.98 $\pm$ 1.38	9.37 $\pm$ 1.43	0.61	-0.37 to 1.59	0.213	0.43
	Post-intervention	7.93 $\pm$ 1.55	7.92 $\pm$ 1.37	0.01	-1.01 to 1.03	0.983	0.01
	Change	—	—	-0.60	—	—	—
	Within-group p-value	—	—	—	—	—	—
NPC recovery, cm	Baseline	11.65 $\pm$ 1.49	11.02 $\pm$ 1.46	0.63	-0.40 to 1.66	0.223	0.42
	Post-intervention	9.88 $\pm$ 1.64	9.25 $\pm$ 1.29	0.63	-0.40 to 1.66	0.222	0.42
	Change	—	—	0.00	—	—	—
	Within-group p-value	—	—	—	—	—	—

CI, confidence interval; NPC, near point of convergence; SD, standard deviation. Between-group differences are Group A minus Group B. Between-group p-values, and 95% CIs were calculated using independent-samples t-tests from the reported means, SDs, and group sizes. Hedges g represents the standardized between-group difference. Mean change was calculated as post-intervention minus baseline. Within-group p-values are those reported in the manuscript.

Table 3. Within-group changes and between-group comparisons for visual acuity

Outcome	Time point	Group A (n=17), mean $\pm$ SD	Group B (n=17), mean $\pm$ SD	Group A mean change	Group B mean change	Groups Difference	95% CI	p-value	Hedges g
VA OD	Baseline	0.704 $\pm$ 0.146	0.747 $\pm$ 0.184	—	—	-0.043	-0.159 to 0.073	0.456	-0.25
	Post-intervention	0.622 $\pm$ 0.134	0.706 $\pm$ 0.182	—	—	-0.084	-0.196 to 0.028	0.135	-0.51
	Change	—	—	-0.082	-0.041	-0.041	—	—	—
	Within-group p-value	—	—	<0.001	<0.001	—	—	—	—
VA OS	Baseline	0.699 $\pm$ 0.199	0.729 $\pm$ 0.171	—	—	-0.030	-0.160 to 0.100	0.641	-0.16
	Post-intervention	0.631 $\pm$ 0.144	0.694 $\pm$ 0.175	—	—	-0.063	-0.175 to 0.049	0.260	-0.38
	Change	—	—	-0.068	-0.035	-0.033	—	—	—
	Within-group p-value	—	—	<0.001	<0.001	—	—	—	—

CI, confidence interval; OD, right eye; OS, left eye; SD, standard deviation; VA, visual acuity. Between-group differences are Group A minus Group B. Between-group p-values, and 95% CIs were calculated using independent-samples t-tests from the reported means, SDs, and group sizes. Hedges g represents the standardized between-group difference. Mean change was calculated as post-intervention minus baseline. Within-group p-values are those reported in the manuscript. The manuscript identifies visual acuity as LogMAR in the Methods; therefore, lower values are interpreted as better visual acuity.

NPC recovery also decreased in both groups, from 11.65 $\pm$ 1.49 cm to 9.88 $\pm$ 1.64 cm in Group A and from 11.02 $\pm$ 1.46 cm to 9.25 $\pm$ 1.29 cm in Group B. Within-group comparisons were reported as $p < 0.001$. At follow-up, however, the difference between-group was 0.63 cm (95% CI -0.40 to 1.66; $p = 0.222$; Hedges $g = 0.42$). Both groups demonstrated the same calculated mean change of -1.77 cm.

Right-eye visual acuity decreased numerically from 0.704 $\pm$ 0.146 to 0.622 $\pm$ 0.134 in Group A and from 0.747 $\pm$ 0.184 to 0.706 $\pm$ 0.182 in Group B. The corresponding mean changes were -0.082 and -0.041, respectively, with reported within-group p-values < 0.001 . The post-intervention difference favored a lower value in Group A, but the estimate remained statistically inconclusive (mean difference -0.084, 95% CI -0.196 to 0.028; $p = 0.135$; Hedges $g = -0.51$).

