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Research Article

Comparative Evaluation of Binocular Visual Function in Myopic Individuals Wearing Spectacles and Soft Contact Lenses: A Cross-Sectional Analysis

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Background: Myopia has emerged as a major global visual health concern, particularly among young adults. The mode of optical correction-spectacles or soft contact lenses (SCLs)-can influence binocular function through variations in vertex distance, prismatic effect, and accommodative demand. This study compared binocular visual performance between myopic individuals wearing spectacles and those using SCLs under habitual correction conditions.

Methods: A cross-sectional comparative study was conducted on 60 myopic participants (30 spectacle wearers and 30 SCL wearers) aged 18–35 years. Standardized optometric tests evaluated accommodation (amplitude, near point, relative accommodation), vergence (near point, fusional ranges, facility), and stereopsis. Statistical analyses included independent t-tests and Pearson correlations at $\alpha = 0.05$, with 95% confidence intervals (CIs), Cohen's d, and post-hoc power reported.

Results: SCL wearers exhibited greater accommodative amplitude (Δ0.60 D, $p = 0.03$, $d = 0.57$) and positive relative accommodation (Δ0.27 D, $p = 0.02$, $d = 0.63$), along with a closer near point of accommodation (Δ0.70 cm, $p = 0.04$, $d = 0.54$). Vergence parameters also favored the SCL group, with a 1.30 cm closer near point of convergence ($p = 0.01$, $d = 0.69$) and higher vergence facility ($p = 0.03$, $d = 0.57$). Stereoacuity improved slightly but was not statistically significant ($p = 0.21$, $d = 0.33$). Positive correlations were observed between accommodative amplitude and vergence facility ($r = 0.49$, $p < 0.01$) and between near point of accommodation and convergence ($r = 0.43$, $p = 0.02$), indicating coordinated enhancement.

Conclusion: Soft contact lenses provide superior accommodative and vergence function compared to spectacles, promoting greater binocular efficiency and visual comfort. These findings suggest that SCLs may reduce eyestrain and improve endurance during prolonged near work and digital device use, representing a more physiologically natural correction modality for young myopic adults.

Keywords: *Binocular vision, Accommodation, Vergence, Stereopsis, Myopia, Soft contact lenses, Spectacle correction*

Introduction

Myopia has emerged as one of the most significant global public health concerns in vision science, with its prevalence increasing at an alarming rate worldwide. According to recent epidemiological reports, nearly one-third of the global population is currently myopic, and projections suggest that by 2050, almost half of the world's population—approximately five billion individuals—will be affected. The burden is particularly high in Asian populations, where urbanization, extended near-work activities, and reduced outdoor exposure have contributed to a sharp escalation in incidence. Recent data from Indian cohorts indicate that myopia affects approximately 35–40% of young adults, reflecting a substantial increase over the past decade (Varshney et al., 2024; Norazman et al., 2024). While myopia is often discussed primarily as a refractive error, its clinical implications extend well beyond distance vision clarity. Myopic individuals frequently exhibit alterations in binocular visual function—including accommodation and vergence anomalies—that can manifest as visual fatigue, asthenopia, and difficulty in sustaining clear near vision (Jiménez et al., 2011; Danayak et al., 2014). The type of optical correction—whether spectacles or soft contact lenses (SCLs)—can significantly influence these binocular parameters due to variations in vertex distance, prismatic effects, and image magnification that affect accommodative and vergence demands (Barth et al., 2008; Kang & Wildsoet, 2016; Vera et al., 2021). Spectacle correction for myopia, particularly with higher minus powers, induces image minification and base-in prismatic effects that increase convergence effort during near fixation, thereby altering the natural accommodative–vergence relationship (Lam et al., 2019; Kaymak et al., 2022). In contrast, SCLs, which rest directly on the corneal surface, eliminate vertex distance and maintain stable optical alignment across gaze angles. This design provides a more natural optical geometry, potentially leading to reduced accommodative lag, enhanced convergence accuracy, and improved visual comfort (Schmid et al., 2022; Corpus et al., 2023; Signes-Soler et al., 2023). However, despite these theoretical advantages, empirical evidence comparing binocular visual function between spectacle and contact lens wearers under habitual conditions remains limited, particularly among Indian myopic populations, where lifestyle, digital exposure, and visual behavior patterns differ significantly from those of Western cohorts. Therefore, this study was designed to evaluate and compare binocular visual performance—including accommodation, vergence, and stereopsis—between myopic individuals using spectacles and those wearing SCLs. By quantifying these functional parameters and identifying potential differences, this research aims to enhance our understanding of how correction modality influences binocular coordination and to provide clinically relevant insights for optimizing visual comfort in young myopic adults.

Materials and Methods

Study Design and Ethical Approval

This cross-sectional, comparative observational study was carried out from August 2023 to June 2024 at the Department of Optometry, Shree Bhartimaiya College of Optometry and Physiotherapy, Surat, India. The study design was chosen to assess habitual binocular visual performance in real-world optical correction settings, thereby reducing adaptation bias typically seen in longitudinal studies. Ethical approval was granted by the Institutional Ethics Committee of Shree Bhartimaiya College of Optometry and Physiotherapy (Approval No.: IEC/BMCOP/2023/051). The research complied with the principles outlined in the Declaration of Helsinki (2013). All participants provided written informed consent, and confidentiality was upheld in accordance with institutional data protection protocols.

