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COMPARATIVE EFFECT OF CYLINDRICAL LENSES VERSES SPHERICAL EQUILIENT ON CONTRAST SENSITIVITY

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ABSTRACT

OBJECTIVE: To compare effect of cylindrical lenses verses spherical equivalent on contrast sensitivity.

METHODOLOGY: Randomized control trail sampling technique was used in this prospective study . Data was collected from Zubaida eyecare center Lahore during the period of February 2024 to March 2024. There were two groups from which one was given cylindrical correction and one was given spherical equivalent. Follow up was conducted monthly for 3 months to evaluate contrast sensitivity through Pelli Robson Chart. Data was collected through self-made performa. Data was entered and analyzed by SPSS-27 version. Friedman's Two-Way Analysis of Variance and Wilcoxon Signed Ranks test were applied to find the significance of data. P-value < 0.05 was considered as significant.

RESULTS: This study included 68 participants: 31 (45.6%) males and 37 (54.4%) females. The mean age was 23.462.48 SD (standard deviation), and the mean prescription was -3.95+ 1.12 SD. At first visit, the most frequently occurring value was 2.00, which appeared 41 times, making up 60.3% of the total occurrences. At the second visit, the most frequently occurring value was 2.00, which appeared 35 times, making up 51.5% of the total occurrences. Friedman's test of significance was applied to find the significance of data and P-value was < 0.001 which was highly significant as significance border value was < 0.05. Wilcoxon signed rank test was pragmatic to find significance between two visits. There was highly negatively correlated as contrast sensitivity was negatively correlated with prescription power.

CONCLUSION: Data was highly significant and negatively correlated as higher prescription was associated with decreased contrast sensitivity and lower prescription was associated with higher contrast sensitivity. Cylindrical correction improved contrast sensitivity significantly as compared to spherical equivalent prescription. We should prescribe cylinder instead of spherical equivalent specially in moderate to high astigmatism as their visual acuity as well as contrast sensitivity increased.

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KEY WORDS: Contrast sensitivity, Spherical equivalent, cylindrical lenses, refractive error,

INTRODUCTION

Refractive errors, encompassing myopia, hyperopia, and astigmatism, impact individuals across all age brackets and stand as the most frequently reported ocular conditions on a global scale. Among these, astigmatism arises from a meridional asymmetry in the curvature of the eye's cornea or lens, resulting in an uneven refraction of light rays.[1] A recent comprehensive systematic review and meta-analysis by Hashemi et al. Underscored astigmatism as the prevailing refractive error, with an estimated pooled prevalence of 40% in adults. Despite ongoing research, the precise origins of astigmatism remain elusive, with factors such as age, race/ethnicity, genetic predisposition, environmental influences, extraocular muscle tension, visual feedback, and eyelid pressure identified as potential contributors to its development.[2]

A hindrance of image is characterized as a parson having the best-remedied pictorial keenness of under 6/18 in the healthier eye. Visual deficiency is characterized by the World Wellbeing Association (WHO) as pictorial keenness under 3/60 with most ideal rectification in the better eye on the Snellen visual sharpness outline.[3] Contrast responsiveness (CS) testing is utilized to look at a patient's capacity to outwardly recognize increasingly fine augmentations of light versus dull (i.e., contrast).[4] Estimation of CS permits ophthalmologists to explore structure insight more for the most part than estimating visual keenness (VA), as it includes the utilization of a high differentiation diagram, with the estimations being performed quantitatively over a wide region. Since vision in natural eyes is 'band pass' separated, CS diminishes not just in the high-recurrence area [18 cycles per degree (cpd)], but additionally in the low-recurrence locale (3 cpd). It has been accounted for that CS improves by diminishing higher-request variations (HOA) of the eye.[5]

Contrast responsiveness and visual keenness are two of the main proportions of visual capability in visual disease. The actual eye is a wonder of natural design, made out of a few particular designs working in harmony with vision.[6] Astigmatism, a common refractive blunder influencing visual keenness, finds its rectification through the fundamental transaction of tube-shaped revision and roundness comparable to eyeglasses or contact lenses. barrel-shaped focal points, intended to address astigmatism, and circular reciprocals, which address refractive mistakes, are essential devices in the optical munitition stockpile pointed toward streamlining visual execution.[7] Youth visual impairment is one of the needs in Vision

