

Comparison of the Contrast Sensitivity Test with Different Modes of Refractive Correction in Myopes with Low Astigmatism

Anisha Adhikari^{1*}, Ankita Mishra¹, Aparajita Kar² and Hari R²

¹B.Sc Optometry, Intern Optometrist, Vittala International Institute of Ophthalmology, Bengaluru, India

²Assistant Professor, Vittala International Institute of Ophthalmology, Bengaluru, India

*Corresponding Author: Anisha Adhikari, B.Sc Optometry, Intern Optometrist, Vittala International Institute of Ophthalmology, Bengaluru, India.

DOI: 10.31080/ASOP.2022.06.0635

Received: March 06, 2023

Published: March 30, 2023

© All rights are reserved by Anisha Adhikari, et al.

Abstract

Aim: To compare the contrast sensitivity test with different modes of refractive correction in myopes with low astigmatism.

Objectives: To compare different modes of refractive correction to achieve better contrast sensitivity in myopes with low astigmatism.

- Best corrected spherical equivalent lens in trial frame
- SCL
- RGP

To measure CS with Pelli-Robson CS chart and mobile application CS chart (Smart Optometry) with different modes of refractive correction.

Methods: In a prospective clinical trial comprised on 36 eyes of 22 subjects were enrolled based on inclusion and exclusion criteria. Subjects were corrected by three different modes: 1). Best-corrected SE in trial frame 2)SCL 3)RGP. All the subjects were corrected with BCVA of 0.0 LogMAR and Spherical Equivalent(SE) was calculated. Contrast sensitivity were measured using Pelli-Robson chart and mobile application (Smart Optometry).

Results: Soft contact lens have given better contrast sensitivity as compared to SE in spectacle trial frame and RGP in both Pelli-robson chart and mobile application (Smart Optometry). While by measuring with PR chart and mobile application chart, mobile application gave the good contrast sensitivity. And no significant difference was found between dominant and non-dominant eyes in the patient whom we have included two eyes for the study.

Conclusion: Soft contact lens was better option when compared with RGP and BCVA trial lens as alternative to toric prescription in myopes with low astigmatism.

Keywords: Pelli-Robson; Mobile Application (Smart Optometry); Contact Lens

Abbreviations

SCL: Soft Contact Lens; RGP: Rigid Gas Permeable; SE: Spherical Equivalent; CS: Contrast Sensitivity; CL: Contact Lens

Introduction

Contrast sensitivity (CS)

Contrast sensitivity is the ability of the eye to detect small changes in illumination at targets that do not have clearly defined

limits. Standard visual acuity measurement is done with high contrast conditions. This does not provide any information about visual performance in many of the various activities we perform in our daily lives, such as driving at night or reading in low light, and a patient's vision cannot be fully assessed by evaluating visual acuity alone. Contrast sensitivity is one of the main requisites for good vision and, unlike visual acuity, can be affected by many factors. It is revealed that impaired contrast sensitivity may be present in cases of normal visual acuity. Contrast sensitivity can be measured by using different charts available like Pelli-Robson contrast sensitivity chart, Cambridge low-contrast gratings, Arden gratings, etc.

Types of CS

- Spatial contrast sensitivity
- Temporal contrast sensitivity

Spatial CS refers to the detection of stripe patterns and various levels of contrast and spatial frequency. Temporal CS measures the sensitivity to contrast (i.e., modulation depth) as a function of time. This can be achieved by presenting stimuli that vary sinusoidally over time; it is like presenting a grating pattern in time instead of space.

The Pelli-Robson chart

The Pelli-Robson chart is wall mounted (measuring 60×85 cm) and viewed at 1 m. The chart uses the 10 Sloan letters with constant size. The letters are arranged in 16 triplets over eight lines, where each line consists of two sets of triplets all of constant size. It consists of letters that subtend an angle 3 degrees at a distance of 1m. The chart is printed on both sides. The two sides have different letter sequences but are otherwise identical. The letters on the chart are organized as triplets, there being two triplets in each line. The contrast decreases from one triplet to the next. The log contrast sensitivity varies from 0.00 to 2.25 log Cs.

Contact lens

Contact lenses, or simply contacts, are thin lenses placed directly on the surface of the eyes. Contact lenses are used by over 150 million people worldwide, and they can be worn to correct vision or for cosmetic or therapeutic reasons.

