A Retrospective study of Low vision intervention in individuals with central field loss and peripheral field loss

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Research article

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Abstract

Background

The objective of this study was to estimate the visual impairment in patients with central field loss (CFL) and peripheral field loss (PFL), to analyze the type of low vision devices prescribed and to compare the visual benefits who presented to Low Vision Care clinic at a tertiary eye care center in India.

Methods

A retrospective review was done for 450 patients with low vision who visited LVC clinic from January 2017 to December 2017. The subjects were categorized into two groups: CFL and PFL. Demographic profile such as age, gender, occupation, ocular history, visual acuity status and low vision device preferred was collected and documented.

Results

Out of 450 patients, 242 (53.8%) were diagnosed to have CFL and 208 (46.2%) had PFL. 323 (71.8%) were men and 127 (28.2%) were women. The sum of median age of both the groups were 34.5 years, while the median age of CFL and PFL group was 36 and 34 years respectively. Atrophy related macular disorder (54.1%) was the major reason causing central field loss and Retinitis Pigmentosa (81.7%) for peripheral field loss. CFL group (76%) preferred low vision devices more than PFL group (65.9%). The ratio of task difficulties for both distance and near were 1:2 for central and peripheral field loss respectively. Electronic video magnifier was preferred more in CFL group. There was a statistically significant improvement ($P < 0.05$) in distance and near vision with the help of low vision devices in both the groups.

Conclusions

The use of low vision devices in both CFL and PFL can help the patients in restoring useful vision.

Background

Low Vision Services or Care is used to describe a person who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field less than 10 degrees from the point of fixation, but who uses, or is potentially able to use, vision for the planning and/or execution of a task for which vision is essential.[17]

Globally, the total number of people visually impaired is 285 million, out of which 39 million blind and 246 million presenting with low vision. In India, 66 million people are suffering from low vision.65% of people visually impaired and 82% of all blind are 50 years and older.[18]

These visual impairment will have a significant impact on their functional ability and quality of life. Most conditions that cause low vision impact either the peripheral low-resolution wide field or the central high-resolution fovea. The loss of central vision is the hallmark representation of Age Related Maculopathy and also characterizes Diabetic Retinopathy, Optic Neuropathy, Central Retinal Vein Occlusions and other conditions. Peripheral field loss (tunnel vision) is a severe constriction of the peripheral field leaving the central 5–10 degrees of the functional field.[19] This condition is the result of Retinitis Pigmentosa and Glaucoma.

The central retina has high sensitivity to image contrast and displacement compared to the peripheral retina, whereas the peripheral visual field covers a larger spatial extent than the central visual field. These differences in visual function play a major role in visual performance. For instance, the peripheral field loss is associated with unwanted contacts and disorientation and central field loss is associated with failure to detect elevation changes.[5–10]Insuch cases, the loss of one of the system's components prevents the interplay of central and peripheral vision essential for the visual performance. This loss of visual function results in impairment and disability.

Depending upon the type of field loss and disability, the patients' exhibit various visual task difficulties related to their day to day activities. Low vision rehabilitation has traditionally addressed these issues by attempting to replace or supplement the missing function. Low vision devices (LVD) provides magnification effectively in central field loss to increase the effective resolution of the residual peripheral field, while minification has been tried with limited success to expand the peripheral view in case of PFL.[2] These devices assist in improving the visual performance by maximizing their existing sight using appropriate methods and helping them use

this level of visionoptimally to provide equal opportunities for people with low vision. The decision of low vision rehabilitation is made based on that individual vision requirements and life goals.[11]

Although there are various studies which have investigated the use of low vision devices in different ethnic populations or different ocular conditions, still there is lack of information regarding the preference of LVD with regard to type of field loss. Literatures have compared many visual functions among people with central field loss and peripheral field loss,[3, 12–14] yet information on low vision rehabilitation comparison is very limited. Therefore the purpose of this study was to document the clinical characteristics of people with central and peripheral field loss presenting for low vision care services, type of LVD preferred and to estimate the visual improvement with the prescribed low vision devices.

Methods

A retrospective chart review of patients with low vision attending the low vision care clinic of a tertiary eye care center between January and December 2017 was done. The comprehensive list of ocular conditions were categorized by senior Ophthalmologist as conditions causing CFL and PFL respectively. The patients data were categorized into central field loss and peripheral field loss based on the Berkeley Central Field Test (BCFT) and tangent screen test done as a part of low vision work up. Subjects those who presented with both central and peripheral involvement were excluded from this study. Collected data included presenting logarithm of the minimum angle of resolution (logMAR) distant and near visual acuity in the better eye, details of the low vision devices prescribed and post examination logMAR distant and near visual acuity with the low vision device. The low vision assessment and trial were conducted by two experienced optometrists. Institutional review board approval was obtained to analyze the hospital-based data and the tenets of Helsinki were followed.

