Section: Ophthalmology

Original Research Article

ASSESSMENT OF VISUAL ACUITY AND CONTRAST SENSITIVITY IN PRESBYOPIC PATIENTS AND THEIR COMPARISON WITH NORMAL SUBJECTS

Mani Kiran Kujur[1], Prabha Sonwani[2], Lubna Maroof[3]

[1]Assistant Professor, Department of Ophthalmology, Lt BRKM GMC Jagdalpur (C.G.), India.
[2]Assistant Professor, Department of Ophthalmology, CIMS Bilaspur (C.G.), India.
[3]Senior Resident, Department of Ophthalmology, United Institute of Medical Sciences, Prayagraj, Uttar Pradesh, India.

Received : *27/11/2023*
Received in revised form : *06/01/2024*
Accepted : *24/01/2024*

Keywords:
Visual acuity, Contract sensitivity, Presbyopic, Non Presbyopic.

Corresponding Author:
Dr. Lubna Maroof,
Email:manikirankujur@gmail.com

DOI: 10.47009/jamp.2024.6.1.174

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 885-889

Abstract

Background: Visual acuity (VA) and contrast sensitivity (CS) characterize different aspects of visual function. In everyday activities, the ability to resolve fine details, often measured by VA, is critical to pattern recognition, such as reading small print. Contrast sensitivity test measures your ability to distinguish between finer and finer increments of light versus dark. This is not like the conventional visual acuity tests performed during a standard eye exam, which gauge your ability to read ever-tinier letters on an eye chart. A crucial indicator of visual function is contrast sensitivity, which is particularly relevant in low-light, foggy, or glaring conditions where objects' backgrounds are often less contrasted. One activity that needs strong contrast sensitivity for safety is driving at night. **Material & Methods:** An observational, prospective, non-interventional cross-sectional study was carried out at the Institute of Ophthalmology, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh. There were 120 subjects in all for this investigation. The study was conducted at AMU, Aligarh, following ethical clearance from the Jawaharlal Nehru Medical College ethics committee. Performed the statistical analysis using SPSS version 20. We compared the quantity and percentage using the Chi-square test. Students compare the Means (SD) using the t-test. **Results:** Out of the 60 patients in the Presbyopic group, 37 (61.7%) were men and 23 (38.3%) were women. In contrast, 26 (43.3%) of the 60 patients in the non-presbyopic group were male, and 34 (56.7%) were female. The Mean (SD) age of the patients in the Presbyopic group was 58.08 (12.39) years whereas in the Non-presbyopic group was 29.12 (5.14) years. **Conclusion:** Patients in the Non-presbyopic group had a greater percentage of patients with cylindrical errors compared to the Presbyopic group ($P < 0.05$). The presbyopic group's contrast sensitivity was shown to be significantly higher than the non-presbyopic group's, both unilaterally and bilaterally ($P < 0.05$).

INTRODUCTION

Visual acuity is the traditional standard measurement of the visual function. It is defined as the "spatial resolving capacity" of the eye. It represents the state of entire ocular system, including the visual pathways.

There are many aspects of vision, including light sensitivity, target resolution and reorganization, contrast sensitivity, colour vision and motion detection.[1]

Visual acuity is measured by identifying the angle subtended at the eye by the smallest recognizable optotype. The ability of the eye to resolve fine detail is essentially a measure of macular function. Although minimum detectable resolution and minimum separable resolution can be tested, minimum recognizable resolution is commonly measured.[2] Minimum recognizable resolution is the measurement to facuity by using optotype symbols.[3] Optotypes are standardization symbols, usually letters, although it can be numbers or pictures. Identification of these symbols does not depend on literacy or language, with the result that it can be applied internationally.[4]

Contrast sensitivity is one of the spatial visual functions besides visual acuity. Contrast sensitivity is defined as the ability to differentiate between light and dark in a series of bands with no clear boundary.[5]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

As light levels decrease, visual performance worsens making everyday tasks difficult, especially in older peoples and those with retinal diseases.[6]

MATERIALS AND METHODS

Non-interventional, prospective, cross-sectional study was conducted at Jawaharlal Nehru Medical College's Institute of Ophthalmology, Aligarh Muslim University, Aligarh. Total number of subjects in this study was 120. After receiving ethical approval from the Jawaharlal Nehru Medical College's ethics committee at AMU, Aligarh, the study was carried out. Every patient provided written, informed consent. Every patient underwent an ophthalmoscopic and slit lamp examination before being tested for contrast sensitivity and visual acuity. The Pelli-Robson contrast sensitivity chart, which comes with an LED backlight with a display size of 18.5 inches, resolution of 1280 x 720 pixels, and luminance of 200 cd/m2, was used to conduct the contrast sensitivity test. The Pelli-Robson chart is made up of capital letters arranged horizontally. With every line, the contrast gets less. The range of the log contrast sensitivity is 0.00 to 1.69. The subject sits one meter in front of the chart while the recording is being made.