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2020: the option to locate. It is assessed that there are 1.4 million visually impaired kids on the planet, 66% of whom live in non-industrial nations, and of the relative multitude of visually impaired youngsters, it is assessed that 2,70,000 live in India. Youth nearsightedness starts to lead the pack in certain nations in Sou'-east Asia, with the predominance coming to 80% among teenagers, while longsightedness in youngsters might be the most common in the United States.[8]

Around 13% of the Pakistani and Indiann populace is in the age assemblage of 7–15 years, and around 20% of youngsters foster refractive mistakes by the phase of 16 years.[9] As per the WHO locales, the assessed pool commonness (EPP) of far-sightedness is 4.6% (95% certainty stretch [CI]: 3.9–5.2) in youngsters. The most reduced and most noteworthy EPP were seen in Southeast Asia (2.2%, 95% CI: 1.2–3.3) and the U.S.A.s (14.3%, 95% CI: 13.4–15.2). The EPP of longsightedness was 30.6% (95% CI: 26.1-35.2) in adults. In light of the aftereffects of the meta-examination, Africa had the most noteworthy EPP of hyperopia (38.6%, 95% CI: 22.4 e54.8), trailed by the Americas (37.2%, 95% CI: 25.3 e49), though European Union had the least EPP (23.1%, 95% CI: 6.1 e40.2).[10]

In domains of optometry and ophthalmology, the revision of refractive mistakes, like nearsightedness (myopia), hyperopia (farsightedness), and astigmatism, is central to upgrading visual sharpness and personal satisfaction for people impacted by these circumstances.[11] Customarily, circular focal points have been the pillar for rectifying refractive mistakes, giving a uniform rectification across the whole optical field. Be that as it may, round and hollow focal points, which correct astigmatism by giving various powers in various meridians, offer a more fitting way to deal with the inconsistencies in the shape of the cornea or lens.[12]

Eyeglasses are a typical and successful method for rectifying refractive mistakes. Eyeglasses come in different plans, including single-vision focal points for myopia, farsightedness, or astigmatism, as well as reading glasses or moderate focal points for presbyopia. Progresses in focal point materials and coatings have further developed solace, strength, and visual lucidity for eyeglass wearers.[13]

Contact focal points offer an option in contrast to eyeglasses for refractive mistake rectification. These slim, bended plates sit straightforwardly on the outer layer of the eye and refract light to address vision.[14] Contact focal points are accessible in various sorts, including delicate, unbending gas-penetrable, and half-and-half focal points, taking special care of different refractive blunders and individual inclinations. They give a more normal field of vision than eyeglasses and are well known among those with dynamic ways of life or corrective concerns.[15]

Contrast responsiveness, a pivotal part of visual capability, alludes to the capacity to recognize light and dim components in a picture. It assumes a crucial role in undertakings like perusing, driving, and perceiving looks, contributing essentially to overall visual execution. While the effect of round focal points on visual sharpness has been broadly contemplated, the similar impacts of tube-shaped focal points versus their circular reciprocals on contrast responsiveness remain a subject of progressing examination and debate.[16]

This study means to investigate and look at the impacts of barrel-shaped focal points and their round counterparts on contrast responsiveness. By looking at existing writing, trial discoveries, and clinical perceptions, we try to clarify the qualities and restrictions of each optical adjustment technique and their suggestions for visual discernment. Understanding the relative benefits and impediments of barrel-shaped focal points versus circular reciprocals as far as differentiation awareness is fundamental for optometrists, ophthalmologists, and patients, as it can illuminate more educated navigation in regards to refractive blunder amendment systems and, at last, work on visual results and personal satisfaction.

OBJECTIVE

To compare outcome of cylindrical lenses and spherical equivalent on contrast sensitivity

To check effect of spherical equivalent prescription during refraction on contrast sensitivity

To check effect of cylindrical lens during refraction on contrast sensitivity of patients