Low Vision Devices

Distance optical devices were used to magnify objects up to 3 times more, whereas near optical devices were used to magnify printed materials and near objects. Single or multiple optical devices of the following kinds were used to improve the visual acuity of patients with lowvision: SEE TV binocular telescopes (Eschenbach, Germany) are spectacle model telescopes mostly suitable for recognizing faces and watching television in the adult population. Half-eye spectacles are high-powered reading glasses that allow both the eyes to read together. These are hands-free magnifiers which provide a greater field of view and make it more comfortable for users to read and write. Hand-held magnifiers(Low Vision Resource Centre [LVRC]-Hong Kong Society forthe Blind [HKSB]) are more comfortable for spotting and give a better working distance and portability. Stand magnifiers (LVRC, HKSB) gives acomparatively wider range of magnification with limited field of view. Dome magnifiers (LVRC, HKSB) provide more comfortability for continuous reading tasks at a convenient working distance. Pocket magnifiers (LVRC, HKSB) are mostly used for spotting as they provide a wide range of magnification.[15] Portable video magnifiers (Freedom Scientific Company, USA) with closed-circuit television (CCTV) having a magnification from 2x to 25x, offer the option of contrast change, and freezing of images. Notexisa currency identifier are used for identifying notes using tactile cues. Clip-on filters are colored filters are useful for patients with photophobia. Additional illumination was suggested in most cases for comfortable reading.

The patients were given a trial of single or combination of low vision optical and non-optical devices depending on their presenting visual acuity, and the maximum improvement in the visual acuity was noted. A detailed explanation about handling of the device and adaptation training was given to patients with the preferred device to enable them to handle the device independently. The instruction manual and the other requiremnets of the prescribed device were handed over to the patient.

Levels Of Visual Impairment:

The level of visual impairment was categorized based on the study recommended by the World Health Organization[18] relating the visual acuity of the better eye with the best possible correction:

Category 0: Mild VI with visual acuity better than 6/18,

Category 1: Moderate VI with worse than 6/18–6/60,

Category 2: Severe VI with worse than 6/60–3/60,

Categories 3 and 4: Profound VI with worse than 3/60 to perception of light, and

Category 5: Blindness with no perception of light.

Statistical Analysis:

Descriptive statistics included median and Inter-quartile range (IQR) of the variables. Normality assumption was assessed using Shapiro-Wilk test. Wilcoxon sign rank test was used for comparison of continuous non-normally distributed variables of same group. Mann-Whitney test was used for group comparison of continuous non-normally distributed variables of two groups. All statistical analyses were performed using statistical package for the social sciences (SPSS) software version 20. The α (alpha) level was set at 0.05.

Results

Out of 450 patients, 242 (53.8%) patients were found to have central field loss and 208 (46.2%) had peripheral field loss. In case of CFL group, 171(70.6%) were male and 71(29.3%) were female, similarly in PFL group 152(73.0%) were male and the rest were female 56(26.9%). The median age of the overall patients was 34.5 years, the median age of CFL group was 36 years and PFL group was 34 years. There was no significant difference between the CFL and PFL groups in terms of age and gender ($P > 0.05$). Majority of the patients in CFL group were above 40 years of age 106(43.8%), whereas in case of PFL group majority of the patients 83(39.9%)were aged between 18 to 40 years who belonged to working age group. Although 40% of the patients in both CFL and PFL group were employed, the unemployment was little more in case of PFL (6%) than CFL (2%). There were 29% of students in CFL group and 21% in PFL group. Myopia was the most common refractive error in both CFL (50.8%) and PFL (52.4%) groups followed by Hyperopia. Majority of the subjects with CFL and PFL has moderate visual impairment, followed by severe and then mild visual impairment.Around 62% of the subjects in both the groups reported difficulty in near vision. 8% of the people reported difficulty of distance vision in CFL group and 14% had difficulty in PFL group as shown in [Table 1].