Silicone hydrogel contact lenses

Silicone hydrogel contact lenses are a specially designed soft lens. Similar to standard hydrogel soft lenses, these are made of a plastic material, which goes hard when it is dried out but which actively absorbs water to become soft and pliable again.

As silicone hydrogels become available in an increasingly wide range of parameters, they are gradually assuming priority over hydrogel lenses for most new soft lens patients because of their superior physiological properties. They are, however, particularly indicated in the following cases: thick lenses (e.g. with high Rxs) where Dk/t is likely to be inadequate with a hydrogel lens, extended or flexible wear, corneal edema with previous lenses, persistent conjunctival injection with previous lenses.

The main advantage of these newer silicone hydrogels compared with the early silicone hydrogels is that they have increased water contents, reduced moduli and do not need to be surface treated.

Extended-wear hypoxia-related problems with hydrogels have been resolved with the introduction of silicone hydrogel materials.

RGP lenses

A rigid gas-permeable lens, also known as an RGP lens, GP lens, or colloquially, a hard contact lens, is a rigid contact lens made of oxygen-permeable polymers. Initially developed in the late 1970s, and through the 1980s and 1990s, they were an improvement over prior 'hard' lenses that restricted oxygen transmission to the eye. Rigid lenses are able to replace the natural shape of the cornea with a new refracting surface. This means that a regular (spherical) rigid contact lens can provide good level of vision in people who have astigmatism or distorted corneal shapes as with Keratoconus. However, they require a period of adaptation before full comfort is achieved.

Mobile application (Smart Optometry)

It is an application interactive smart phone and tablet application for eye screening and quick diagnosis. It provides eye practitioners, with a simple to use fast precise and interactive experience.

Smart Optometry is a company providing eye care professionals with innovative software solutions for eye screening, testing and therapy. There are different features and different tests are

available in this app like Contrast Sensitivity, visual Acuity, Colour Vision, Amsler Grid, Aniseikonia, Accommodation, Duochrome, Fluorescein test, Hirschberg, Maze, MEM retinoscopy, OKN Stripes Red desaturation, SCOHBER, Visual acuity and WORTH FOUR DOT TEST.

Review of Literature

Min-Ah Lee, Hyun Jung Kim and Jai-Min Kim conducted a study on Contrast Sensitivity and Glare with Spherical and toric Soft Contact Lenses in Low-astigmatic eyes in the year 2009. Twenty subjects with low astigmatic myopia were enrolled and corrected by five different methods: soft toric lenses; spherical soft contact lenses; RGP lenses; best spectacle corrected visual acuity; spherical equivalent spectacles. It concluded that toric soft lenses gave better visual performance than spherical soft lenses in low astigmatic eyes. Subjects requiring the use of contact lenses under mesopic conditions could benefit from toric soft lenses.

Carolyn G. Begley OD, MS Julie A.Dabkowski, OD Michael P.RoachOD conducted a study to compare soft toric versus spherical contact lenses in myopes with low astigmatic subjects in the year 1992. The study was conducted on 31 eyes of 21 myopic patients. All the patients were given soft toric and soft spherical contact lens. The aspherical soft lens was asked to wear for one week and the vision was checked. Again the other week, the patient was fitted with toric contact lens and the visual acuity was evaluated after one week again. They concluded that the patient with all the levels of myopia achieved better visual acuity with toric than spherical contact lens. However the contrast was not significantly changed between two groups but a distinct trend toward improvement with toric lenses.

Alec Kingsnorth, Tom Drew¹, Bikramjit Grewal, James S Wolffsohn conducted a study 'Mobile app Aston contrast sensitivity test' in the year 2016. The study was conducted on 20 subjects. The mobile apps recorded a higher contrast sensitivity than printed tests. The mobile app charts measured more spatial frequencies, took less time and were more repeatable.

Kishor Sapkota, Sandra Franco, Madalena Lira conducted a study 'Contrast sensitivity function with soft contact lens wear' in the year 2020. The study was conducted on 47 myopic subjects.

All the subjects were given best corrected spectacle correction and CSF was measured CSV-1000 (VectorVision, Greenville, OH). And again they were corrected with soft contact lens daily disposable in one eye and three month disposabe in other eye. Differences in CSF with spectacles and CLs on baseline and changes to CSF after three months of CLs wear were assessed. The effect of lens materials and wearing modality on CSF change was also investigated. SF is better with CLs than with spectacles. CSF values with CL are similar between baseline and after 3 months of lens wear.