Inclusion Criteria

- Patients, both male and female, over 40 years of age, complaining of near vision problems.

Exclusion Criteria

- Patients with anomalies related to the cornea.
- Patients with anomalies related to the lens of the eye
- Patients with vision impairment resulting from reasons other than presbyopia.

Statistical Analysis

SPSS version 20 was used for the statistical analysis. Using the Chi-square test, the number and percentage were compared. Students use the t-test to compare the Means (SD). If the P value for the statistical difference in the data between the two groups is less than 0.05, the difference is deemed significant.

RESULTS

The Mean (SD) age of the patients in the Presbyopic group was 58.08 (12.39) years whereas in the Non-presbyopic group was 29.12 (5.14) years. [Table 1]

In the Presbyopic group out of 60 patients, 37 (61.7%) were males and 23 (38.3%) were females. Whereas in the Non-presbyopic group out of 60 patients, 26 (43.3%) were males and 34 (56.7%) were females. [Table 2]

Thirteen of 60 patients had UCVA of 6/6 in the Presbyopic group as compared to 41 of 60 patients in the Non-presbyopic group. Similarly, 19 of 60 patients had UCVA of 6/9 in the Presbyopic group compared to five of 60 in the Non-presbyopic group. [Table 3]

Seventeen of 60 patients in the Presbyopic group had visual acuity of 6/6 as compared to 43 of 60 patients in the Non-presbyopic group. Similarly, 21 of 60 patients in the Presbyopic group had visual acuity of 6/9 compared to four of 60 patients in the Non-presbyopic group. Thirteen of 60 patients had visual acuity of ≤ 6/18 in the Presbyopic group compared to 11 of 60 patients in the Non-presbyopic group. [Table 4]

Twenty-eight of 60 patients in the Presbyopic group had BCVA of6/6 as compared to all of the 60 patients in the Non-presbyopic group. Similarly, 31 of 60 patients in the Presbyopic group had BCVA of 6/9 and one of 60 patients had BCVA of 6/12. [Table 5]

Thirty-two of 60 patients in the Presbyopic group had BCVA of 6/6 as compared to all of 60 patients in the Non-presbyopic group. Similarly, 27 of 60 patients in the Presbyopic group had BCVA of 6/9 and one of60patientshad BCVAof6/12. [Table 6]

In the Presbyopic group, 34 of 60 patients and 39 of 60 patients had no spherical error for the right eye and left eye respectively. Seven of 60 patients (RE) and four of 60 patients (LE) had hyper metropics Spherical error, while 19 of 60 patients (RE) and 17 of 60 patients (LE) had myopic spherical error in the Presbyopic group. In the Non-presbyopic group five of 60 patients (RE) and six of 60 patients (LE) had hypermetropic spherical error, while 14 of 60 patients (RE) and 11 of 60 patients (LE) had myopic spherical error. [Table 7]

In the Presbyopic group 41 of 60 patients and 43 of 60 patients had no cylindrical error for the right eye and left eye respectively. Six of 60 patients (RE) and seven of 60 patients (LE) had hypermetropic cylindrical error, while 13 of 60 patients (RE) and 10 of 60 patients (LE) had myopic cylindrical error in the Presbyopic group. In the Non-presbyopic group two of 60 patients (RE) and one of 60 patients (LE) had hypermetropic cylindrical error, while two of 60 patients(RE)andtwoof60patients(LE)had myopic cylindrical error. [Table 8]

Table 1: Age distribution of study subjects in Presbyopic and Non-presbyopic groups

Study group	Age(years) Mean(SD)	Mean difference	P value (t-test)	95%CI
Presbyopic (n = 60)	58.08 (12.39)	28.97	0.00	25.54 to 32.34
Non-presbyopic (n = 60)	29.12 (5.14)	28.97		25.52 to 32.41

SD = Standard deviation, I= Confidence interval, n=Number of patients.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 2: Gender distribution of study subjects in Presbyopic and Non-presbyopic groups

Study group	Male Number (%)	Female Number (%)	P value (Fisher's exact)
Presbyopic (n = 60)	37 (61.7)	23 (38.3)	0.67
Non-presbyopic (n = 60)	26 (43.3)	34 (56.7)	

Table 3: Uncorrected visual acuity (UCVA) of right eye (RE) in the patients of Presbyopic and Non-presbyopic group