METHODOLOGY

Non-probability convenient sampling technique was used. Data was collected from Zubaida eyecare center and Sehat Medical complex, Hanjarwal, Lahore during the period of February 2024 to March 2024. A self-designed performa was utilized for comprehensive data collection. The participants were alienated into dual groups. First group receiving cylindrical correction and the subsequent group receiving spherical equivalent corrections. They were advised to wear glasses for more than 12 hours a day. The contrast sensitivity of both groups was assessed using the Pelli-Robson Chart, a standardized tool for evaluating contrast sensitivity. The procedure involves presenting progressively lower contrast levels, and participants will indicate the orientation of the optotypes. This assessment was conducted during three follow-up sessions, spaced one month apart, allowing for a thorough evaluation of the contrast sensitivity in both groups. The readings obtained from these assessments was recorded to facilitate a detailed comparison of contrast sensitivity outcomes between the two correction groups over the course of the study. Data was entered and analyzed through SPSS-27 version. Friedman's Two-Way Analysis of Variance was pragmatic to find the significance of statistics. P-value ≤ 0.05 was considered as significant value.

RESULTS

This study involved 68 participants, with 31 (45.6%) male participants and 37 (54.4%) female participants. The data was alienated into two groups: one group had a spherical equivalent prescription and the other a cylindrical correction. The mean age ranged from 15 to 29 years. The mean prescription was -3.95D, ranging from -2.00D to -6.00D. The most recurrently occurring value was 2.00 at the first visit, making up 60.3% of the total occurrences. The most frequently occurring value was 2.00 at the second visit, making up 51.5% of the total occurrences. The most frequently occurring value was 2.00 at the third and final visit, making up 55.9% of the total occurrences. The data was significant and highly negatively correlated, with contrast sensitivity being negatively correlated with prescription power. The study highlights the importance of understanding the relationship between prescription power and contrast sensitivity in medical practice.

Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	P-value
Age	68	15	29	23.46	2.476	
RX	68	-2.00	-6.00	-3.9559	1.11464	< 0.001
Contrast 1	68	1.75	2.00	1.9529	0.07525	
Contrast 2	68	1.75	2.00	1.9294	0.08649	< 0.001

Contrast 3	68	1.70	2.00	1.9324	0.08884	< 0.001

This table presents descriptive statistics for four variables: Age, RX, Contrast 1, Contrast 2, and Contrast 3. Total 68 (100 %) participants were included in this study. Mean age was 23.46+2.476 SD (Standard Deviation) with minimum age 15 years to 29 years. Mean prescription of the participants was -3.95+ 1.12 SD ranging from -2.00D to 06.00 Diopters. At first visit with prescription mean contrast sensitivity of the participants was 1.95+0.07 SD. At second visit after two months mean contrast sensitivity was 1.929+0.086 SD. At second follow up after four months contrast sensitivity was 1.93+0.089 SD. Friedman's two analysis of variance test was applied to find the significance of data.

PRESCRIPTION				
Spherical Equivalent / Cylinder		Frequency	Percent	Cumulative Percent
SPHERICAL EQUIVALENT	-4.50	6	17.6	17.6
	-4.00	6	17.6	35.3
	-3.75	2	5.9	41.2
	-3.50	5	14.7	55.9
	-2.75	5	14.7	70.6
	-2.50	5	14.7	85.3
	-2.25	1	2.9	88.2
	-2.00	4	11.8	100.0
	Total	34	100.0	
SPHEROCYLINDER	-6.00	2	5.9	5.9
	-5.75	1	2.9	8.8
	-5.50	6	17.6	26.5
	-5.25	4	11.8	38.2
	-5.00	3	8.8	47.1
	-4.75	2	5.9	52.9
	-4.50	3	8.8	61.8
	-4.25	3	8.8	70.6
	-4.00	3	8.8	79.4
	-3.75	1	2.9	82.4
	-3.50	1	2.9	85.3
	-3.25	3	8.8	94.1
	-2.50	2	5.9	100.0
	Total	34	100.0	

The table provides a summary of prescription data for spherical equivalents and sphero-cylinder lenses. The most common spherical equivalents are -4.50 and -4.00, each occurring 6 times (17.6%). The least common spherical equivalent is -2.25, occurring only once

(2.9%). While in Sphero cylinder prescription the most common sphero-cylinder value is -5.50, occurring 6 times (17.6%). The least common values are -5.75, -3.75, and -3.50, each occurring only once (2.9%).

