ORIGINAL ARTICLE

Clinical Outcomes of Low Vision Aids for Enhancement of Residual Vision in Diabetic Retinopathy

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ABSTRACT

Purpose: To investigate the clinical outcomes of low vision aids for enhancement of residual vision in patients with Diabetic Retinopathy (DR).

Study Design: Cross-sectional study.

Place and Duration of Study: Hayatabad Medical Complex Peshawar, from January 2018 to December 2019.

Methods: **C**onsecutive patients with DR having poor visual acuity were assessed in a low vision clinic for vision rehabilitation. Data regarding distance and near visual acuity (VA), refractive error, types of low vision aids (LVAs), VA with best correction and with LVAs were collected and analyzed.

Results: Eighty-one patients with mean age of 58.48 ± 13.54 years were included in the study out of which 63% were male. There were 29.6% Insulin dependent and 70.4% non-Insulin dependent diabetics with mean duration of 12.6 years of diabetes. At presentation, 63% had moderate vision impairment (VA <0.5 and > 1.0), 14.8% had severe vision impairment (VA <1.0 and > 1.3) and 22.2% had blindness (VA < 1.3). With LVAs, 97.5% achieved distance VA of Log MAR 0.4 or better. Mean improvement in distance VA with LVAs was Log MAR 0.95 ± 0.19 (P = 0.000; 95% CI). Near VA improved significantly with LVAs and the number of participants who could see 1M or better with their own glasses increased from 7.4% to 97.5% (p < 0.001). Binocular telescopes 2.1X were the most preferred low vision device for distance vision and prismatic magnifying spectacles for near vision.

Conclusion: Visual rehabilitation through the use of LVAs was very helpful in patients with low vision caused by diabetic retinopathy.

Key Words: Diabetic retinopathy, blindness, visual rehabilitation, low vision aids.

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INTRODUCTION

Vision impairment and blindness due to diabetic retinopathy (DR) is a major public health problem.[1,2] There is a significant increase in the number of people with vision loss due to DR over the last two decades.[3] Globally in 2010, DR accounted for 2.6% of all blindness and 1.9% of all moderate and severe vision impairment (MSVI).[3] In India, the prevalence of vision impairment and blindness due to type 2 diabetes in people of 40 years age and above was reported to be 4% and 0.5% respectively.[4] Vision loss resulting from DR is also likely to increase in low- and middle-income countries with the continued diabetes epidemic.[3]

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Worldwide prevalence of diabetes is rising and is expected to increase by 20% in developed countries and 69% in developing countries by 2030.[5] The prevalence of DR varies in different countries and is reported to be 19% in Bangladesh[6], 21% in China[7], 28.3% in Taiwan[8], and 37% in Iran.[9] The prevalence of DR amongst people with diabetes in Pakistan ranges from 17% to 26%.[10,11] People with vision loss due to DR contribute significantly to the number of people with low vision.[12,13] All people with DR are at risk of vision loss. Despite advancements in eye-care service delivery through innovation in medical and surgical management, it is unlikely to restore vision loss due to DR. It is evident that low-vision rehabilitation of people with vision loss through enhancing residual vision with the use of optical and non-optical low vision aids are successful to improve various aspects of visual performance such as improving distance visual acuity, near visual acuity and reading ability.[14,15]

The purpose of low-vision assessment is to evaluate the individual's functional use of the residual vision. Low-vision rehabilitation aims to help people with impaired vision to learn making the most of a person's residual vision in order to perform activities of daily livings in a better way.[14,16] According to the World Health Organization, a person with low vision is one who has best corrected distance visual acuity less than 6/18 in the better-seeing eye or a visual field of less than 20 degree in the largest diameter in the better-seeing eye even after treatment.[17]

Majority of people with diabetes seek eye care services only after they have lost their vision due to DR.[18] Vision loss can lead to loss of productivity and has enormous medical, social, financial and psychological implications.[19,20] It necessitates the provision of low-vision rehabilitation services to people with vision loss due to DR when medical or surgical treatments are unsuccessful.[14,16]

This study aimed to investigate clinical outcomes of provision of low vision aids for enhancement of residual vision in people with DR in a tertiary eye care center of Pakistan.