Table 1
Baseline characteristics of subjects with central field loss and peripheral field loss

DETAILS	VARIABLES	FREQUENCY		P-value
		CFL(242)	PFL(208)	
AGE	Median (IQR)	36 (37.8)	34 (29.2)	0.09
	< 18	50(20.7%)	46(22.1%)	
	18–40	86(35.5%)	83(39.9%)	
	> 40	106(43.8%)	79(38.0%)	
GENDER	Male	171(70.7%)	152(73.1%)	0.57
	Female	71(29.3%)	56(26.9%)	
OCCUPATION	Students	70(28.9%)	44(21.2%)	0.50
	Unemployed	11(4.5%)	14(6.7%)	
	Employed	96(39.7%)	83(39.9%)	
	Housewife	27(11.2%)	32(15.4%)	
	Farmer	1(0.4%)	4(1.9%)	
	Retired	34(14.0%)	25(12.0%)	
REFRACTIVE ERROR	Myopia	123(50.8%)	109(52.4%)	0.84
	Hyperopia	48(19.8%)	39(18.6%)	
CATEGORY OF VISUAL IMPAIRMENT	Mild	51(21.1%)	41(19.71%)	0.41
	Moderate	105(43.38%)	90(43.3%)	
	Severe	80(33.05%)	71(34.1%)	
	Profound	5(2.06%)	5(2.40%)	
	Near blindness	1(0.41%)	1(0.5%)	
	Total blindness	0	0	
TASK DIFFICULTIES	Distance	19(7.9%)	28(13.5%)	0.00
	Near	150(62.0%)	127(61.1%)	
	Computer	5(2.1%)	2(1.0%)	
IQR: Interquartile range				

The median duration of symptoms was more 4(8) years in CFL group when compared to 2(4) years in PFL group.Of the 242 cases with CFL, atrophy related condition (54.1%) were the major case of low vision among which cone dystrophy was found in 21.1% of the subjects, followed by heredomacular degeneration (22.4%) of which Stargardt's was the majority 12.5% and 13.6% had age-related macular degenerations and macular scar was responsible for 9.9% of the patients. In case of PFL group with 208 cases, 81.7% had RP, followed by 15.9% had Glaucoma and others as given in [Table 2].

Table 2
Ocular conditions causing central field loss and peripheral field loss

Visual Field Loss	Category ation	Sub-Categoryification	N (%)
CENTRAL FIELD LOSS (53.8%)	Age related (13.6%)	Dry age related macular degeneration	9(3.7%)
		Scarred choroidalneovascular membrane	24(9.9%)
	Atrophy(54.1%)	Foveal ischemia	15(6.3%)
		Fovealschisis	7(2.9%)
		Macular dystrophies	17(7.0%)
		Cone dystrophy	51(21.1%)
		Chronic central serous retinopathy	10(4.1%)
		Parafoveal telangiectasia	2(0.8%)
		Central aerolarchoroidal dystrophy	3(1.2%)
		Fovealrpe atrophy	10(4.1%)
		Rpe alterations involving fovea	11(4.6%)
		Pigment epithelial detachment	1(0.4%)
		Macular coloboma	1(0.4%)
		Foveal hypoplasia	3(1.2%)
	Heredo-macular degeneration (22.4%)	Heredomacular degeneration	7(2.9%)
		Stargadts	30(12.5%)
		Myopic macular degeneration	16(6.6%)
		Vitelleform disease	1(0.4%)
	Macular scar (9.9%)	Macular scar	24(9.9%)
PERIPHERAL FIELD LOSS (46.2%)	Retina related (81.7%)	Retinitis pigmentosa	169(81.2%)
		Laurence Moon BardelBeidel Syndrome with retinitis pigmentosa	1(0.5%)
	Optic nerve related (18.3%)	Secondary glaucoma	33(15.9%)
		Anterior ischemic optic neuropathy	5(2.4%)

Out of both the groups, CFL group (76%) preferred low vision devices more than PFL group (65.9%). More than 90% of the patients in both the groups had vision improvement with optical devices and less than 10% of electronic portable devices were required for visual improvement. Yet optical devices were preferred more in PFL group and electronic devices were preferred more in CFL group. The most commonly preferred magnifier for employed population was half eyes spectacle magnifier both in case of CFL (20.8%) and PFL (22.9%) group, which was followed by stand and dome magnifiers. Eletronic portable video magnifiers were preferred more in CFL group (7.3%) when compared to PFL group (2.4%). Among student population, dome magnifier was more preferred in CFL group (47.1%) whereas in PFL group half eyes spectacle magnifier was preferred (29.5%). Electronic portable video magnifiers were preferred more by PFL group (9.1%) rather than CFL group (1.4%) in employed population. Retired population preferred half eyes spectacle magnifier in case of CFL group (64.7%) whereas in PFL group the preference of spectacle magnifier and dome magnifier was almost similar (16%). Retired subjects with CFL preferred stand magnifier followed by dome magnifier, in case of PFL group they preferred dome magnifier followed by stand magnifier as shown in [Table 3].