For left-eye visual acuity, values decreased from 0.699 $\pm$ 0.199 to 0.631 $\pm$ 0.144 in Group A and from 0.729 $\pm$ 0.171 to 0.694 $\pm$ 0.175 in Group B. The calculated mean changes were -0.068 and -0.035, respectively, and both within-group comparisons were reported as $p < 0.001$. The post-intervention between-group difference was -0.063 (95% CI -0.175 to 0.049; $p = 0.260$; Hedges $g = -0.38$).

Overall, both groups showed numerical improvement from baseline across visual comfort, NPC, and visual-acuity outcomes. The manuscript-reported paired analyses indicated statistically significant within-group changes; however, recalculated comparisons based on the reported group means, SDs, and sample sizes did not demonstrate statistically significant post-intervention differences between Group A and Group B for any outcome.

Discussion

The present randomized controlled trial compared accommodative vergence training (AVT) performed with and without full optical correction in young patients with myopic anisometropia. Both groups demonstrated improvements from baseline in visual comfort, near

point of convergence (NPC) break and recovery, and visual acuity following six weeks of training. However, the recalculated between-group comparisons did not demonstrate statistically significant differences between the two groups at post-intervention assessment. These findings suggest that improvement occurred with AVT under both optical-correction conditions, while the available data do not establish a clear additional benefit of performing AVT with full optical correction over AVT without full optical correction.

The improvement in visual comfort observed in both groups is broadly consistent with previous evidence showing that structured vergence and accommodative therapy can reduce functional difficulties associated with disorders of accommodation and convergence. Previous randomized evidence has demonstrated improvements in binocular visual parameters following vision therapy in individuals with convergence insufficiency and accommodative dysfunction (8). Similarly, the American Academy of Ophthalmology review concluded that vergence and accommodative therapies can improve motor outcomes in children and young adults with symptomatic convergence insufficiency, although treatment effects may vary according to the outcome assessed and mode of therapy (9). A systematic review examining neural changes following vision therapy for convergence insufficiency has also described evidence of functional and neurophysiological adaptation following treatment (12). Although these studies were not conducted specifically in patients with myopic anisometropia, they provide a plausible clinical context for the improvement in visual symptoms observed following AVT in the present study.

Both groups also demonstrated reductions in NPC break and recovery distances. These findings are consistent with previous research showing that vergence/accommodative therapy can improve convergence function, including NPC, in children with symptomatic convergence insufficiency (7). NPC represents an important clinical measure of the ability to maintain binocular convergence as a target approaches the eyes, and abnormalities in convergence may contribute to symptoms during sustained near work. Diagnostic literature on accommodative and vergence anomalies emphasizes the importance of evaluating convergence together with accommodative function when assessing binocular visual disorders (13). Reviews of convergence insufficiency similarly identify receded NPC as an important clinical sign, although NPC should be interpreted alongside other measures of binocular function rather than as an isolated indicator (14). The reductions in NPC distances observed in both groups may therefore reflect improved functional convergence following repeated accommodation and vergence stimulation.

A plausible explanation for these changes is that repeated vergence and accommodative tasks provide structured stimulation of the coupled accommodative-convergence system. Vision therapy requires repeated responses to changing accommodative and vergence demands and may thereby improve the efficiency and flexibility of these responses. Previous research in children with convergence insufficiency and accommodative dysfunction has demonstrated improvement in accommodative measures following vergence/accommodative therapy (15). Such adaptive responses may partly explain the parallel improvements in visual comfort and NPC observed in the present study. Nevertheless, the underlying physiological mechanisms were not directly measured, and the observed changes should therefore not be interpreted as evidence of a specific neural or oculomotor mechanism.

Visual acuity also showed numerical improvement in both eyes in both intervention groups. The changes were greater numerically in the full-correction group, particularly for the right eye, but the post-intervention between-group comparisons did not reach statistical significance. This pattern should therefore be interpreted cautiously rather than as evidence of superiority of full optical correction. Previous work in anisomyopia has demonstrated disturbances in binocular balance across spatial frequencies and has shown that optical correction can influence binocular visual processing (4). Optical correction may reduce differences in retinal image quality between the eyes and facilitate more balanced binocular input, while structured visual training may address functional aspects of binocular coordination. In addition, visual training has previously been associated with improvements in visual acuity and binocular function among children with anisometropic amblyopia (11). However, anisometropic amblyopia and myopic anisometropia without explicitly defined amblyopia are clinically distinct populations; consequently, direct extrapolation of those findings to the present participants should be avoided (12).

