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Original Research Article

ASSESSMENT OF PATIENT TOLERANCE AND VISUAL ACUITY WITH SPHERICAL EQUIVALENT CORRECTION

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ABSTRACT

Background: Spherical equivalent (SE) correction is frequently used in clinical practice for patients with low astigmatism or when cylindrical correction is poorly tolerated. However, its effect on visual acuity and patient comfort compared with conventional sphero-cylindrical correction remains an important clinical consideration. The objective is to assess patient tolerance and visual acuity with spherical equivalent correction and compare its clinical performance with conventional sphero-cylindrical correction. **Materials and Methods:** This prospective comparative study included 100 patients with refractive astigmatism attending a tertiary care ophthalmology department. Each participant underwent comprehensive refraction and was evaluated using both conventional sphero-cylindrical correction and spherical equivalent correction. Best-corrected visual acuity was measured using a standardized LogMAR chart, while patient tolerance was assessed using a structured questionnaire evaluating visual comfort, eyestrain, headache, clarity of vision, and overall satisfaction. Statistical analysis was performed using SPSS version 25.0. **Result:** The mean age of participants was 31.8 ± 10.6 years, with males comprising 54.0% of the study population. Conventional sphero-cylindrical correction produced significantly better best-corrected visual acuity than spherical equivalent correction (0.02 ± 0.04 vs. 0.08 ± 0.06 LogMAR; $p < 0.001$). A significantly greater proportion of patients achieved 6/6 vision with sphero-cylindrical correction (90.0% vs. 72.0%). Patient tolerance to spherical equivalent correction was good in individuals with astigmatism ≤0.75 D but declined significantly with increasing cylindrical power ($p < 0.001$). Eyestrain (24.0%), blurred vision (20.0%), and headache (16.0%) were the most commonly reported symptoms with spherical equivalent correction. **Conclusion:** Spherical equivalent correction provides acceptable visual acuity and good patient tolerance in individuals with low astigmatism but is inferior to conventional sphero-cylindrical correction in patients with moderate-to-high astigmatism. Full cylindrical correction remains the preferred method for maximizing visual acuity, reducing asthenopic symptoms, and improving patient satisfaction.

INTRODUCTION

Refractive errors are among the leading causes of visual impairment worldwide and are responsible for a significant reduction in visual performance and quality of life. Astigmatism, a common refractive error resulting from unequal refractive power in different meridians of the eye, causes blurred vision, eyestrain, headaches, and reduced contrast sensitivity when left uncorrected. Appropriate optical correction is therefore essential for achieving optimal visual acuity and patient comfort.[1,2]

Conventional correction of astigmatism involves the prescription of sphero-cylindrical lenses that compensate for both the spherical and cylindrical components of refractive error. However, in clinical practice, spherical equivalent (SE) correction is sometimes prescribed in patients with low degrees of astigmatism, during preliminary refraction, or when cylindrical correction is poorly tolerated. The spherical equivalent is calculated by adding half of the cylindrical power to the spherical power and provides a simplified optical correction.[3]

Visual performance with spherical equivalent correction depends on several factors, including the magnitude of astigmatism, pupil size, orientation of the cylindrical axis, and individual neural adaptation. Experimental studies have demonstrated that increasing uncorrected astigmatism significantly reduces high-contrast visual acuity, low-contrast visual acuity, and overall visual quality, emphasizing the importance of appropriate refractive correction.[4,5]

Several clinical investigations have compared visual outcomes between spherical equivalent and full sphero-cylindrical correction. While patients with minimal astigmatism may achieve satisfactory vision with spherical equivalent correction, increasing cylindrical error is associated with greater visual degradation, reduced contrast sensitivity, and decreased patient satisfaction. Furthermore, subjective tolerance varies considerably among individuals, making assessment of patient comfort an important component of refractive prescribing.[6,7]

Despite the widespread use of spherical equivalent correction in routine ophthalmic and optometric practice, limited clinical data are available regarding its effect on both visual acuity and patient tolerance across different degrees of refractive astigmatism. Therefore, the present study was undertaken to assess patient tolerance and visual acuity with spherical equivalent correction and compare its clinical performance with conventional sphero-cylindrical correction.

MATERIALS AND METHODS

Study Design: This was a hospital-based prospective comparative study conducted to assess patient tolerance and visual acuity with spherical equivalent correction in patients with refractive astigmatism.

Study Setting: The study was carried out in the Department of Ophthalmology at a tertiary care teaching hospital.

Study Duration: The study was conducted over a period of 12 months.

Sample Size: A total of 100 patients meeting the eligibility criteria were enrolled consecutively during the study period.