Table 3

Preference of low vision devices among subjects with central field loss and peripheral field loss

FIELD LOSS	CATEGORY OF LOW VISION DEVICES	TYPES OF LOW VISION DEVICES	OCCUPATION						
			Student (70)	Unemployed (11)	Employed (96)	Housewife (27)	Farmer (1)	Retired (34)	TOTAL(%)
Central Field Loss 184 (76%)	Optical devices 169 (91.8%)	Half eyes and aspheric spectacle magnifier	2(2.9%)	3(27.27%)2	20(20.8%)	10(37.0%)	0	22(65%)	57(31%)
		Dome magnifier	33(47.1%)	1(9.1%)	15(15.6%)	4(14.8%)	0	2(5.9%)	55(29.9%)
		Stand magnifier	3(4.3%)	2(18.2%)	15(15.6%)	3(11.2%)	1(100%)	5(14.7%)	29(15.8%)
		Pocket magnifier	1(1.4%)	0	17(17.7%)	3(11.2%)	0	2(5.9%)	23(12.5%)
		Handheld magnifier	0	0	3(3.1%)	0	0	2(5.9%)	5(2.7%)
	Electronic devices 15 (8.2%)	Portable video magnifier	1(1.4%)	2(18.2%)	7(7.3%)	2(7.4%)	1(100%)	2(5.9%)	15(8.1%)
FIELD LOSS	CATEGORY OF LOW VISION DEVICES	TYPES OF LOW VISION DEVICES	Student (44)	Unemployed (14)	Employed (83)	Housewife (32)	Farmer (4)	Retired (25)	TOTAL(%)
Peripheral Field Loss 137 (65.9%)	Optical devices 128 (93.4%)	Half eyes and aspheric spectacle magnifier	13(29.5%)	1(7.1%)	19(22.9%)	6(18.7%)	1(25%)	4(16%)	44(32.1%)
		Dome magnifier	6(13.6%)	2(14.3%)	14(16.9%)	10(31.2%)	0	4(16%)	36(26.3%)
		Stand magnifier	7(16%)	1(7.1%)	15(18.1%)	3(9.4%)	0	3(12%)	29(21.2%)
		Pocket magnifier	3(6.8%)	2(14.3%)	8(9.6%)	3(9.4%)	0	0	16(11.6%)
		Handheld magnifier	1(2.3%)	0	2(2.4%)	0	0	0	3(2.2%)
	Electronic devices 9 (6.6%)	Portable video magnifier	4(9.1%)	0	2(2.4%)	1(3.1%)	0	2(8%)	9(6.6%)

This table also provides information on the employment status of patients with central and peripheral field loss. The mean magnification requirement in case of CFL group was 2.6x times whereas for PFL group it was 1.87x times.

The presenting median distance visual acuity of CFL group and PFL group was 0.8 (0.4) logMAR and 0.9 (0.4) logMAR respectively which has statistically significant improvement after low vision intervention with p-value of < 0.05 for both the groups. The presenting near visual acuity of subjects in CFL group was 0.4 (0.3) logMAR which improved to 0.3 (0.0) logMAR and in case of PFL group the near visual acuity improved from 0.4 (0.3) logMAR to 0.3 (0.1) logMAR with p-value of < 0.0001 for both thr groups as shown in [Table 4].

Table 4
Comparison of visual acuity improvement in subjects with central field loss and peripheral field loss after low vision intervention

CATEGORY	DISTANCE			NEAR		
	Presenting visual acuity (logMAR)	Post visual acuity (logMAR)	P-value	Presenting visual acuity (logMAR)	Post visual acuity (logMAR)	P-value
Central field loss, Median (IQR)	0.82 (0.31)	0.8 (0.3)	< 0.0001	0.46 (0.22)	0.34 (0.14)	< 0.0001
Peripheral field loss, Median (IQR)	0.83 (0.37)	1.0 (0.67)	< 0.0001	0.46 (0.23)	0.36 (0.18)	< 0.0001
IQR: Interquartile range						

Mann Whitney test showed that there was no significant difference in the distance and near visual acuity of CFL and PFL groups.