The absence of statistically significant post-intervention differences between the groups is clinically important when interpreting the study objective. Although full optical correction has a clear role in managing refractive error, the present results do not demonstrate that adding full optical correction to AVT produced superior short-term outcomes for visual comfort, NPC, or visual acuity compared with AVT performed without full optical correction. For NPC break, the post-intervention group means were particularly similar, indicating little separation between the treatment conditions at the end of the six-week intervention. The visual-acuity outcomes showed somewhat larger numerical differences favoring lower values in Group A, but the confidence intervals included no between-group difference. Given the small sample size, these estimates remain imprecise and should not be interpreted either as definitive evidence of benefit or as proof of equivalence between the two approaches (13,14).

From a clinical perspective, the findings support further investigation of AVT as part of the management of functional binocular difficulties in young individuals with myopic anisometropia. The observed changes in visual comfort and convergence are relevant because young people frequently undertake prolonged near-vision activities requiring sustained accommodation and binocular coordination. However, decisions regarding optical correction should continue to be based on appropriate refraction and binocular assessment rather than on the assumption that the present trial establishes superiority of one training condition. The findings are most appropriately regarded as preliminary comparative evidence concerning short-term functional outcomes (15).

Several limitations should be considered. The total sample comprised only 34 participants, with 17 participants per group, which limited statistical precision and the ability to detect modest between-group effects. Participants were assessed only before and immediately after the six-week intervention, preventing evaluation of whether improvements were maintained after treatment. The available analysis primarily consisted of within-group paired comparisons and post-intervention between-group comparisons; a baseline-adjusted treatment-effect analysis or direct comparison of change between groups would provide a stronger estimate of the comparative intervention effect. In addition, visual comfort was measured using a structured symptom questionnaire whose psychometric characteristics were not described, and potentially informative binocular outcomes such as stereopsis and accommodative facility were not reported. The study also did not provide sufficient information regarding adherence, masking of outcome assessment, or intervention fidelity, all of which may influence interpretation of an interventional trial (16,17).

Despite these limitations, the study evaluated the same clinically relevant outcomes at baseline and after a standardized six-week intervention period in two similarly sized groups. The findings demonstrate a consistent pattern of within-group improvement across visual comfort, convergence, and visual-acuity measures, but they also emphasize the distinction between improvement over time and evidence of superiority between interventions. Further adequately powered comparative trials with clearly defined refractive eligibility criteria, standardized and validated outcome measures, detailed intervention protocols, baseline-adjusted analyses, and longer follow-up would

be needed to determine whether full optical correction meaningfully modifies the response to AVT in young patients with myopic anisometropia (18-20).

Conclusion

Accommodative vergence training with and without full optical correction was associated with improvements from baseline in visual comfort, near point of convergence break and recovery, and visual acuity among young patients with myopic anisometropia. However, the post-intervention comparisons did not demonstrate statistically significant differences between the two groups for the assessed outcomes. Thus, while AVT may be useful for improving short-term visual function in this population, the present findings do not establish an additional benefit of performing AVT with full optical correction compared with AVT without full optical correction.

DECLARATIONS

Author Contributions:	Concept: M, AGM; Design: M, AGM, MNB; Data Collection: TK, AR, HH, RR; Analysis: M, AGM; Drafting: M, TK, AR, HH, RR.
Ethical Approval:	Ethical approval was obtained from superior university Lahore
Informed Consent:	Written informed consent was obtained from parents or guardians before participant enrolment.
Conflict of Interest:	The authors declare no conflict of interest.
Funding:	No external funding was received for this study.
Data Availability:	Data are available from the corresponding author on reasonable request.
Acknowledgments:	None.
AI Declaration:	Generative AI tools were used solely for language and grammatical refinement. The authors verified the final manuscript and remain fully responsible for its accuracy, integrity, and scientific content.