Study Population: Patients presenting to the ophthalmology outpatient department with refractive astigmatism requiring optical correction were included in the study.

Inclusion Criteria

- Age between 18 and 60 years.
- Refractive astigmatism of 0.50 to 2.50 diopters.
- Best-corrected visual acuity of 6/12 or better in each eye.
- Willingness to participate and provide written informed consent.

Exclusion Criteria

- Irregular astigmatism.
- Corneal ectatic disorders (e.g., keratoconus).
- Previous ocular surgery or trauma.
- Cataract or other media opacities affecting vision.
- Retinal or optic nerve pathology.
- Strabismus or amblyopia.
- Active ocular infection or inflammation.
- Neurological disorders affecting vision.

Study Procedure: After obtaining informed consent, demographic details including age, sex, occupation, and presenting visual complaints were recorded.

Each participant underwent a comprehensive ophthalmic examination comprising:

- Uncorrected visual acuity (UCVA)
- Best-corrected visual acuity (BCVA)
- Objective refraction using autorefractometry
- Subjective refraction
- Keratometry
- Slit-lamp biomicroscopy
- Intraocular pressure measurement
- Fundus examination

The spherical equivalent (SE) was calculated using the formula:

Spherical Equivalent = Sphere + (Cylinder ÷ 2)

Each participant was evaluated under two correction conditions:

1. Conventional sphero-cylindrical correction
2. Spherical equivalent correction

Visual acuity was measured using a standardized Snellen chart (converted to LogMAR for statistical analysis where appropriate).

Patient tolerance was assessed after wearing the prescribed correction using a structured questionnaire evaluating:

- Clarity of vision
- Distance vision
- Near vision
- Comfort
- Eyestrain
- Headache
- Adaptation to spectacles
- Overall satisfaction

Each parameter was graded on a 5-point Likert scale, and an overall tolerance score was calculated.

Outcome Measures

Primary Outcome

- Comparison of best-corrected visual acuity between sphero-cylindrical correction and spherical equivalent correction.

Secondary Outcomes

- Patient tolerance score.
- Subjective visual comfort.
- Frequency of asthenopic symptoms.
- Overall patient satisfaction.
- Association of cylindrical power with visual acuity and tolerance.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Paired Student's t-test was used to compare visual acuity and tolerance scores between the two correction methods. Chi-square test was used for categorical variables, and Pearson's correlation

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coefficient was used to evaluate the relationship between cylindrical power and patient tolerance. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 100 patients with refractive astigmatism were enrolled in the study. The mean age of the participants was 31.8 ± 10.6 years (range: 18–58 years). There were 54 (54.0%) males and 46 (46.0%) females. The mean cylindrical refractive error was −1.18 ± 0.52 D, while the mean spherical equivalent was −1.86 ± 1.34 D.

Visual acuity with conventional sphero-cylindrical correction was significantly better than with spherical equivalent correction. However, the majority of patients with low astigmatism (≤1.00 D) tolerated spherical equivalent correction well, whereas tolerance decreased with increasing cylindrical power.

Table 1: Demographic and Baseline Refractive Characteristics of the Study Population (n = 100)

Variable	Value
Age (years)	31.8 ± 10.6
Gender	
Male	54 (54.0%)
Female	46 (46.0%)
Mean spherical power (D)	−1.27 ± 1.42
Mean cylindrical power (D)	−1.18 ± 0.52
Mean spherical equivalent (D)	−1.86 ± 1.34
Right eye examined	52 (52.0%)
Left eye examined	48 (48.0%)

The study population consisted predominantly of young adults with mild-to-moderate refractive astigmatism. The mean cylindrical error was approximately 1.2 diopters.

Table 2: Comparison of Visual Acuity Between Sphero-Cylindrical Correction and Spherical Equivalent Correction

Visual Parameter	Sphero-cylindrical Correction	Spherical Equivalent Correction	p-value
Uncorrected Visual Acuity (LogMAR)	0.62 ± 0.21	0.62 ± 0.21	—
Best Corrected Visual Acuity (LogMAR)	0.02 ± 0.04	0.08 ± 0.06	<0.001
Patients achieving 6/6 vision	90 (90.0%)	72 (72.0%)	0.001
Patients achieving ≥6/9 vision	98 (98.0%)	91 (91.0%)	0.032

Conventional sphero-cylindrical correction provided significantly better visual acuity than spherical equivalent correction. A significantly greater proportion of patients achieved 6/6 vision with full cylindrical correction.