Study group	UCVARE (Snellen's) Number (%)							
	6/6	6/9	6/12	6/18	6/24	6/36	6/60	P value (Chi-square)
Presbyopic (n = 60)	13 21.7	19 31.7	13 21.7	4 6.7	5 8.3	5 8.3	1 1.7	0.00
Non- presbyopic (n = 60)	41 68.3	5 8.3	2 3.3	6 10	2 3.3	2 3.3	2 3.3	

Table 4: Uncorrected visual acuity (UCVA) of left eye (LE) in patients of Presbyopic and Non-presbyopic group

	UCVALE (Snellen's) Number (%)							
Study group	13	19	13	4	5	5	13	P value (Chi-square)
Presbyopic (n = 60)	17 28.3	21 33	9 15	5 8.3	3 5	5 8.3	0	0.00
Non- presbyopic (n = 60)	43 71.7	4 6.7	2 3.3	6 10	1 1.7	2 3.3	2 3.3	

Table 5: Best corrected visual acuity (BCVA) of right eye (RE) in the patients of Presbyopic and Non-presbyopic group

Study group	BCVARE (Snellen's) Number (%)			
	6/6	6/9	6/12	P value (Chi-square)
Presbyopic (n = 60)	28 (46.7)	31 (51.7)	1 (1.7)	0.00
Non- presbyopic (n = 60)	60 (100)	0	0	

Table 6: Best corrected visual acuity (BCVA) of left eye (LE) in the patients of Presbyopic and Non-presbyopic group

Study group	BCVARE (Snellen's) Number (%)			
	6/6	6/9	6/12	P value (Chi-square)
Presbyopic (n = 60)	32 (53.3)	27 (45)	1 (1.7)	0.00
Non- presbyopic (n = 60)	60 (100)	0	0	

Table 7: Spherical error of right eye (RE) and left eye (LE) in the patients of Presbyopic and Non-presbyopic group

Study group	Emmetrope Number (%)	Hypermetrope Number (%)	Myope Number (%)	P value (Chi-square)
RE				
Presbyopic (n= 60)	34 (56.7)	7 (11.7)	19 (31.7)	0.418
Non-presbyopic (n= 60)	41 (68.3)	5 (8.3)	14 (23.3)	
LE				
Presbyopic (n= 60)	39 (65)	4 (6.7)	17 (28.3)	0.390
Non-presbyopic (n= 60)	43 (71.7)	6 (10)	11 (18.3)	

Table 8: Cylindrical error of both eyes (BE) in the patients of Presbyopic and Non-presbyopic group

Study group	Emmetrope Number (%)	Hypermetrope Number (%)	Myope Number (%)	P value (Chi-square)
RE				
Presbyopic (n= 60)	41	6	13	0.002
	(68.3)	(10)	(21.7)	
Non-presbyopic (n= 60)	56	2	2	
	(93.3)	(3.3)	(3.3)	
LE				
Presbyopic (n= 60)	43	7	10	0.003
	(71.7)	(11.7)	(16.7)	
Non-presbyopic (n= 60)	57	1	2	
	(95)	(1.7)	(3.3)	

ISSN (O): 2687-5365; ISSN (P): 2753-6556

DISCUSSION

Pekel G et al, in 2014 studied the effect of ocular dominance on contrast sensitivity in middle aged people. It was a retrospective study including 90 eyes of 45 subjects (30 males and 15 females) with age between 40 and 60 years (Mean = 51.26) and visual acuity was 6/9 or better. The spherical and cylindrical refractive error values were between + 0.50 and – 0.50 D. In their study they found no statistically difference in the photopic contrast sensitivity at all spatial frequencies. But in mesopic condition (18 cycles per degree) the difference was 0.035 with better contrast in the dominant eye.[7]

Gillespie-Gallery H et al, in 2013 studied the functional contrast sensitivity changes with age and decreasing light level in monocular and binocular vision. They included 95 patients of age 22 to 85years.Contrast threshold was measured using 4-alternative-forced-choice procedure in a Landolt C optotype at the fovea and parafovea. They found that the contrast sensitivity showed a steeper decline and higher correlation with age at parafovea than the fovea.[8]

Leung et al, in 2012 studied the visual functioning and quality of life among the elderly patients. In their study they included four thousand subjects. They found that visual acuity was the strongest visual predictor of recreational activities, reading and fine handiwork domains while contrast sensitivity was the strongest predictor for activities and driving domains. Contrast sensitivity was measured by Vector vision CSV-1000E chart.[9]

Nomura H et al, in 2003 studied the age-related changes in the contrast sensitivity among the Japanese adults (40-79years). Contrast sensitivity test were performed