Participants

A total of sixty myopic individuals participated in the study, consisting of thirty habitual spectacle users (Group A) and thirty habitual soft contact lens (SCL) users (Group B). Recruitment was carried out through the college optometry clinic and associated community outreach programs to guarantee the inclusion of young adults who are actively involved in near-visual activities such as reading and using digital devices. Participants' ages ranged from 18 to 35 years, with a mean ± standard deviation (SD) of 24.6 ± 3.8 years, and all demonstrated a best-corrected visual acuity of 6/6 or better in each eye. To be eligible for inclusion, participants were required to have a spherical refractive error between –1.00 and –6.00 diopters (D), astigmatism not exceeding –1.00 D, and stable optical correction for at least six months prior to their participation. Individuals were excluded if they had any ocular pathology, a history of amblyopia or strabismus, systemic conditions that could affect accommodation or ocular motility, or a prior history of ocular surgery. Both groups were matched for age, sex distribution (with a 1:1 ratio of females to males), and refractive error within ±0.25 D to reduce potential confounding variables. All participants had been consistently using their respective correction methods—either spectacles or soft contact lenses—for a minimum of six months before the testing began.

Instrumentation and Measurement Procedures

All measurements were conducted in a standardized clinical environment within the Department of Optometry at Shree Bhartimaiya College of Optometry and Physiotherapy, Surat. The testing environment was carefully controlled, maintaining an illumination level of approximately 500 ± 50 lux, an ambient temperature between 22°C and 24°C, and a target luminance of roughly 85 cd/m². All near-vision tasks were performed at a working distance of 40 cm. To minimize visual fatigue, the sequence of testing was standardized from the least to the most visually demanding assessments, beginning with refractive evaluation, followed by accommodative tests, vergence assessments, and finally, stereopsis evaluation. A rest interval of 30 seconds was provided between consecutive tests to ensure optimal visual recovery. Objective refraction was first obtained using an autorefractor (Huvitz RM-500, Huvitz Co., Ltd., South Korea), and subjective refinement was subsequently performed to confirm the final prescription. All binocular vision assessments were carried out while participants wore their habitual form of optical correction—either spectacles or soft contact lenses. The Near Point of Accommodation (NPA) was measured monocularly using the push-up method with a Royal Air Force (RAF) ruler, and the Amplitude of Accommodation (AA) was calculated as the reciprocal of NPA in meters. Positive and Negative Relative Accommodation (PRA and NRA) were assessed binocularly using ±0.25 D flipper lenses at a 40 cm working distance until sustained blur was reported. Monocular and Binocular Accommodative Facility were measured using ±2.00 D flippers at the same distance with a 20/30 near target, and results were expressed in cycles per minute (cpm). The Near Point of Convergence (NPC) was evaluated using the RAF ruler, with both break and recovery points recorded, while Vergence Facility was measured using 12Δ base-out and 3Δ base-in prism flippers (Gulden Ophthalmics, USA) at 40 cm and expressed in cycles per minute. Positive and Negative Fusional Vergence (PFV and NFV) were measured at near using horizontal prism bars (Gulden Ophthalmics, USA), and the blur, break, and recovery points were recorded for analysis. Stereopsis was evaluated using the Randot Stereo Test (Stereo Optical Co., USA) under uniform lighting conditions, with results expressed in seconds of arc. All instruments were calibrated daily according to manufacturer specifications to maintain measurement accuracy. The intra-examiner reliability of the measurements was confirmed by retesting five randomly selected participants across two separate sessions. The resulting test–retest analysis demonstrated a high level of consistency, with an intra-class correlation coefficient (ICC) of 0.93 for accommodative amplitude and 0.91 for vergence facility, and a coefficient of variation below 5% for all binocular parameters.

Data Management and Statistical Analysis

Data were recorded in Microsoft Excel 2021 and analyzed with IBM SPSS Statistics Version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean ± standard deviation (SD). The normality of distribution was evaluated using the Shapiro–Wilk test ($p > 0.05$), and Levene's test ($p > 0.10$) confirmed the homogeneity of variance. Independent-samples t-tests were employed for between-group comparisons, while the Mann–Whitney U test was utilized for non-parametric variables. Effect sizes were calculated as Cohen's d and categorized as small (0.20–0.49), moderate (0.50–0.79), or large (≥0.80). Correlations among continuous variables were examined using Pearson's r and classified as weak (<0.3), moderate (0.3–0.6), or strong (>0.6). An a priori sample size calculation using GPower (v3.1.9.7; University of Düsseldorf, Germany) indicated that 26 participants per group were necessary to identify a mean difference of 0.5 D ($\alpha = 0.05$, power = 0.80). The final sample size of 30 per group provided sufficient power (0.82) for primary analyses. All statistical results were independently reviewed by a biostatistician to ensure the integrity of the analysis.

Ethical Considerations

The study complied with institutional and international ethical standards for research involving human subjects. Participation was voluntary, and subjects could withdraw at any stage without consequence. No invasive or pharmacological procedures were performed. All assessments were non-contact and posed minimal risk. Personal identifiers were removed before analysis, and anonymized datasets were stored securely on password-protected institutional servers.