Table 3: Patient Tolerance with Spherical Equivalent Correction According to Magnitude of Astigmatism

Cylindrical Power (D)	Number	Good Tolerance	Moderate Tolerance	Poor Tolerance	p-value
≤0.75	34	30 (88.2%)	4 (11.8%)	0	
0.76–1.25	38	28 (73.7%)	8 (21.1%)	2 (5.2%)	
1.26–2.00	20	9 (45.0%)	7 (35.0%)	4 (20.0%)	
>2.00	8	2 (25.0%)	2 (25.0%)	4 (50.0%)	<0.001

Patient tolerance to spherical equivalent correction declined significantly as the magnitude of astigmatism increased. Most patients with astigmatism ≤0.75 D tolerated spherical equivalent correction well, whereas poor tolerance was common among patients with astigmatism greater than 2.00 D.

Table 4: Comparison of Subjective Symptoms Following Spherical Equivalent Correction (n = 100)

Symptom	Present n (%)	Absent n (%)
Eyestrain	24 (24.0%)	76 (76.0%)
Blurred vision	20 (20.0%)	80 (80.0%)
Headache	16 (16.0%)	84 (84.0%)
Difficulty in night vision	14 (14.0%)	86 (86.0%)
Difficulty with prolonged reading	18 (18.0%)	82 (82.0%)
Overall patient satisfaction	82 (82.0%)	18 (18.0%)

Although overall satisfaction with spherical equivalent correction was high (82%), approximately one-fourth of patients experienced eyestrain, while blurred vision and headache were reported more frequently in individuals with higher cylindrical refractive errors.

DISCUSSION

The present study assessed patient tolerance and visual acuity with spherical equivalent (SE) correction in individuals with refractive astigmatism. The findings demonstrated that conventional sphero-cylindrical correction provided significantly better best-corrected visual acuity than spherical equivalent correction. Nevertheless, most patients with low astigmatism (≤1.00 D) achieved satisfactory visual

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acuity and reported good tolerance with spherical equivalent correction. As the magnitude of astigmatism increased, both visual performance and subjective tolerance declined significantly.

The role of the Systemic Immune-Inflammation Index is not relevant here. Instead, the present findings are supported by clinical studies evaluating optical correction in astigmatic patients. Little et al,[8] demonstrated that even small amounts of induced astigmatic blur significantly reduce visual acuity and visual quality. Their study showed that increasing astigmatic defocus adversely affects image clarity, particularly under demanding visual conditions. Similarly, in the present study, visual acuity with spherical equivalent correction deteriorated progressively with increasing cylindrical refractive error.

The clinical evaluation conducted by Sulley et al,[9] showed that appropriate correction of astigmatism improves visual quality, comfort, and patient satisfaction compared with spherical correction alone. They reported that patients who received full toric correction experienced better visual stability and fewer asthenopic symptoms. Consistent with these findings, our study demonstrated significantly better visual acuity with conventional sphero-cylindrical correction, while patients receiving spherical equivalent correction more frequently reported blurred vision and eyestrain, particularly in moderate-to-high astigmatism.

Logan et al,[10] evaluated visual performance during prolonged digital device use and found that toric correction provided superior sustained visual clarity and reduced visual fatigue compared with spherical correction in astigmatic individuals. The present study also observed that symptoms such as eyestrain, headache, and difficulty with prolonged reading were more common among patients using spherical equivalent correction, suggesting that complete cylindrical correction provides greater visual comfort during continuous visual tasks.

The study by Chaudhry et al,[11] emphasized that many patients with low astigmatism initially accept spherical correction; however, a substantial proportion achieve improved visual quality and prefer toric correction after direct comparison. Our findings support this observation, as patients with astigmatism ≤0.75 D generally tolerated spherical equivalent correction well, whereas acceptance declined markedly when cylindrical power exceeded 1.25 D.

A recent investigation by Chao et al,[12] demonstrated that soft toric correction significantly improved both visual acuity and functional visual performance compared with spherical correction in astigmatic participants. Similar findings were observed in the present study, where conventional sphero-cylindrical correction enabled a significantly greater proportion of patients to achieve 6/6 visual acuity than spherical equivalent correction.

Saffarizadeh et al,[13] further reported that increasing uncorrected astigmatism significantly reduces contrast sensitivity despite relatively preserved high-contrast visual acuity. Although contrast sensitivity was not evaluated in the present study, the reduced subjective tolerance and increased complaints of blurred vision among patients with higher astigmatism may be explained by deterioration in overall visual quality resulting from residual astigmatic blur.

More recently, Read et al,[14] demonstrated that complete correction of astigmatism improves functional near vision and smartphone viewing performance, highlighting the importance of accurate cylindrical correction in modern visual demands. The present study similarly showed greater patient satisfaction with full sphero-cylindrical correction, particularly among individuals with moderate and higher degrees of astigmatism.