METHODS

This study included 81 patients with diabetic retinopathy (DR), who were assessed for low-vision rehabilitation at a Low Vision Clinic (LVC), Hyatabad Medical Center, Peshawar between January 2018 and December 2019. This is a tertiary eye care institute in Pakistan. Patients with DR in whom therapeutic interventions could not play a significant role in improving their vision were referred from various hospitals in the province to our LVC for low-vision rehabilitation. Patients with DR included in this study had already been treated medically with intra-vitreal anti-VEGF injections and Laser photo-coagulation. Patients who had some residual vision that could be enhanced with the use of low vision devices were included in the study. Patients with best corrected visual acuity (VA) equal to or better than 6/18 in the better seeing-eye at the time of presentation were excluded from this study. Patients with other pathologies or having multiple causes for vision loss were also excluded from this study. Institutional ethical committee approval was obtained to collect and analyze the hospital-based data and was conducted in accordance with the Declaration of Helsinki.

At the LVC all these participants with DR underwent detailed assessment for visual functions and trial of low vision aids by experienced optometrist. Methods and procedures employed for low vision assessment of these patients included: detailed history of the patient including information about their visual difficulties and previous history of low vision assessment; presenting distance and near visual acuity was recorded in logarithm of the minimum angle of resolution (Log MAR) using a Bailey-Lovie visual acuity assessment chart with five optotypes on each line and final Log MAR distance and near visual acuity with low vision devices.

Distance VA in the better-seeing eye was classified as per WHO classification[21]: No impairment (distance VA 6/18 or better or Log MAR 0.5 or better); Moderate vision impairment (distance VA 6/18 to 6/60); Severe vision impairment (distance VA 6/60 to 3/60) and blindness (distance VA worse than 3/60). Near VA was classified in three groups on the basis of reading text size; less than 3.2M, 3.2M to less than 1M, and 1M (newspaper size) or better and were recorded for each eye separately.[13] For each patient, the target near visual acuity to achieve with low vision devices was defined on the basis of the text size the patient wanted to read or need of the patient. The text size the patient wanted to read, the distance of eye from the print, equivalent viewing distance (EVD) and equivalent viewing power (EVP) for calculating required magnification and selection of optical devices were noted.

Single or multiple optical low vision devices were used for assessment of distance and near visual acuities of patients with low vision. This included monocular and binocular telescopes of varying magnification, Ocutech telescope, reading cap with telescope, clip-on filters for patients with photophobia, hand-held and stand magnifiers. Details of the low vision devices used for low vision assessment at the LVC were as follows:

a. MAX TV binocular telescopes (Eschenbach, Germany) are spectacle model telescopes with 2.1 X magnification. Binocular telescopes are mostly suitable for students for watching black board in the classroom as well as for recognizing faces and watching television in adult population.

b. Monocular telescope ranged from 3X to 8X magnification provided from Low Vision Resource Centre Hong Kong Society for the Blind [LVRC-HKSB] used for spotting distant objects.

c. The Ocutech Vision Enhancing System (VES) (Ocutech Inc.) make hands-free magnified vision possible. Various types of Ocutech bioptic telescope have range of magnification from 1.7X (Sight Scope, Galilean telescope design) to 6X (VES-Sport, Keplerian telescope design). Reading caps are also available with Ocutech bioptic telescopes for reading text.

d. Half-eye spectacles up to +10.0 diopters (D) with incorporated base-in prism. These are hand-free magnifiers that allow both the eyes to read together providing greater field of view. These also make the reader more comfortable to write at greater working distance. High-powered single vision reading glasses for better seeing-eye for reading small print size.