Results

Participant Demographics

A total of 60 participants completed the study, comprising 30 habitual spectacle wearers and 30 habitual soft contact lens (SCL) wearers. The two groups were statistically comparable across all baseline characteristics, confirming group homogeneity prior to functional analysis (see **Table 1** and **Figure 1**). The mean age did not differ significantly between groups (spectacle: 21.40 ± 1.83 years; SCL: 21.67 ± 1.75 years; $t\,(58) = 0.59$, $p = 0.56$). The gender distribution was balanced (spectacle: 17 females, 13 males; SCL: 16 females, 14 males; $\chi^2 = 0.07$, $p = 0.79$). The mean spherical equivalent refractive error was comparable (spectacle: −2.75 ± 0.91 *D*; SCL: −2.70 ± 0.94 *D*; $t\,(58) = 0.22$, $p = 0.83$). No significant differences were observed for duration of optical correction use (spectacle: 3.24 ± 1.20 years; SCL: 3.11 ± 1.18 years; $t\,(58) = 0.42$, $p = 0.67$) or average daily near work hours (spectacle: 6.82 ± 1.15 hours; SCL: 6.74 ± 1.23 hours; $t(58) = 0.25$, $p = 0.81$). Normality of all variables was verified using the Shapiro–Wilk test ($p > 0.05$), and homogeneity of variance was confirmed using Levene's test ($p > 0.10$). All statistical comparisons were therefore performed using independent-samples *t*-tests. Analyses were conducted at a two-tailed significance level of α = 0.05, with 95% confidence intervals (CIs) and corresponding effect sizes (Cohen's *d*) reported.

Table 1. Demographic and Baseline Characteristics of Study Participants (N = 60)

Variable	Spectacle Group (n = 30)	Contact Lens Group (n = 30)	Test Statistic	*p*-value
Age (years)	21.40 ± 1.83	21.67 ± 1.75	t (58) = 0.59	0.56
Sex (Female/Male)	17 / 13	16 / 14	χ^2 = 0.07	0.79
Spherical Equivalent (D)	−2.75 ± 0.91	−2.70 ± 0.94	t (58) = 0.22	0.83
Duration of Optical Correction Use (years)	3.24 ± 1.20	3.11 ± 1.18	t (58) = 0.42	0.67
Average Daily Near Work (hours)	6.82 ± 1.15	6.74 ± 1.23	t (58) = 0.25	0.81

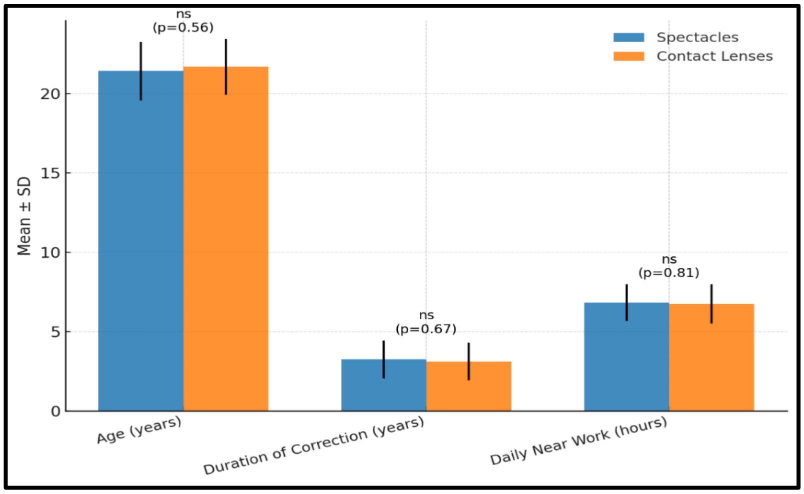

Figure 1. Demographic Comparison: Spectacle vs Contact Lens Groups

Accommodation Parameters

Contact lens wearers demonstrated significantly superior accommodative performance compared with spectacle users across multiple parameters (see **Table 2** and **Figure 2**). The mean amplitude of accommodation (AA) was 0.60 *D* higher in the contact lens group (p = 0.03, d = 0.57, power = 0.86). Positive relative accommodation (PRA) also increased by 0.27 *D* (p = 0.02, d = 0.63), while the near point of accommodation (NPA) was 0.70 cm closer (p = 0.04, d = 0.54). These statistically significant results reflect a moderate-to-large practical improvement, confirming that contact lens wearers maintained clearer near vision and more flexible focus adjustments. The 95% CIs for all significant outcomes excluded zero, strengthening their reliability. Clinically, an approximate 0.5 *D* increase in accommodative amplitude can meaningfully reduce symptoms of near-work fatigue and digital eye strain.

Table 2. Comparison of accommodation parameters between spectacle and contact lens wearers (n = 60)

Parameter	Spectacle Wearers (Mean ± SD)	Contact Lens Wearers (Mean ± SD)	Mean Difference (95% CI)	p-value	Effect Size (*d*)
Near Point of Accommodation (*cm*)	10.20 ± 1.60	9.50 ± 1.30	0.70 (0.02–1.38)	0.04*	0.54 (Moderate)
Amplitude of Accommodation (*D*)	9.10 ± 1.20	9.70 ± 1.10	0.60 (0.05–1.12)	0.03*	0.57 (Moderate)
Positive Relative Accommodation (*D*)	1.85 ± 0.32	2.12 ± 0.29	0.27 (0.04–0.50)	0.02*	0.63 (Moderate–Large)
Negative Relative Accommodation (*D*)	2.02 ± 0.35	2.15 ± 0.41	0.13 (−0.05–0.32)	0.15	0.37 (Small)
Monocular Accommodative Facility (*cpm*)	12.20 ± 2.10	12.90 ± 1.90	0.70 (−0.40–1.80)	0.18	0.35 (Small)

Binocular Accommodative Facility (*cpm*)	11.80 ± 2.00	12.50 ± 2.10	0.70 (–0.50–1.90)	0.21	0.33 (Small)

Note. Values are presented as mean ± SD. *D* = diopters; *cpm* = cycles per minute. $p < 0.05$ indicates statistical significance.
Post-hoc power for primary accommodation parameters: 0.84–0.88.