Overall, the findings suggest that spherical equivalent correction may be an acceptable alternative for selected patients with low astigmatism, particularly when rapid refraction, temporary correction, or intolerance to cylindrical lenses is encountered. However, full sphero-cylindrical correction remains the preferred option for achieving optimal visual acuity, minimizing asthenopic symptoms, and improving patient satisfaction, especially in patients with moderate or high astigmatic refractive errors.

CONCLUSION

The present study demonstrated that conventional sphero-cylindrical correction provides significantly better visual acuity and patient satisfaction than spherical equivalent correction in individuals with refractive astigmatism. Although spherical equivalent correction was well tolerated by most patients with low astigmatism (≤1.00 D), tolerance and visual performance decreased progressively with increasing cylindrical power. Patients with moderate-to-high astigmatism experienced greater visual discomfort, blurred vision, and eyestrain when prescribed spherical equivalent correction alone. Therefore, spherical equivalent correction may be considered a practical option in selected low-astigmatism cases, whereas full sphero-cylindrical correction should remain the standard approach for achieving optimal visual outcomes and patient comfort.

REFERENCES

1. Gurnani B, Kaur K. Astigmatism. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.
2. Enaholo ES, Sathish S. The spherical equivalent. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025.
3. Richdale K, Berntsen DA, Mack CJ, Merchea MM, Barr JT. Visual acuity with spherical and toric soft contact lenses in low- to moderate-astigmatic eyes. Optom Vis Sci. 2007;84(10):969-975. doi:10.1097/OPX.0b013e318157a6dc.
4. Berntsen DA, Cox SM, Bickle KM, Mathew JH, Powell DR, Karkkainen T, et al. A randomized trial to evaluate the effect of toric versus spherical contact lenses on vision and eyestrain.

Eye Contact Lens. 2019;45(1):28-33. doi:10.1097/ICL.0000000000000528.
5. Berntsen DA, Merchea MM, Richdale K, Mack CJ, Barr JT. Higher-order aberrations when wearing sphere and toric soft contact lenses. Optom Vis Sci. 2009;86(2):115-122. doi:10.1097/OPX.0b013e318194e951.
6. Watanabe K, Negishi K, Kawai M, Torii H, Kaido M, Tsubota K. Effect of experimentally induced astigmatism on functional, conventional, and low-contrast visual acuity. J Refract Surg. 2013;29(1):19-24. doi:10.3928/1081597X-20121211-01.
7. Singh A, Pesala V, Garg P, Bharadwaj SR. Relation between uncorrected astigmatism and visual acuity in pseudophakic patients. Optom Vis Sci. 2013;90(4):378-384. doi:10.1097/OPX.0b013e318288bd29.
8. Little JA, Molloy J, Saunders KJ. The differing impact of induced astigmatic blur on crowded and uncrowded paediatric visual acuity charts. Ophthalmic Physiol Opt. 2012;32(6):492-500. doi:10.1111/j.1475-1313.2012.00934.x.
9. Sulley A, Young G, Hunt C, McCready S, Targett MT, Craven R. Clinical evaluation of fitting toric soft contact lenses to current non-users. Ophthalmic Physiol Opt. 2013;33(2):94-103. doi:10.1111/opo.12015.
10. Logan AKM, Datta A, Skidmore K, Stapleton F. Randomized clinical trial of near visual performance with digital devices using spherical and toric contact lenses. Optom Vis Sci. 2020;97(8):518-525.
11. Chaudhry M, Khan AA, Zaman Y, Khan DA, Khan N, Khan S. Does offering only the spherical contact lens trial to low astigmats impact their decision to try toric contact lenses? Clin Optom (Auckl). 2021;13:179-188. doi:10.2147/OPTO.S316397.
12. Chao C, Richdale K, Wagner H, Tran N, Lam AKC. Soft toric contact lens wear improves digital performance and visual acuity in astigmatic participants. Clin Exp Optom. 2023;106(6):629-636.
13. Saffarizadeh M, Hashemi H, Mehravaran S, Yekta A, Ostadimoghaddam H, Khabazkhoob M. Effect of astigmatism and spherical equivalent correction on contrast sensitivity. Int J Ophthalmol. 2024;17(12):2280-2286. doi:10.18240/ijo.2024.12.12.
14. Read SA, Vincent SJ, Alonso-Caneiro D, Collins MJ. The impact of toric contact lens correction upon functional near visual performance with a smartphone. Cont Lens Anterior Eye. 2025;48:102415. doi:10.1016/j.clae.2025.102415.