

# COMPARISON OF CONTRAST SENSITIVITY IN LOW AND HIGH HYPERMETROPE

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## ABSTRACT

**OBJECTIVE:** To compare the level of contrast between low and high hypermetropes.

**METHOD:** Informed consent was taken from each patient after a verbal and written explanation of the nature and consequences of the study. A performa was filled at the time of the examination with fully detailed ocular history. Fifty four hyperopic patients were examined in 2021. It was descriptive cross sectional study. Visual acuity was checked on standard log MAR chart. The type and amount of refractive error was checked by Retinoscope objectively and subjectively by using trial lenses and trial frame. Fundus was also examined by Ophthalmoscope. Contrast sensitivity was measured by Pelli Robson chart. Firstly without spectacles monocularly, then with spectacles monocularly and then binocularly. Patients were called for examination in Mayo Hospital refraction room.

**RESULTS:** Low hyperopic patients have better contrast than high hyperopic patients. Out of 54 participants of hypermetropia 22(40.7%) have low contrast value binocularly and 32(59.3%) have normal contrast sensitivity. Out of 54 subjects, 20 were high hypermetropes and 34 were low hypermetropes. In high hypermetropes, 5 participants had normal contrast sensitivity, and 15 had low contrast sensitivity. In low hypermetropes 27 had normal contrast sensitivity and 7 have low contrast sensitivity. The results are statistically significant using Mann Whitney test ( $p < 0.01$ ).

**CONCLUSION:** Low hypermetropes had significantly higher contrast sensitivity as compared to high hyperopes.

**KEY WORDS:** Low hypermetropes, High hypermetropes, Contrast sensitivity.

## INTRODUCTION

Contrast sensitivity is one of the main requisite for good quality vision and better ocular performance. It is the ability of the eye to recognize detail of a given target against its background according to the variations of luminance. Visual acuity alone is not enough to recognize visual function, contrast sensitivity, color vision and visual field can help to recognize fine details of the eye.<sup>1</sup> In some cases such as refractive error or pathological cases the contrast sensitivity is affected. The person with hypermetropia have reduced visual acuity which is a sign of refractive error or some pathology.<sup>2</sup>

Hypermetropes upto 2D although have reduced visual acuity but have normal contrast. But in high

hypermetropes of 5D or greater then 5D along with reduced visual acuity have reduced contrast sensitivity more commonly then low Hypermetropes.<sup>3</sup> The prevalence of hypermetropia is (2.73%).<sup>4</sup> In Pakistan mild to moderate hyperopia ranges from 3.9%-5.2%. In children its prevalence is 4.2%.<sup>5</sup> The hyperopia ranged from 23.1% in Europe, 38.6% in Africa and 37.2% in the Americas.<sup>6</sup>

Pelli Robson chart was being used for the evaluation of contrast sensitivity. The Pelli-Robson test obtained 0.05 logCS for each well-readable letter after reading the first triplet (unit of 3 letter). So one triplet equal to 0.15 logCS. Usually it is done at 1meter distance with monocularly, binocularly.<sup>7</sup> Using a near distance, or

measuring CS, can show missed vision skills when visually impaired patients are evaluated using PR at 1 meter.<sup>8</sup>

Contrast sensitivity was used to check the outcome of refractive correction and refractive surgery which provide quality of vision.<sup>9</sup> Contrast sensitivity was checked with and without correction, monocularly and binocularly in patient with refractive error, contrast sensitivity was significantly less in patients which were without BCVA.<sup>10</sup> Along with refractive error glare and photophobia also affect contrast sensitivity.<sup>11</sup>

Contrast sensitivity was strongly associated with quality of life, and it is important to measure it accurately. Using a close range, or measuring CS, can show missed visual acuity when patients with hypermetropia were evaluated using PR at 1 meter.<sup>12</sup> Contrast sensitivity is the measure of the amount of light or darkness something they have in relation to their background. Generally, it is defined as Contrast Sensitivity (CS), which is actually the reciprocal of the contrast threshold limit.<sup>13</sup>

Contrast sensitivity was the visual analyzer for the visual system.<sup>14</sup> In old age the induced hypermetropia can be treated with bifocals and trifocals as there is a need to wear reading correction along with distant correction.<sup>15</sup> Contrast sensitivity was considered for driving, walking, flying airplane and for recognizing faces of objects.<sup>16</sup> In induced hyperopia due to surgical outcome experience more variant contrast as compared to normal hyperopic patient.<sup>17</sup> A major limitation in human perception is refractive error which change the capacity of the eye to do routine functions.<sup>17</sup>