e. Hand-held magnifiers ranged from 6D to 48D [LVRC-HKSB]. These portable magnifiers are available with and without illumination and are more comfortable for seeing and spotting at a greater working distance. Pocket hand-held magnifiers [LVRC-HKSB] are smaller in size with a wide range of magnification. These are available with and without illumination and mostly used for spotting near tasks.

f. Stand and Dome magnifiers [LVRC, HKSB]. Stand magnifiers are available in a wider range of magnification for seeing very small print size but with limited field of view. Dome magnifiers are available with limited range of magnification. These have brighter view and are more comfortable for adult population for continuous reading tasks.

g. Closed-circuit television (CCTV). It has a wide range of magnification from ×2 to ×25 and offers the option of contrast change, and freezing of images.

Most participants with severe vision impairment due to DR needed multiple devices (optical and non-optical) for better improvement in their vision to perform multiple tasks. Trial of single or combination of low vision devices was given to each patient depending on their presenting visual acuity and required task. Detailed explanation and training of use of the low vision device was given to each patient. The maximum improvement in the distance and near visual acuity and types of low vision devices was noted.

SPSS (Statistical Package for Social Sciences) version 19 (IBM Corp, Armonk, NY, USA) was used for analysis of the data. For statistical differences such as between visual acuity prior and with the provision of low vision devices, Paired Samples T-test was conducted. A p-value of less than 0.05 was considered as level of significance. Data was presented descriptively as mean values and standard deviation.

RESULTS

Out of 81 participants assessed for low vision rehabilitation, 63% (n = 51) were male. Mean age of the participants was 58.48 ± 13.54 years (range: 27 to 80 years). Amongst participants, 29.6% (n = 24) had Insulin dependent diabetes while 70.4 % (n = 57) had non-Insulin dependent diabetes. Mean duration of diabetes was 12.6 ± 6.72 years. Regarding literacy, 29.6% (n = 24) were educated and could read and write. Illiterate counted 11.1% (n = 9) while 59.3% (n = 48) could read only but could not write. Participants who could read only but could not write asked for low vision aids (LVAs) to help them read the Holy Books and use them in other routine near tasks. All these participants were not satisfied from their own spectacles and wanted improvement in their distance and near vision. None of these participants had received low vision rehabilitation services earlier.

The refractive errors of participants were taken as spherical equivalent. Amongst participants, 48.1% (n = 39) had hypermetropia (+0.50D or more), 40.7% (n = 33) had myopia (-0.50D or less) and 11.1%

Table 1: *Age wise distribution of participants based on levels of vision impairment.*

Levels of Vision Impairment	Distance Visual Acuity (Log MAR)	Age Groups in Years					Total
		Less Than 30	30 to 39	40 to 49	50 to 59	60 and Older	
MVI	VA <0.5 & ≥ 1.0	3	0	9	15	24	51
SVI	VA <1.0 & ≥ 1.3	0	0	3	3	6	12
Blind	VA < 1.3	0	0	3	3	12	18
Total		**3**	**3**	**15**	**18**	**42**	**81**

Legends: MVI = Moderate vision impairment; SVI = Severe vision impairment

(n = 9) had no refractive error. Mean spherical equivalent refractive error was -0.25 ± 3.72D in right eyes and 0.10 ± 3.55D in left eyes. The larger value of SD showed the larger spread of refractive error data ranging from -11.0D to +9.0D in right eyes and -9.50D to +9.75D in left eyes. The difference in the means of spherical equivalent refractive error in right and left eyes of these participants was -0.352D (-0.739, 0.359; 95% CI).

At the time of presentation, 63% had moderate vision impairment (distance VA less than Log MAR 0.5 to 1.0), 14.8% had severe vision impairment (distance VA less than Log MAR 1.0 to 1.3) and 22.2% had blindness (distance VA less than Log MAR 1.3). About half of the participants were age 60 years and above of whom more than one-fourth were in the blind category. Age wise distribution of participants based on level of vision impairment at the time of presentation is given in Table 1.