Using the Vicstech contrast sensitivity test chart (VCTS 6500), they found statistically significant decrease in contrast sensitivity with advancing age ($P < 0.001$).[10]

Santos N A et al, in 2004 compared the angular frequency (range between 2 and 96 cycle/360 degree) contrast sensitivity in young and older adults. They measured the contrast thresholds for young adults (N = 6; age range, 20 - 26 years) and older adults (N = 6; age range, 60-67 years) using the psychophysical forced-choice method. They found that older adults had loss in contrast sensitivity at high and medium angular frequencies compared to the young adult (i.e., from 8 to 96 cycle per 360 degree). Contrast sensitivity at low angular frequencies, i.e., 2 and 4 cycle per 360 degree, was better for the older group than for the younger group. On the other hand, contrast sensitivity for sine-wave grating at 3 and 4 cycles per degree was higher for young adults.[11]

Ross J E in 1985 studied the effect of age on contrast sensitivity function in both uniocular and binocular cases. They included 70 patients between age 20 and 87years. In the younger age group there were 17 patients: seven males, Mean age 23 years, and [910 females with Mean age 25 years. In the older group there were 53 patients: 24 males, Mean age 71 years, and 29 females with Mean age 73 years. Optical correction was between -6 diopters to +6 diopters. Visual acuity was taken from 6/6 to 6/12. Contrast sensitivity was measured using a display oscilloscope by a two-channel computer addressed micro processer wave form generator. The pre- programed sequences used were: double staircase technique and the up-down transformed response rule (UDTR). They observed that older patients had reduced contrast sensitivity for all spatial frequencies. This was particularly marked for medium and high spatial frequencies. In the age group 50 to 87 years there was linear decline in the contrast spatial frequency, for medium and high frequency with the age.[12]

CONCLUSION

According to our research, the non-presbyopic group's uncorrected and best corrected visual acuities—for both the right and left eye—were noticeably higher than those of the presbyopic group. Both spherical and cylindrical refractive errors were present; however, there was a significant difference in the cylindrical type (for both the left and right eye), with a higher degree of error in the Presbyopic group and a higher proportion of patients with cylindrical errors in the Non-presbyopic group ($P < 0.05$). Both unilaterally and bilaterally, the contrast sensitivity of the presbyopic group was found to be substantially higher than that of the non-presbyopic group ($P < 0.05$). Our study confirms the findings of previous research, which show that aging causes a considerable decline in both contrast sensitivity and visual acuity.

REFERENCES

1. Kniestedt C, Stamper RL. Visual acuity and its measurement. OphthalmolClin North Am 2003; 16:155-170.
2. BaileyIL. Borish's Clinical Refraction. WB Sauders Philadelphia; 1998. Pp.179-202.
3. Jackson AJ, Bailey IL. Visualacuity.OptomPract.2004; 5:53-70
4. Woodruff E. Visual Acuity and the selection of the Test Letters. Hatton Press London; 1947.
5. Ginsburg AP. Contrast sensitivity and functional vision. International Ophthalmology Clinics 2003; 43(2):5-15.
6. Puell MC, Palomo C, Sanchez-Ramos C, Villena C. Normal values for photopic and mesopic letter contrast Sensitivity. J Refract Surg. 2004; 20:484- 488.
7. Pekel G, Alagoz N, Peels E, Alagoz C, Yilmaz OF. Effect of Ocular Dominance on Contrast Sensitivity in Middle-Aged People. ISRN Ophthalmology 2014.
8. Gillespie-Gallery H, Konstantakopoulou E, Harlow JA, Barbur JL. Capturing age-related changes in functional contrast sensitivity with decreasing light levels in monocular and binocular vision. Invest Ophthalmol Vis Sci. 2013; 54(9):6093-103.
9. Leung JCS, Kwok TCY, Chan DCC, Yuven KWK, Kwok AWL, Choy DTKet al. Visual Functioning and Quality of Life among the Elderly in HongKong, Int J Geriatr Psychiatry. 2012; 27(8):807-815.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

10. Nomura H, Ando F, Niino N, Shimokata H, Miyake Y. Age-related Change in Contrast Sensitivity among Japanese Adults. Jpn J Ophthalmol. 2003; 47:299- 303.
11. Santos NA, Simas MLB, Nogueira RMTBL. Comparison of angular frequency contrast sensitivity in young and older adults, Brazilian Journal of Medical and Biological Research. 2004; 37:375-378.
12. Ross JE, Clarke DD, Bron AJ. Effect of age on contrast sensitivity: uniocular and binocular findings. Br J Ophthalmol. 1985; 69:51-56.

ISSN (O): 2687-5365; ISSN (P): 2753-6556