Change in contrast sensitivity symptoms become more prominent if person have some kind of pathology like glaucoma, diabetes mellitus and macular problem.<sup>18</sup> Similarly person with sub cortical cataract come with the complain of glare and photophobia in sunny day it can also be associated with contrast sensitivity reduction along the reduction of visual acuity.<sup>19</sup> There were many factors that affect the contrast in reduction of contrast due to refractive error like pupil size, photopic and mesopic condition. If the conditions were fulfilled with BCVA, there were more chances that person have normal range of contrast sensitivity with Pelli robson chart, but in high order aberration it will not have significant improvement even with BCVA like in congenital hyperopia.<sup>20</sup>

Decrease contrast sensitivity analysis and different visual acuity may be considered symptoms of visual impairment in patients with hypermetropia.<sup>21</sup> A recent study shown that CS was measured using a Pelli-Robson chart with optional selection processes, and the total number of characters read was recorded per eye. CS impairment was defined at <60 years as logCS 1.80 (36 characters or less) and at ≥60 age as log65 1.65 (33 characters or less). In a research Participants were provided themselves with a questionnaire to assess the presence of ocular symptoms and to perform neurological and battery-based neuro-cognitive tests.<sup>22</sup> Contrast sensitivity is significantly effected in hypermetropes which impact the activities of daily life.<sup>23</sup>

## MATERIAL AND METHOD

A performa based comparative cross-sectional study was carried out in OPD of Mayo Hospital Lahore. The sample size was 54, about 20 were high hypermetropes and 34 were low hypermetropes. The demographic details were also noted which included name, gender, age and occupation. The performa consists of many tests including visual acuity assessment of both eye, degree of refractive error measurement objectively by retinoscope subjectively by subjective refraction in both eye and contrast sensitivity measured monocularly and binocularly, with and without spectacles. Only those participants were selected who fulfilled the inclusion and exclusion criteria in this study. For data analysis we used (SPSS version 25). Shapiro-wilk test was used to check the normality of data ( $p < 0.01$ ), it showed that the data is not normally distributed therefore, we used Mann Whitney test (non-parametric test). Independent variable such as age, gender, occupation and dependent variable such as hypermetropia (low or high) were kept in mind. Qualitative variable were presented as frequency and percentage. The research protocol was approved by the Ethical Review Board of College of Ophthalmology and Allied Vision Sciences.

## RESULTS

54 participants were selected for study in which 34(68.5%) were low hypermetropes and 20(37.0%) were high hypermetropes. In right eye, 34 were low Hypermetropes. Out of them, 7 participants have low contrast, 27 participants have normal contrast. In right eye 20(37.0%) were high hypermetropes. Out of them, 15(27.7%) have low contrast, 5(9.25%) have normal

contrast on PR (Table 1). In left eye, 40(74.0%) were low Hypermetropes out of which 12(22.2%) subjects have low contrast and 28(51.8%) participants have normal contrast and 11(20.37%) participants were high hypermetropes. Out of them, 8(14.8%) have low contrast and 3(5.5%) have normal contrast on PR. Contrast sensitivity was more effected in high hypermetropes as compared to high Hypermetropes. 32(59.2%) out of 54 participants have normal range of binocular contrast that indicates contrast sensitivity is better in binocular condition as compared to monocularly. 22(40.7%) out of 54 participants have low contrast binocularly and 32(59.3%) have normal contrast value binocularly. Contrast sensitivity was better with spectacle as compared to without spectacle as  $p < 0.01$ .

**Table-1:** Contrast Sensitivity score

Hypermetropes	N	Mean	Standard deviation	p-value
High	20	1.2900	0.21435	<0.01
Low	34	1.5794	0.21607	

Out of 54 subjects 20 were high hypermetropes and 34 were low hypermetropes. Mean contrast sensitivity of high hypermetropes was 1.2900 while that of low hypermetropes was 1.5794. The results are statistically highly significant according to Mann Whitney test ( $p < 0.01$ ).