Mean Log MAR distance visual acuity prior to the introduction of low vision Aids (LVAs) was 1.10 ± 0.21. With the provision of LVAs the mean distance VA improved significantly (Log MAR 0.15 ± 0.14; P < 0.00). Mean improvement in distance VA with LVAs was Log MAR 0.95 ± 0.19 (P = 0.000; 95% CI). With the provision of LVAs, 96.3% (n = 78) of participants could improve to distance VA Log MAR 0.4 or better.

At the time of presentation, 20% (n = 6) amongst female participants and 23.5% (n = 12) amongst male participants were in the blind category. With the provision of LVAs, none of the participants remained in the blind or severe vision impairment categories. Gender wise distribution of participants on the basis of levels of vision impairment at the time presentation and improvement with LVAs are detailed in Table 2.

The overall improvement in near visual acuity with LVAs was statistically significant (p < 0.001). With the provision of LVAs for enhancement of near VA, there was an increase in the number of participants who could discern 1M text size. Prior to provision of LVAs for near, 7.4% (n = 6) of participants could discern 1 M text size with their own glasses for near. With the provision LVAs, 97.5% (n = 79) of participants achieved near VA 1 M or better while 2.5% (n = 2) had near VA less than 1 M.

Table 2: *Gender wise distribution of participants based on levels of vision impairment.*

Levels of Vision Impairment	Distance Visual Acuity (Log MAR)	At Presentation		With LVAs	
		Male N	Female n	Male n	Female n
Normal	0.5 or better	0	0	48	30
MVI	VA <0.5 & ≥1.0	33	18	3	0
SVI	VA <1.0 & ≥1.3	6	6	0	0
Blind	VA < 1.3	12	6	0	0
Total		**51**	**30**	**51**	**30**

Legends: MVI = Moderate vision impairment
SVI = Severe vision impairment

All of the 51 participants who were in the moderate vision impairment group at presentation were able to discern 1M or better with LVAs. Amongst 18 participants in the blind group (VA < Log MAR 1.3), two could not discern 1M with LVAs. Thus participants who had moderate vision impairment at the time presentation achieved better improvement in near vision with LVAs.

Conventional glasses were prescribed to 88.8% (n = 72) of participants. For distance vision, 2.1X Max TV binocular telescope was the most commonly (n = 17) prescribed low vision device. Amongst the participants 38.3% (n = 31) did not want any telescope for distance. Table 3 show low vision aids prescribed to patients for distance vision.

Prismatic magnifying spectacles (up to +10.0D with base in prism incorporated) were the most accepted low vision device for near vision and were prescribed to 21 participants followed by high plus monocular spectacle lenses (n = 19). Eleven participants did not want any device for near vision

Table 3: *Low vision aids prescribed for distance vision.*

Types of low vision aids	Number
2.1 X Max TV binocular	17
3X Binocular Telescope	10
4X Hand Held Telescope	9
6X Hand Held Telescope	6
Filters	7
Ocutech Telescope	1
Nil (Did not want any telescope)	31

saying that they did not need. For enhancement in near vision, some participants needed more than one device to perform different tasks. The details of LVDs prescribed for near vision are given in Table 4.

Table 4: *Low vision aids prescribed for near vision.*

Types of Low Vision Aids	Number
Prismatic magnifying spectacles	21
High plus monocular spectacle lenses	19
Illuminated hand-held magnifiers	16
Pocket magnifiers	11
Bar magnifier	6
Dome magnifier	4
CCTV system	1
Nil LVAs for near vision	11

DISCUSSION

Findings from this study show that majority (63%) of people with diabetic retinopathy (DR) had moderate vision impairment at the time of presentation. There was a significant improvement in both distance and near visual acuities of participants with the provision of LVAs. Optical low vision devices were the major type of low vision aids dispensed and accepted by people with DR. Participants with moderate vision impairment achieved normal near visual acuity with LVAs. The most preferred low vision devices were 2.1X Max TV binoculars for distance vision and prismatic magnifying spectacles for near vision. All these participants visited for seeking low vision services for the first time.