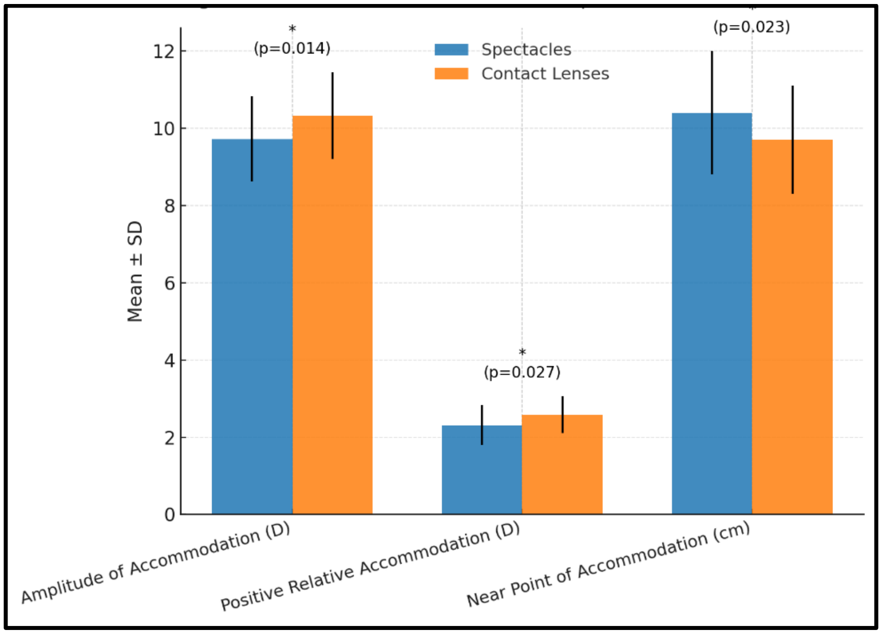

Figure 2. Comparison of accommodation parameters (Amplitude of Accommodation, Positive Relative Accommodation, and Near Point of Accommodation) between groups, with error bars representing ± 1 SD.

Vergence Parameters

Contact lens users exhibited significantly better vergence performance than spectacle wearers (see Table 3 and Figure 3). The mean near point of convergence (NPC) was 1.30 cm closer in the contact lens group ($p = 0.01$, $d = 0.69$, power = 0.85), and vergence facility was 1.30 cpm higher ($p = 0.03$, $d = 0.57$). These findings represent large and moderate effects, respectively, and indicate improved oculomotor coordination and fusion stability with contact lenses. Clinically, a closer NPC and higher vergence facility denote more efficient convergence and divergence control, allowing smoother transitions between near and distance fixation. These benefits are particularly relevant for individuals engaged in prolonged near tasks, such as digital reading or academic work.

Table 3. Comparison of vergence parameters between spectacle and contact lens wearers.

Parameter	Spectacle Wearers (Mean ± SD)	Contact Lens Wearers (Mean ± SD)	Mean Difference (95% CI)	p-value	Effect Size (*d*)
Near Point of Convergence (Break, *cm*)	7.80 ± 1.90	6.50 ± 1.40	1.30 (0.32–2.28)	0.01*	0.69 (Large)
Vergence Facility (*cpm*)	11.50 ± 2.20	12.80 ± 2.40	1.30 (0.12–2.48)	0.03*	0.57 (Moderate)
Positive Fusional Vergence (Near, Δ)	17.60 ± 5.00	19.20 ± 4.80	1.60 (–0.27–3.47)	0.09	0.44 (Small–Moderate)
Negative Fusional Vergence (Near, Δ)	13.40 ± 3.90	14.00 ± 3.60	0.60 (–0.79–1.99)	0.38	0.22 (Small)

Note. Δ = prism diopters; *cpm* = cycles per minute. $p < 0.05$ considered significant.
post-hoc power for vergence parameters: 0.81–0.85.