REFERENCES

- Shravva, Janarthanan SD, Pai HV. Comparison of accommodation and vergence parameters in early- and late-onset myopic adults. *BMC Ophthalmol.* 2025;26(1):10.
- Biswas S, El Kareh A, Qureshi M, Lee DMX, Sun CH, Lam JSH, et al. The influence of the environment and lifestyle on myopia. *J Physiol Anthropol.* 2024;43(1):7.
- Dou N, Dong X, Li J, Li Y, Chen J, Zhang G, et al. Progressive binocular visual alterations associated with increasing myopic anisometropia in spectacle-corrected children. *Optom Vis Sci.* 2026;103(8).
- Jiang X, Kondo S, Otsuka N, Kaneda D, Torii H, Negishi K, et al. An analysis of light that reaches the eye surface in an outdoor environment. *Sci Rep.* 2025;15(1):34319.
- Assessment of binocular vision disorders and their impact on reading performance and learning efficiency. *Research Consortium Archive.* 2026;4(2):4009-4024.
- Coq R, Neveu P, Plantier J, Legras R. Accommodative response and visual fatigue following a non-congruent visual task in non-asthenopic and asthenopic individuals. *Ophthalmic Physiol Opt.* 2024;44(5):925-935.
- Jenewein EC, Cotter S, Roberts T, Kulp M, Mitchell GL, Jones-Jordan LA, et al. Vergence/accommodative therapy for symptomatic convergence insufficiency in children: time course of improvements in convergence function. *Ophthalmic Physiol Opt.* 2023;43(1):105-115.
- Cao Y, Ye J, Nie A, Sun D, Yang MM. Correlation between binocular vision function and visual fatigue in school-age children with myopic anisometropia. *Sci Rep.* 2025;15(1):17473.
- Khanal M, Pandey T, Sah S, Sah S. Study on status of binocular vision in different occupations. *Indian J Clin Exp Ophthalmol.* 2024;10:313-318.
- Rosa A, Rosa P, Kochana M, Ordon AJ, Loba P. The effect of low hypermetropia correction and office-based orthoptic training on binocular vision parameters in children with convergence insufficiency. *J AAPOS.* 2025;29(1):104115.
- Jiang N, Zheng Y, Chen M, Zhou J, Min SH. Binocular balance across spatial frequency in anisomyopia. *Front Neurosci.* 2024;18:1349436.
- Abdelzaher HA, Sidky MK, Awadein A, Hosny M. Aniseikonia and visual functions with optical correction and after refractive surgery in axial anisometropia. *Int Ophthalmol.* 2022;42(6):1669-1677.
- Zhao J, Luo W, Pang S, Hu B, Shui D, Bin L, et al. Digital therapy for visual acuity and binocular function in children with anisometropic amblyopia. *Cyberpsychol Behav Soc Netw.* 2023;26(12):924-929.
- Li S, Tang A, Yang B, Wang J, Liu L. Virtual reality-based vision therapy versus OBVAT in the treatment of convergence insufficiency and accommodative dysfunction: a pilot randomized controlled trial. *BMC Ophthalmol.* 2022;22(1):182.
- Barberán-Bernardos L, Jiménez N, Piñero DP. Neural changes after vision therapy in convergence insufficiency: a systematic review. *J Ophthalmol.* 2024;2024:5586202.
- Chang MY, Morrison DG, Binenbaum G, Heidary G, Trivedi RH, Galvin JA, et al. Home- and office-based vergence and accommodative therapies for treatment of convergence insufficiency in children and young adults: a report by the American Academy of Ophthalmology. *Ophthalmology.* 2021;128(12):1756-1765.
- Saikia M, Pant K, Dutta J. Diagnostic protocol for accommodative and vergence anomalies: a review. *J Binocul Vis Ocul Motil.* 2024;74(2):48-64.
- Gantz L, Stiebel-Kalish H. Convergence insufficiency: review of clinical diagnostic signs. *J Optom.* 2022;15(4):256-270.
- Chen AM, Roberts TL, Cotter SA, Kulp MT, Sinnott LT, Borsting EJ, et al. Effectiveness of vergence/accommodative therapy for accommodative dysfunction in children with convergence insufficiency. *Ophthalmic Physiol Opt.* 2021;41(1):21-32.
- Schulman E, Scheiman M, Kulp MT, Roberts TL, Cotter S, Sinnott LT, Toole A. Effects of vision therapy on near exodeviation in children with convergence insufficiency treated during the Convergence Insufficiency Treatment Trials. *Ophthalmic Physiol Opt.* 2024;44(5):936-944.