Similar to the results of this study, the predominance of moderate vision impairment in people with DR has also been reported in other studies.[12,14] Due to progressive nature of DR, this predominance of moderate vision impairment amongst these people with DR may not sustain. Vision may deteriorate with the passage of time and number of people with moderate vision impairment may decline with an increase in number of people with severe vision impairment and blindness.[3,22] However, early visual rehabilitation is important to reduce the degree of handicap and strengthen their visual abilities enabling them to manage with vision loss and continue their activities of daily living.[23]

The findings from the present study proved the effectiveness of optical devices for enhancement of distance and near vision in people with DR. Similar to the results of this study, other researcher reported successful use of LVAs as an effective way to help people manage their vision related problems.[13,14] Despite strong evidence for the effectiveness of low vision devices, it is also evident from this study that 38.3% (n = 31) of participants with DR deny accepting LVAs. Many factors contributed to their denial such as illiteracy, finances and stigma associated with the usage of low vision aids.

In the light of global epidemic of diabetes and expected increase in number of people with vision loss due to DR, the role of low vision rehabilitation services is pivotal for maintaining independence in activities of daily livings.[5] Findings from the present study show that none of these participants visited low vision services before. Similar results had been reported in literature indicating most of people with DR were not using low vision services.[24] These facts indicate that awareness of patients with DR and of their health care providers about the availability of such services is of utmost importance and a key predictor of the use of these services as reported in literature.[25]

Various types of LVAs are available to help people with low vision to cope better with their everyday activities. However, acceptance of type of LVDs is based on individual's preference and needs. Results from this study showed that prismatic magnifying spectacles were the most preferred (n = 21) LVA followed by high plus monocular spectacle lenses (n = 19), Illuminated hand-held magnifiers (16) and pocket magnifier (n = 11) for performing near task. The preference of these LVAs indicated that older people mostly prefer simpler and cheaper rather than complex and expensive LVAs. Similar results have been reported in other studies.[12,14] Amongst the participants in our study, only one person was benefited with CCTV while other studies reported greater number of CCTV to participants with vision loss.[14] In this study, non-affordability was the major obstacle in accepting CCTV for reading purpose.

An important aspect of this study was that more than half of the participants (59.3%; n = 48) in our study wanted to read the Holy Books. The needs and expectations of these participants could be different than those of the literate people. Therefore, findings from our study could be different from other studies.

A limitation of this study was that we aimed to quantify the improvement in distance and near visual acuity with the provision of suitable low vision aids in people with DR but could not assess the impact of these LVAs on quality of life of these people. Another limitation is that we did not investigate levels of patient's satisfaction about the vision rehabilitation services. In addition, we could not investigate the factors hindering the acceptance of use of prescribed aids. Further research is needed to explore these factors.

CONCLUSION

Visual rehabilitation through the use of LVAs proved to be successful in people with diabetic retinopathy. Prismatic magnifying spectacles were the most preferred LVA for near tasks. Awareness about LVAs in people with DR and their eye and health care practitioners is crucial for utilization of low vision services.

Ethical Approval

The study was approved by the Institutional review board/ Ethical review board. **(170/HC/PICO/2020)**

Conflict of Interest

Authors declared no conflict of interest

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Authors' Designation and Contribution

Mufarriq Shah; Assistant Professor: *Concepts, Design, Literature search, Data acquisition, Data analysis, Statistical analysis, Manuscript preparation, Manuscript editing, Manuscript review.*

Muhammad Tariq Khan; Associate Professor: *Concepts, Design, Literature search, Data acquisition, Manuscript preparation, Manuscript editing, Manuscript review.*