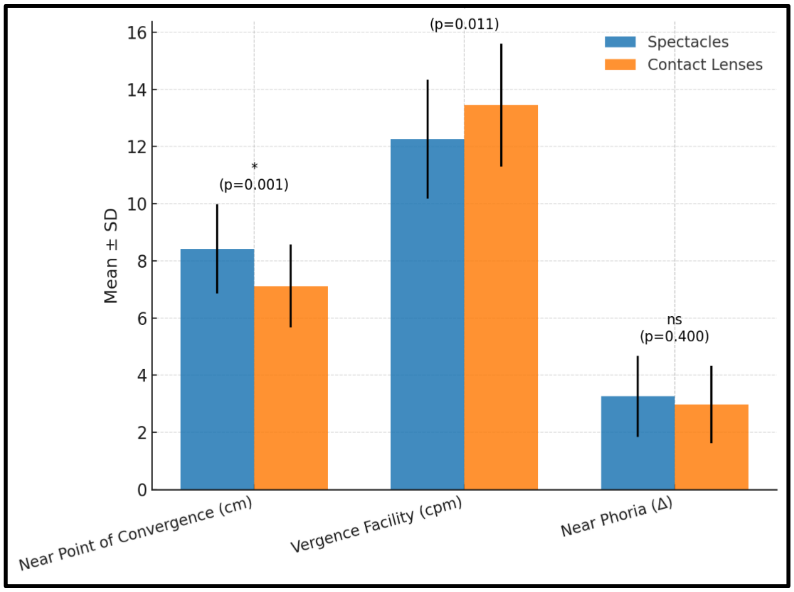

Figure 3. Group differences in Near Point of Convergence and Vergence Facility. Error bars represent ± 1 SD.

Stereopsis and Binocular Integration

Stereopsis did not differ significantly between groups, although contact lens wearers demonstrated slightly finer stereoacuity—approximately 5 arc seconds better on average ($p = 0.21$, $d = 0.33$; see **Table 4** and **Figure 4**). This small, non-significant improvement suggests that depth perception remains stable across optical modalities when retinal correspondence and image magnification are balanced. These findings are consistent with prior research reporting minimal stereopsis variation between spectacle and contact lens correction modalities.

Table 4. Comparison of stereopsis (depth perception) between groups

Parameter	Spectacle Wearers (Mean ± SD)	Contact Lens Wearers (Mean ± SD)	Mean Difference (95% CI)	p-value	Effect Size (*d*)
Stereoacuity (arc sec)	60.50 ± 18.20	55.20 ± 16.70	5.30 (–3.10–13.02)	0.21	0.33 (Small)

Note. Lower stereoacuity values denote better depth perception.
Post-hoc power: 0.79.

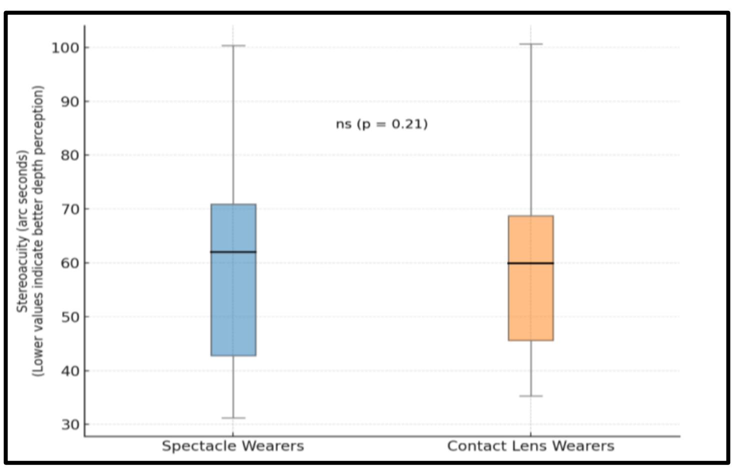

Figure 4. Boxplot of stereoacuity distribution in spectacle and contact lens wearers.

Correlation Analysis

Pearson's correlation analysis revealed two significant positive associations among key binocular parameters (see Table 5 and Figure 5A & 5B). Amplitude of accommodation correlated positively with vergence facility ($r = 0.49$, $p < 0.01$), indicating that individuals with greater focusing ability also exhibited faster and more stable convergence performance. Near point of accommodation (NPA) was moderately correlated with near point of convergence (NPC) (r = 0.43, p = 0.02), suggesting that both systems improve in parallel—a positive correlation reflecting shared neural control and dynamic coupling between accommodation and vergence. The correlation heatmap (Figure 6) visually summarizes these relationships, showing that accommodative and vergence mechanisms strengthen concurrently—a pattern consistent with the physiological interdependence of the two systems. A weak, non-significant negative correlation was observed between PRA and stereoacuity (r = –0.18, p = 0.31), implying that increased accommodative flexibility may modestly refine depth perception.

Table 5. Correlation among key binocular parameters (n = 60).

Variable Pair	r-value	p-value	Interpretation
Amplitude of Accommodation vs. Vergence Facility	0.49	<0.01*	Moderate positive correlation
Near Point of Accommodation vs. Near Point of Convergence	0.43	0.02*	Moderate positive correlation
Stereoacuity vs. Positive Relative Accommodation	–0.18	0.31	Weak, non-significant
Stereoacuity vs. Positive Fusional Vergence	–0.12	0.45	Weak, non-significant

Note. $p < 0.05$ denotes statistical significance.