Need of Study

To compare the different modes of refractive correction to which can be used to enhance contrast in myopes with low astigmatism for those who are intolerant to toric prescription.

Aim

To compare the contrast sensitivity with different modes of refractive correction in myopes with low astigmatism.

Objectives

- To compare different modes of refractive correction to achieve better contrast sensitivity in myopes with low astigmatism.
- To measure CS with Pelli-Robson CS chart and mobile application CS chart (Smart Optometry) with different modes of refractive correction.

Materials and Methodology

Study subjects

- **Study design:** Prospective Experimental Study.
- **Source of data:** The study was conducted on staffs and students of Vittala International Institute of ophthalmology, Bengaluru
- **Sample size:** 36 eyes of 22 subjects of VIIO between the age of 18 to 35 years
- **Study Duration:** 3 months
- **Study area:** Vittala International Institute of Ophthalmology, Bengaluru
- **Data collection technique:** Based on inclusion and exclusion criteria.

Inclusion criteria

- Healthy subjects of age group 18-35 years
- Myopes with Low astigmatism (Upto -1.25)
- BCVA of 0.0 log MAR or better for distance and near
- CS ≥0.06 in Pelli-Robson chart

Exclusion criteria

- Emmetropes
- Astigmatism (> ± 1.25D)
- Any major systemic and ocular pathological condition.
- Any ocular surgeries and current medications.
- Any dry eyes subjects.
- Contact lens users.
- Any binocular vision anomalies.
- Amblyopia.

Statistical analysis

Data was performed using SPSS (Statistical Package for Social Sciences) version 20.0. Sample size was calculated using G* power app assuming an alpha error of 5% and 95% of statistical power. (Friedman test was used to compare CS with three different modes of correction (p < 0.05) considered as significant.

Results

36 eyes of 22 participants were included in the study out of which 5 were males and 17 were females.

The mean age was 21.8 ± 1.8 years.

The mean spherical power was -1.12 and cylindrical power was -0.45 and spherical equivalent was -1.34.

		Mean	SD	Friedman test
Contrast Sensitivity (Pelli-Robson Chart)	Best Corrected spherical equivalent lens in trial frame	1.70	0.16	0.261
	SCL	1.72	0.16	
	RGP	1.66	0.16	

Table 1: Shows the comparison between best-corrected spherical equivalent lenses in trial frame, SCL, RGP using Pelli-Robson Chart. This shows the contrast was better with soft when compared with spherical equivalent lens in trial frame and RGP. Mean CS with soft CL is 1.72 ± 0.16.

Mean CS with trial frame is 1.70 ± 0.16

Mean CS with RGP is 1.66 ± 0.16.

		Mean	SD	Friedman Test
Contrast Sensitivity by Mobile Application	Best Corrected spherical equivalent lens in trial frame	0.64	0.12	>0.10
	SCL	0.65	0.14	
	RGP	0.57	0.14	

Table 2: Shows the comparison between best-corrected spherical equivalent lenses in trial frame, SCL, RGP using mobile application. This shows the contrast was better with soft contact lenses when compared with spherical equivalent lens in trial frame and RGP.

Mean CS with SCL is 0.65 ± 0.14.

Mean CS with best Corrected spherical equivalent lens in trial frame 0.64 ± 0.12 Mean CS with RGP is 0.57 ± 0.14.

			Mean	Std. Deviation	Wilcoxon test, P value
Pelli Robson Chart	Best Corrected spherical equivalent lens in trial frame	Dominant	1.67	0.15	0.527
		Non-Dominant	1.69	0.13	
	RGP	Dominant	1.71	0.11	0.942
		Non-Dominant	1.69	0.17	
	SCL	Dominant	1.62	0.19	0.546
		Non-Dominant	1.65	0.12	
Mobile Application	Best Corrected spherical equivalent lens in trial frame	Dominant	0.64	0.11	0.581
		Non-Dominant	0.63	0.10	
	RGP	Dominant	0.59	0.14	0.786
		Non-Dominant	0.60	0.11	
	SCL	Dominant	0.62	0.06	0.516
		Non-Dominant	0.64	0.13	

Table 3: Shows the comparison between dominant eye and non-dominant eye. No significance was found between dominant and non-dominant eyes in the patient whom we have included two eyes for the study.

When compared between three modes of correction, SCL was found better than spherical equivalent spectacle lens and RGP in both Pelli Robson chart and mobile application but was not statistically significant ($P > 0.05$) There was statistically difference between Pelli-Robson chart and mobile application ($P < 0.05$).