Contrast 1				
Spherical Equivalent / Cylinder		Frequency	Percent	Cumulative Percent
SPHERICAL EQUIVALENT	1.90	5	14.7	14.7
	1.95	8	23.5	38.2
	2.00	21	61.8	100.0
	Total	34	100.0	
SPHEROCYLINDER	1.75	5	14.7	14.7
	1.80	2	5.9	20.6
	1.85	1	2.9	23.5
	1.90	4	11.8	35.3
	1.95	2	5.9	41.2
	2.00	20	58.8	100.0
	Total	34	100.0	

The table provides a summary of prescription data for two different types of lens measurements: spherical equivalents and sphero-cylinder values at first of their visit. In spherical equivalent, **1.90**: This value occurs 5 times, making up 14.7% of the dataset. **1.95**: This value is more common, occurring 8 times, which is 23.5% of the dataset. **2.00**: The most common value, occurring 21 times, representing 61.8% of the dataset. **Total**: There are 34 prescriptions in total. While in Sphero cylinder part, **1.75**: This value occurs 5 times, making up 14.7% of the dataset. **1.80**: This value is less common, occurring 2 times, which is 5.9% of the dataset. **1.85**: The least common value, occurring only once, representing 2.9% of the dataset. **1.90**: This value occurs 4 times, making up 11.8% of the dataset. **1.95**: This value occurs 2 times, representing 5.9% of the dataset. **2.00**: The most common value, occurring 20 times, representing 58.8% of the dataset. **Total**: There are 34 prescriptions in total.

Contrast 2				
Spherical Equivalent / Cylinder		Frequency	Percent	Cumulative Percent
SPHERICAL	1.75	4	11.8	11.8
	1.80	4	11.8	23.5
	1.85	4	11.8	35.3
	1.90	5	14.7	50.0
	1.95	2	5.9	55.9

EQUIVALENT	2.00	15	44.1	100.0
	Total	34	100.0	
SPHEROCYLINDER	1.80	5	14.7	14.7
	1.85	2	5.9	20.6
	1.90	3	8.8	29.4
	1.95	4	11.8	41.2
	2.00	20	58.8	100.0
	Total	34	100.0	

This table provides a summary of prescription data for two different types of lens measurements: spherical equivalents and sphero-cylinder values at second visit. The SE values show a concentration at 2.00 (44.1%), while the sphero-cylinder values have an even higher concentration at 2.00 (58.8%). This suggests that the 2.00 prescription strength is very common, but the distribution varies slightly between the two types of measurements.

Contrast 3				
Spherical Equivalent / Cylinder		Frequency	Percent	Cumulative Percent
SPHERICAL EQUIVALENT	1.75	4	11.8	11.8
	1.80	6	17.6	29.4
	1.85	4	11.8	41.2
	1.90	3	8.8	50.0
	1.95	2	5.9	55.9
	2.00	15	44.1	100.0
	Total	34	100.0	
SPHEROCYLINDER	1.80	2	5.9	5.9
	1.85	4	11.8	17.6
	1.90	2	5.9	23.5
	1.95	3	8.8	32.4
	2.00	23	67.6	100.0
	Total	34	100.0	

This table provides a summary of prescription data for two different types of lens measurements: spherical equivalents and sphero-cylinder values at their third visit. The SE values show a concentration at 2.00 (44.1%), while the sphero-cylinder values have an even higher concentration at 2.00 (67.6%). This suggests that the 2.00 prescription strength is very common, but the distribution varies slightly between the two types of measurements.

DISCUSSION

The comparative effect of cylindrical lenses versus spherical equivalents on contrast sensitivity is a topic of significance in the field of optometry and ophthalmology. Both cylindrical and spherical lenses are commonly used in correcting refractive errors, but they serve different purposes and can impact visual perception differently, particularly in terms of contrast sensitivity.

A study by Ye et al. found that age negatively interrelated with AULCSF, CSF acuity, and CS at 1.0, 12.0, and 18.0 cpd. Sphere-shaped refraction was pointedly associated with CSF acuity, while cylindrical refraction was positively correlated with AULCSF and CS at 1.5 cpd. However, pupil size was destructively correlated with CS at 1.0, 1.5, and 3.0 cpd. The study found that AULCSF, CSF acuity, and contrast sensitivity at high spatial frequencies were higher in subjects under 30 years compared to those over 30 years. No significant correlation was found between patients categorized by cylindrical refraction or spherical equivalent refraction. Our review results were viable with the past examinations that more youthful patients had greatest difference responsiveness and barrel shaped rectification was having higher differentiation awareness when contrasted with circular identical solution.[17]