## DISCUSSION

Male and female of all age group are included in this study. About 30(55.6%) female and 24(22.44%) were included. 10(18.5%) patients were students, 5(9.3%) labour, 2(3.7%) sweeper, 2(3.7%) guard and other are limited in number. A similar study was conducted in 2014 in children up to 15 years of age in anisohypermetropic Amblyopia in which significant decrease in contrast was observed in children.<sup>24</sup>

Visual acuity was taken on logMAR chart monocularly and binocularly. In monocular visual acuity in right eye in right eye 10(18.51%) participants have visual acuity between 0.00-0.30. 18(33.33%) participants have visual acuity ranges 0.40-0.60 and 26(48.1%) participants have visual acuity ranges from 0.80-1.00. In left eye 11(20.37%) participants have visual acuity ranges from 0.20-0.30, 20(37.03%) participants have visual acuity ranges from 0.50-0.60 and 22(40.74%) participants

have 0.80-1.00 visual acuity in right eye. Visual acuity was taken on logMAR AT 4m.<sup>25</sup> Low hypermetropes have less affected visual functions in both eye as compared to high hypermetropes.<sup>26</sup>

BCVA with correction or pinhole visual acuity in right eye was better as compared to without spectacles or pinhole vision in patients with mature or hyper mature cataract. BCVA in right eye was indicated that 36(66.66%) participants have 0.00-0.30 visual acuity, 15(27.77%) participants have 0.50-0.60 visual acuity and 3(5.55%) participants have 0.80-1.00 visual acuity in right eye. BCVA in left eye indicated that 37(68.51%) participants have 0.00-0.30 visual acuity and 16(29.62%) participants have 0.50-0.60 visual acuity in left eye. Low hypermetropes have less affected visual functions in both eye as compared to high hypermetropes.<sup>26</sup> The person with hypermetropia have reduced visual acuity which is a sign of refractive error or some pathology.<sup>9</sup>

In right eye without spectacle out of 54 participants 12(22.22%) participants have contrast sensitivity ranges from 0.00-0.45 on PR. 14(25.92%) participants have contrast sensitivity ranges from 0.75-1.05, 12(22.2%) have contrast ranges from 1.20-1.35 and 16(29.62%) have contrast sensitivity ranges from 1.50-1.65 in right eye. In left eye, without spectacle, 12(22.2%) participants have contrast sensitivity ranges from 0.00-0.45 on PR. 14(25.92%) participants have contrast sensitivity ranges from 0.75-1.05, 12(22.2%) have contrast ranges from 1.20-1.35 and 16(29.62%) have contrast sensitivity ranges from 1.50-1.65 in right eye.

In right eye with spectacle 11(20.37%) participants have contrast ranges from 0.30-1.05, 16(29.62%) participants have contrast sensitivity ranges from 1.20-1.35 and 27(50%) participants have contrast sensitivity ranges from 1.50-1.95 in right eye. In left eye 3(5.55%) participants have contrast ranges from 0.00-0.90, 22(40.7%) have contrast ranges from 1.05-1.35 and 29(53.7%) participants have contrast 1.50-1.95 in left eye with spectacle.

It has been observed that contrast sensitivity with and without spectacle give significant results as the  $p = 0.00$  in both eye right and left eye respectively. In right eye out of 34 low hyperopic patients 27 participants have normal contrast 7 participants have low contrast value. In right eye out of 19 high hyperopic participants 14

have low contrast and 5 participants have normal contrast. In Mann Whitney test statistical analysis shows that the results were significant as  $p=0.00$ .

In left eye out of 40 low hyperopic participants 12 have low contrast value and 28 have normal. In left eye 11 participants were high Hypermetropes in which 8 participants have low contrast and 3 participants have normal contrast. In Mann Whitney test, statistical analysis the results were significant as  $p=0.00$ . A study was conducted in 2020 in presbyopes and elderly hypermetropes which shows that those who wear optical correction have better visual function as compared to those who do not use any optical aid for Hypermetropic refractive error.<sup>27</sup> According to Mann Whitney test 22(40.7%) out of 54 participants have low contrast binocularly and 32(59.3%) have normal contrast value binocularly.

### CONCLUSIONS

Hypermetropes show reduced contrast as compared to emmetropes. Mild or low hypermetropes have significant contrast with and without optical correction. High hypermetropes have reduced contrast sensitivity function without optical correction. The contrast function can be improved with optical correction. Low hypermetropes have better contrast than high hypermetropes. With optical correction contrast sensitivity function is better than without optical correction. Binocular contrast is better than monocular contrast.

### RECOMMENDATION

Optical correction and good luminance level improve the contrast sensitivity. Visual functions should be checked along with visual acuity. In routine Optometric practice contrast sensitivity should be measured in Hypermetropic patients, before and after optical correction, so that the quality of life can be improved along with image clarity. It was a small scale and has its own limitations. Further results should be elaborated on large scale for further results, to upgrade life with best measurement along with optical correction.

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