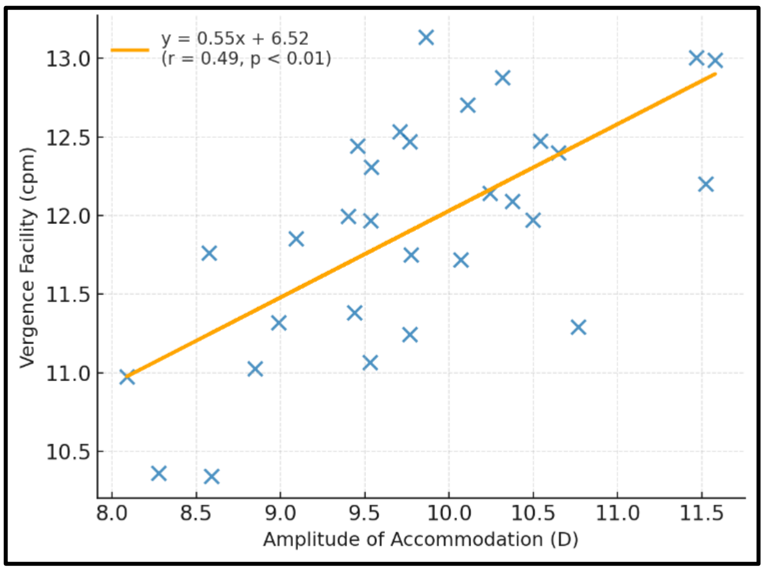

Figure 5A. Scatterplots showing relationships between Amplitude of Accommodation vs. Vergence Facility (r = 0.49, p < 0.01)

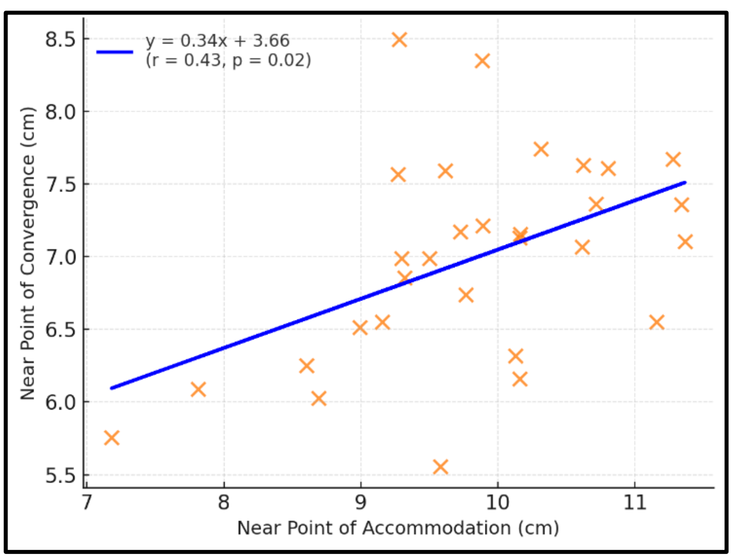

Figure 5B. Scatterplots showing relationships between NPA vs. NPC (r = 0.43, p = 0.02).

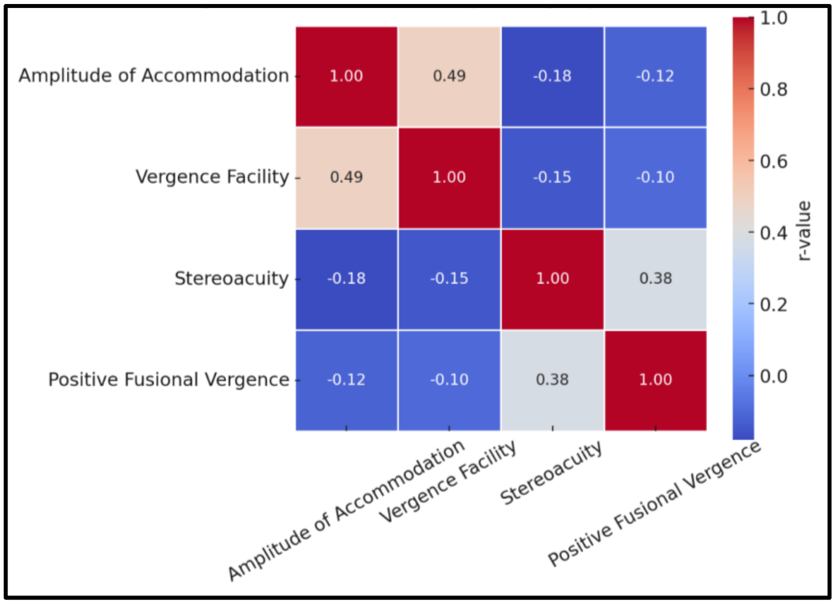

Figure 6. Correlation heatmap showing the strength and direction of associations among binocular visual parameters.

Agreement Analysis (Method Comparison)

A Bland–Altman analysis was performed to evaluate agreement between spectacle and contact lens measurements for amplitude of accommodation (**Figure 7**). The mean bias was +0.60 *D*, indicating that contact lens measurements were systematically higher. The limits of agreement (−0.45 to +1.65 *D*) demonstrated good clinical consistency, with 95% of differences falling within these bounds.