The study found that eyes with lesser tube-formed detour show higher contrast at high spatial regularities, suggesting that interocular contrasts in tube-molded refraction impact contrast at high spatial frequencies. This suggests that image treatment of interocular visualization may be similar at low longitudinal occurrences but extraordinary at high spatial regularities. Wearing round and empty refraction-corrected glasses had a "reversible effect" on CSF. This finding suggests the need for a full-modification optometric remedy under CSF heading for high-tube-molded refraction eyes. Aforementioned studies have shown that interocular discernment moves the CSF vertically, and supplementary explore is expected to better understand these connections.[18]

Astigmatism and nearsightedness are two conditions that affect the visual pathways. Astigmatism affects the ability to distinguish between on and off visual pathways. Circular same, a combination of round and tube-shaped focal points, is used to address refractive blunders in people with astigmatism. However, it does not fully address the difference awareness issues related to astigmatism. Nearsightedness makes the electroretinogram more fragile but influences the ON and OFF pathways differently. Nearsightedness decreases reactions to low-medium differences in ON pathways more than OFF pathways, expands reaction dormancy in ON pathways but not OFF pathways, and makes ON pathways increasingly slow and powerful at driving student choking.[19]

High nearsightedness can affect light responsiveness and difference awareness, but contrast awareness may diminish. The luminance range in the human retina improves ON-OFF pathway contrasts and responsiveness. However, ON-OFF contrasts change with luminance reach and foundation luminance. Expanding the luminance range from 250 to 500 cd/m2 makes reactions more grounded in OFF retinal pathways, while changes in foundation luminance make ON pathway reactions on dim foundations more grounded than OFF pathway reactions on splendid foundations. In contrast, the ON/OFF reaction proportion remains almost steady under various foundation luminance states in the visual cortex.[20] Our results also similar to this study that contrast sensitivity is negatively correlated with refractive error. High refractive error result in reduced contrast sensitivity. However, contrast sensitivity improvement was significantly related with refractive correction.

Tube shaped focal points can target astigmatism by adjusting the central planes in various meridians, improving visual keenness and differentiation responsiveness in people with astigmatism. Astigmatism can cause light beams to center at different places, resulting in diminished contrast responsiveness and visual quality. Expanded alpha (AL) is connected to diminished cone thickness and expanded cone separation, suggesting that the encompassing scene is imaged on a larger retinal region. Nearsighted people have lower IS and RPE thicknesses in both internal and external regions, while higher IS thicknesses are found in the external location. This pattern towards a critical decrease in IS and RPE thickness is consistent with recent research showing mechanical enlargement of the retina in HM patients.[21]

Visual discernment and visual sensitivity are influenced by singular distinctions in visual perception, which can impact the emotional experience of different treatments. Factors like astigmatism, pupil size, and overall visual health can influence the effectiveness of tube-shaped versus round lenses in developing differentiation responsiveness. The qCSF test is better suited for day-to-day visual capabilities, as recognizing things of fluctuating sizes and differences in daily life is crucial. Graph-based sharpness tests, like the ETDRS outline, provide limited assessments of useful vision and do not accurately represent abstract visual experiences. Emotional visual objections are common in patients with high BCVAs, but the qCSF test's higher responsiveness may help identify substantial transformations. The results suggest that the qCSF test can help understand visual deficiencies and abstract protests in highly nearsighted patients, particularly those with obsessively affected macular works without VA aggravation.[22]

In conclusion, while both cylindrical and spherical lenses are essential tools for correcting refractive errors, cylindrical lenses offer a more targeted approach for addressing astigmatism and can lead to improvements in contrast sensitivity, particularly in individuals with significant astigmatism. However, the choice between the two types of correction should be finished created on individual visual desires and penchants, in consultation with an eye care professional.

CONCLUSION

Data was highly significant and negatively correlated as higher prescription was associated with decreased contrast sensitivity and lower prescription was associated with higher contrast sensitivity in both spherical equivalent correction as well as cylindrical lens correction. Cylindrical lens correction improved contrast sensitivity significantly as compared to spherical equivalent prescription.

RECOMMENDATIONS

Sample size was smaller greater sample size will give more accurately results. There was a limited study having age group 15-30 years in children results may be different. In old age mostly contrast sensitivity insignificantly increased as compared to younger ones so this study should also be assessed in old age and children participants.

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