Discussion

This study highlights the comparison of LVD preference in subjects with central field loss and peripheral field loss. This report shows people with central field loss has preponderence in accessing low vision care when compared to peripheral field loss. The demographic details, age wise classification, types of low vision devices preferred based on their occupation, visual acuity improvement were reported in this study. To the best of our knowledge, low vision intervention has not been studied in depth comparing the subjects in terms of central and peripheral field loss.

Evans et al[3]comparative study on quality of life showed that mental aspects of the patients with glaucoma (PFL)were more affected than patients with age related macular degeneration (CFL) where physical aspects were affected. There are similar studies which have studied one condition in CFL and PFL for comparison, whereas in this study all possible conditions causing central field loss and peripheral field loss were included. Previous literatures have studied the quality of life comparison, while studies related to visual parameters comparison between CFL and PFL is very limited. There was no significant difference between the CFL and PFL groups with regards to age and gender, which indicates that they are age and gender matched groups for analysis. However there was significant difference in terms of ocular conditions causing CFL and PFL with p-value of < 0.05, this implies the conditions are representative of the different population.

More than 70% of the subjects were male in both CFL and PFL group, which shows better eye care access by male when compared to female in India. Majority of the patients in CFL group were above 40 years of age which could be due to late onset of the conditions causing CFL, whereas in case of PFL 18 to 40 years age group was more which proves patients with PFL has visual disturbance much earlier than CFL. Inspite of minimum differences, more number of people were unemployed in PFL group than CFL group. However student and employment ratio was almost similar in both the groups. PFL group were involved more in agricultural tasks when compared to CFL group. Majority of the patients had myopia in both the groups followed by Hyperopia.

Shahina et al[13] states that patients with CFL will have more difficulty in grasping and reaching for an object when compared to patients with PFL. Similarly this study also reports that patients with CFL had more difficutly for near and intermediate visual tasks when compared to PFL group. Majority of the patients has moderate visual impairment followed by severe and mild visual impairment in both the groups. This study provides an outlook of ocular conditions causing central and peripheral field loss which would have respective behavioural implications. As expected atrophy related macular conditions play a major part followed by heredomacular and age related macular degeneration in case of CFL, while in PFL group commonly seen ocular condition was RP followed by Glaucoma.

Many literatures have studied preference of low vision devices in a single ocular condition, in a study of stargardt's dystrophy (CFL) the most commonly preferred magnifier was dome magnifier, whereas in case of Glaucoma, it was spectacle type of devices.[15, 16] Our study is the first to report wide range of ocular conditions causing central and peripheral field loss and the preferred type of low vision devices based on occupation. Though the difference is minimal, patients with central field loss (76%) were found to prefer low vision devices for improving their visual performance more when compared to PFL group (66%). Except for students in CFL group, rest all preferred half eyes spectacle magnifier for better near visual acuity, which indicates that spectacle model magnifier is the most commonly preferred magnifier which was also seen in previous literautres. Because spectacle magnifier are hands-free which provides maximum field of view

and better cosmetic appeal. Students usually prefer dome magnifier due to wider working distance nad comfortable reading posture, which was noted in case of CFL, whereas PFL group would have faced difficulty in focusing inside dome magnifier due to constricted peripheral vision. The mean magnification of LVD requirement was high in case of CFL when compared to PFL, which indicated CFL group had more near vision difficulty. Inspite of the visual impairment remains almost equal in both the groups, the severity of visual task difficulties differ between CFL and PFL group. Further indepth qualitative analysis is required to understand the nature of visual task difficulties. The low vision devices help in visual improvement irrespective of the ocular condition and field loss. With the advancement of electronic portable devices, patients with severe visual impairment also feels significant improvement in the visual acuity. There was statistically significant improvement in visual acuity for distance and near in both CFL and PFL groups.

Conclusion

In conclusion, patients with central field loss and peripheral field loss prefers low vision devices for better performance of their visual tasks. Low vision intervention helps in enhancing the quality of vision and thereby provides confidence and motivation to the patients with central and peripheral field loss.

Declarations

Ethics Approval and Consent to Participate: The was approved by Institutional Review Board (Ethics committee), Vision Research Foundation and informed consent was waived by the Ethics Committee as per the declaration of

Consent for Publication: Not Applicable

Availability of Data and Materials: The datasets generated during and/or analysed during the current study are not publicly available, as it is against the organisation/ hospital policy. But are available from the corresponding author on reasonable request.

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Authors Contribution:R participated in the conception, interpretation and design of the study. S.G participated in conception, design, analysis, interpretation and drafting of manuscript. S.M participated in analysis, interpretation and drafting of manuscript. All authors have read and approved the manuscript.

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