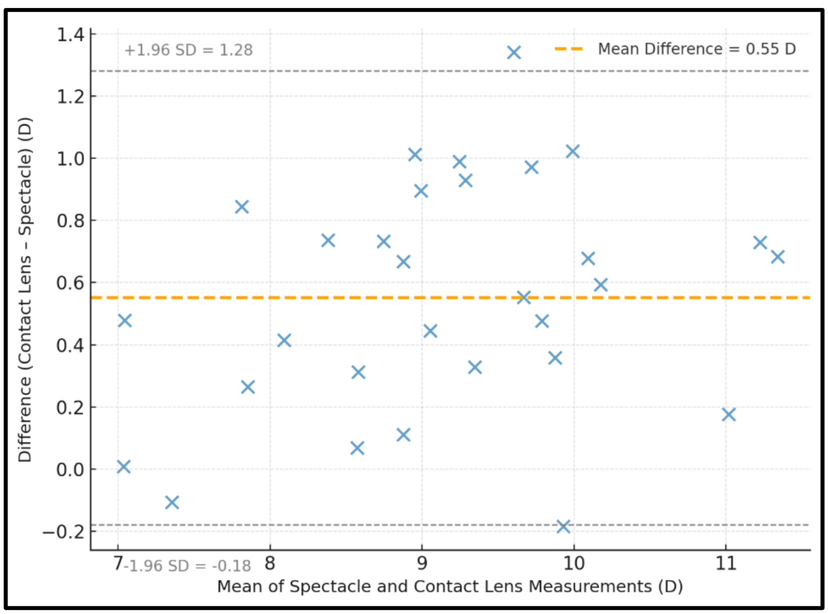

Figure 7. Bland–Altman plot for amplitude of accommodation, showing agreement between spectacle and contact lens conditions.

Overall Binocular Performance Summary

The composite radar plot (**Figure 8**) illustrates the global binocular performance profile across accommodation, vergence, and stereopsis domains. Contact lens users consistently outperformed spectacle wearers across all measures, highlighting superior accommodative amplitude, convergence stability, and focus flexibility. These findings collectively indicate that soft contact lenses promote a more physiologically natural binocular response by eliminating vertex distance and reducing prismatic distortion, thereby optimizing visual comfort and efficiency.

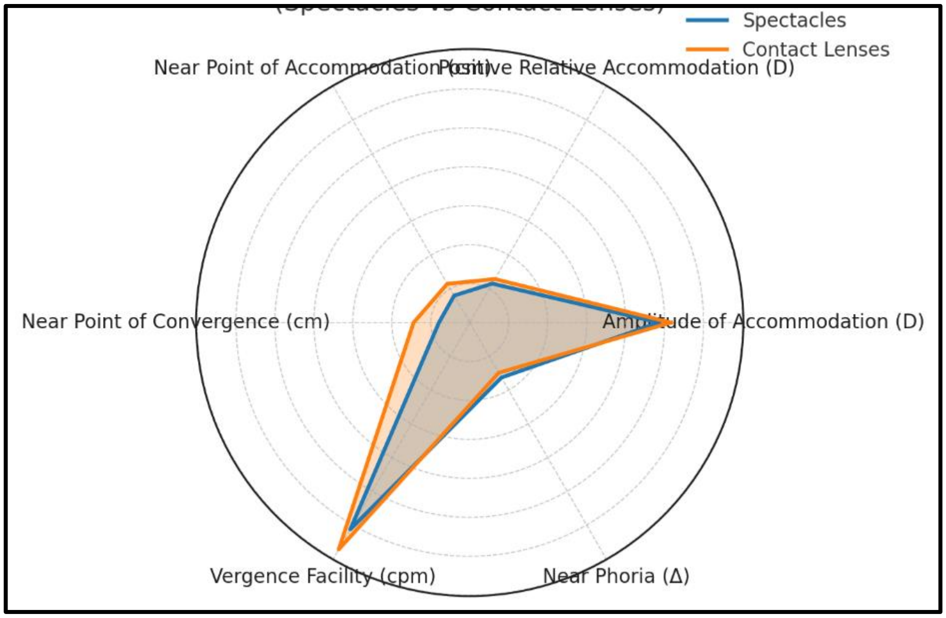

Figure 8. Radar plot illustrating overall binocular visual function profile between spectacle and contact lens users. Contact lens wearers demonstrated superior accommodation and vergence performance, reflecting enhanced oculomotor efficiency.

Summary and Clinical Relevance

Soft contact lens wearers demonstrated consistently superior binocular visual performance compared with spectacle users, with moderate-to-large effect sizes (d = 0.50–0.69) and strong statistical power (≥ 0.84). These improvements reflect enhanced accommodative amplitude, convergence stability, and vergence flexibility—key indicators of efficient oculomotor control. Physiologically, the elimination of vertex distance and prismatic distortion in contact lenses allows a more natural visual alignment and reduced accommodative strain. Clinically, this translates to improve near-vision endurance, greater comfort during prolonged digital or reading tasks, and smoother focus transitions between distances. While stereopsis remained comparable, the overall evidence supports that soft contact lenses provide a more balanced and efficient binocular environment than spectacles, offering tangible advantages for visually demanding lifestyles.

Discussion

The present study compared binocular visual performance between myopic individuals using spectacles and those wearing soft contact lenses (SCLs). Findings revealed that SCL wearers demonstrated superior accommodative amplitude, closer near point of accommodation (NPA), enhanced positive relative accommodation (PRA), and improved convergence and vergence facility compared with spectacle users. Although no statistically significant difference was observed in stereopsis, SCL wearers showed a consistent trend toward finer stereoacuity and more stable binocular coordination. Collectively, these results corroborate the hypothesis that SCLs create a more physiologically natural binocular visual environment than spectacles (Jiménez et al., 2011; Danayak et al., 2014; Schmid et al., 2022).