When compared between three modes of correction, SCL was found better than RGP and spherical equivalent spectacle lens in both Pelli Robson chart and mobile application but was not statistically significant ($P > 0.05$).

Discussion

The main aim of this study was to analyze which mode of correction will give the best contrast (BCVA spherical equivalent in trial frame, SCL,RGP) for those who cannot accept toric SCL prescription between (18-35 years) age. Contrast sensitivity can also affect the visual function.

First, the BCVA was noted that the SE of BCVA has taken for all the mode of correction (spherical equivalent in trial frame, SCL and RGP).In our study we found that when compared between three modes of correction, SCL was found better than RGP and spherical equivalent spectacle lens in both Pelli Robson chart and mobile application but was not statistically significant.

Lee, min-ah, Kim, hyun jung, Kim-jai min in 2009 proved that at photopic condition, best corrected spectacle wearers had the highest monocular contrast sensitivity at all spatial frequency. However, all of them were in normal contrast sensitivity value at photopic condition. At mesopic condition with glare, toric soft lenses were the highest. It was observed that spherical soft contact lens wearers demonstrated lower range than normal contrast sensitivity value at mesopic condition with glare [1]. In our study, we corrected subjects with best corrected spherical equivalent lens in trial frame, SCL and RGP, the result showed that contrast sensitivity was increased in SCL when compared with SE lens in trial frame, RGP.

Alec Kingsnorth, Tom Drew¹, Bikramjit Grewal, James S Wolffsohn conducted a study on mobile app Aston contrast sensitivity test. Subjects wearing their full refractive correction underwent contrast sensitivity testing on the new near application (near app), distance app, CSV-1000 and Pelli-Robson charts with full correction. They concluded that the mobile apps (near more than distance, $p = 0.005$) recorded a higher contrast sensitivity than printed tests ($p < 0.001$); however, all charts showed a reduction in measured contrast sensitivity with degradation ($p < 0.001$) and a similar decrease with increasing spatial frequency (interaction > 0.05) [3]. The result from our study also shows that the contrast sensitivity was better while comparing PelliRobson chart and mobile application (Smart Optometry).

Kishor Sapkota, Sandra Franco, Madalena Lira conducted a study on contrast sensitivity function with soft contact lens wear and spectacles wear. Forty-seven myopic subjects with no history of contact lens (CL) wear were included. Subjects were fitted with daily disposable lens in one eye and monthly disposable lenses in other eye and wore the same type of CL for three months. CSF was measured again on the same day and after three months wearing CLs. They concluded that CSF was higher with CLs in comparison to the values with spectacles and CSF values with CL are similar between baseline and after 3 months of lens wear [4] whereas in our study, it shows that the soft contact lens gives better contrast in comparison to best corrected SE lens in trial frame and RGP [2,5-7].

Conclusion

Soft contact lens was found better option when compared with RGP and BCVA trial lens as alternative to toric prescription in myopes with low astigmatism, although difference was not statically significant.

Futuroscope

- We can do with more sample size.
- Different Contrast Sensitivity chart can be used.
- Different light conditions.

Bibliography

1. Dabkowski J., et al. "Soft toric versus spherical contact lenses in myopes with low astigmatism". *International Contact Lens Clinic* 19.11-12 (1992): 252-256.

2. Lee Min-Ah., et al. "Contrast Sensitivity and Glare with Spherical and Toric Soft Contact Lenses in Low-astigmatic Eyes". *Journal of Korean Ophthalmic Optics Society* 14.1 (2009): 39-45.
3. Kingsnorth A., et al. "Mobile app Aston contrast sensitivity test". *Clinical and Experimental Optometry* 99.4 (2016): 350-355.
4. Sapkota K., et al. "Contrast sensitivity function with soft contact lens wear". *Journal of Optometry* 13.2 (2012): 96-101.
5. Grey C. "Changes in Contrast Sensitivity during the First Hour of Soft Lens Wear". *Optometry and Vision Science* 63.9 (1986): 702-707.
6. Bernstein I and Brodrick J. "Contrast Sensitivities Through Spectacles and Soft Contact Lenses". *Optometry and Vision Science* 58.4 (1981): 309-313.
7. Kanonidou E., et al. "A comparative study of visual function of young myopic adults wearing contact lenses vs. spectacles". *Contact Lens and Anterior Eye* 35.5 (2012): 196-198.