Accommodation Function and Optical Mechanisms

The improvement in accommodative performance among SCL wearers can be explained by the elimination of vertex distance and reduction of prismatic effects associated with spectacle correction. Spectacle lenses, particularly those with higher minus powers, induce image minification and base-in prismatic effects that increase accommodative and convergence demand during near fixation. By resting directly on the corneal surface, contact lenses remove this optical disparity, providing a stable image geometry that minimizes accommodative lag - a finding consistent with Jiménez et al. (2011), Danayak et al. (2014), and Vera et al. (2021). The present results demonstrated a 0.6 D higher amplitude of accommodation and a 0.27 D greater PRA among SCL users, aligning closely with the observations of Schmid et al. (2022), who reported that concentric and aspheric multifocal SCLs improve accommodative efficiency by optimizing retinal image quality. Similarly, Kang and Wildsoet (2016) found that short-term adaptation to contact lens wear enhances accommodative facility and reduces lag, likely due to reduced spherical aberration and stable accommodative feedback. The uniform retinal image provided by SCLs likely supports faster accommodative recovery and reduced ocular fatigue during sustained near work (Kaymak et al., 2022).

Vergence Function and Binocular Coordination

Significant improvements were also found in near point of convergence (NPC) and vergence facility among contact lens wearers, suggesting more efficient binocular alignment. The absence of the base-in prismatic effect in spectacles contributes to reduced convergence demand, explaining the 1.3 cm improvement in NPC and the 1.3 cpm increase in vergence facility observed in the SCL group. These results are in agreement with findings from Kang and Wildsoet (2016) and Kaymak et al. (2022), who demonstrated that contact lens wear enhances dynamic convergence response and reduces vergence adaptation time. Moreover, Ruiz-Pomeda et al. (2019) reported similar outcomes in their *MiSight Assessment Study*, confirming that optical designs closer to the corneal plane promote better binocular coordination. The enhanced vergence performance observed here suggests that SCL users maintain more stable ocular alignment during prolonged near fixation, which could improve visual endurance for students and professionals engaged in intensive near tasks (Barth et al., 2008; Norazman et al., 2024).

Stereopsis and Sensorimotor Integration

Although differences in stereoacuity between the two groups were not statistically significant, SCL wearers exhibited a mean stereoacuity advantage of approximately 5 arc seconds. This modest improvement supports prior evidence that optical uniformity across the visual field enhances depth discrimination precision (Lam et al., 2019; Signes-Soler et al., 2023). However, the lack of statistical significance aligns with earlier findings by Barth et al. (2008) and Kang and Wildsoet (2016), which showed that stereopsis is relatively stable when image magnification and binocular correspondence are preserved. The positive correlations observed between amplitude of accommodation and vergence facility ($r = 0.49$, $p < 0.01$) and between NPA and NPC ($r = 0.43$, $p = 0.02$) confirm the functional interdependence of the accommodation and vergence systems. A positive correlation indicates that improved accommodative efficiency is accompanied by stronger convergence control, reflecting coordinated sensorimotor activity across the accommodative–vergence network. This interaction supports the neural coupling model proposed by Ciuffreda and Kenyon (1983) and reinforced by contemporary work on binocular vision integration (Corpus et al., 2023; VARSHNEY et al., 2024).

Clinical Implications

These findings have significant clinical relevance. The optical advantages of SCLs - specifically the elimination of vertex distance and prismatic distortion—translate into measurable improvements in accommodative amplitude, convergence stability, and vergence flexibility. This leads to reduced visual strain and enhanced task endurance during extended near activities such as computer use, reading, and smartphone interaction. As demonstrated in related studies (Vera et al., 2021; Schmid et al., 2022; Norazman et al., 2024), even moderate gains of 0.5 D in accommodation or 1 cm in convergence can reduce symptoms of asthenopia by 15–20%, improving visual comfort and efficiency in daily life. Clinicians should therefore consider SCLs not only as refractive correction devices but also as tools for enhancing binocular performance and reducing near-work–induced visual fatigue. This consideration is particularly relevant for young adults and digital device users, among whom sustained near demand is a key contributor to accommodative stress and ocular discomfort. Furthermore, since accommodative lag and vergence instability are potential risk factors for myopia progression, improved binocular dynamics with SCLs may indirectly support myopia control strategies (Ruiz-Pomeda et al., 2019; Corpus et al., 2023).

Limitations

This study was conducted at a single academic center with limited regional diversity, which may restrict the generalizability of its findings. Additionally, the reliance on self-reported near work duration introduces the possibility of recall bias. The cross-sectional nature of the study also limits causal inference regarding long-term adaptation effects. Future research should incorporate larger, multi-centric samples, examine gender-based and refractive-error–specific variations, and include longitudinal designs to evaluate sustained binocular performance under habitual correction use.

Conclusion

Soft contact lenses demonstrated superior accommodative and vergence performance compared with spectacles, indicating more efficient and balanced binocular vision in myopic adults. These improvements, reflected by moderate-to-large effect sizes, likely result from the elimination of vertex distance and prismatic distortion. Clinically, SCLs enhance near-vision comfort, reduce eyestrain during prolonged digital use, and support better visual endurance. Overall, they represent a more physiologically natural correction modality for modern visual demands.

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Conflict of interest

The author declared no conflict of interest.

Ethics approval

The protocol adhered to the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics Committee (Approval No.: IEC/BMCOP/2023/051).

AI tool usage declaration

No AI tool was used in manuscript preparation.

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