Low-vision intervention in individuals with age-related macular degeneration

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Purpose: The objective of this study was to estimate the level of visual impairment in patients diagnosed to have age-related macular degeneration (ARMD) who presented to low-vision care (LVC) clinic at a tertiary eye care center in India, to analyze the type of distant and near devices prescribed to them and to compare the visual benefit in different age groups among patients with ARMD. Methods: A retrospective review was done for 91 patients with low-vision secondary to ARMD who were referred to the LVC clinic from 2016 to 2017. Demographic profile: age, gender, occupation, ocular history, visual acuity status, and type of low-vision device (LVD) preferred were documented. The details of LVDs and subsequent improvements were noted. Result: Of the 91 patients, 64 (70.3%) were men and 27 (29.7%) were women. Of the cases which were referred, 36.26% had a severe visual impairment (VI), 32.96% had moderate VI, 28.57% had mild VI, and 5.49% had profound VI. The majority of the patients had myopia 57 (62.63%), followed by hyperopia in 25 (27.47%) subjects. The subjects were divided into three groups based on age 40–65 years, 66–75 years, and above 75 years for the analysis of VI. There was a statistically significant improvement (P < 0.01) in near vision with the help of LVDs in all three groups. SEE TV binocular telescope was the most commonly prescribed LVD for viewing distant objects. The most commonly preferred magnifier for near work was half-eye spectacle (56%) followed by stand magnifier (9.9%) and portable video magnifier (9.9%). Conclusion: The use of LVDs can help these patients with ARMD in cases where medical and surgical treatment have no or a limited role in restoring useful vision.

Key words: Age-related macular degeneration, dome magnifier, low-vision, spectacle magnifier

Age-related macular degeneration (ARMD) is one of the leading causes of visual impairment (VI) in elderly people. ARMD is a progressive disease of the central area in the ocular posterior segment, which leads to deterioration of central vision and thereby affecting the performance of daily living activities of aged people. Visual deterioration can occur within months, or over many years, depending on the type and severity of ARMD. Gradual central vision loss may occur with dry macular degeneration but not as severe as wet ARMD symptoms. However, dry ARMD through a period of years gradually can progress to late-stage geographic atrophy which also can cause severe vision loss. The dry form is more common than the wet form, with about 85–90% of ARMD patients diagnosed with dry ARMD.

Low vision affects more than 246 million people worldwide and over 54.5 million in India. ARMD accounts for 8.7% of the total blindness globally. The persons with ARMD are likely to increase from 3 to 6 million by the year 2020. Low-vision services are scarce, often poorly funded, and under-utilized, especially in developing nations. In India, a person with a best-corrected visual acuity of less than 6/60 is considered legally blind and is allowed to receive government services and financial benefits. Low vision can interfere with simple everyday activities such as the ability to see faces, drive, read, write, or do close work, such as cooking. People with ARMD have been found to experience difficulty with the activities of daily living, which pose serious financial burden on their family in terms of high medical and societal costs that are due to increased risk of falling, need for vision-enhancing equipment, and assistance with activities of daily living.

The aim of this study was to elucidate the causes and level of VI in patients with ARMD who present to low-vision care (LVC) clinic at a tertiary eye care center, to analyze the type of distant and near devices prescribed to them, and to compare the visual benefit in ARMD responsible for causing low vision.

Methods

A retrospective review of 91 case records of people with ARMD who were referred to the LVC clinic for the first time between January 2015 and December 2017 at a tertiary eye care institute in India was done. Of the cases that had ARMD, those for whom therapeutic interventions played a limited role in improving vision were sent to the LVC clinic.

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were not included in the study. The reason for referral was assessed from the electronic medical records, available fundus photographs, fundus fluorescein angiograms, and optical coherence tomography images by a retina specialist (RR). Institutional review board approval was obtained to analyze the hospital-based data and the tenets of Helsinki were followed. 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 (LVDs) prescribed, and final logMAR distant and near visual acuity with the LVD. The low-vision assessment and trial were conducted by experienced optometrists.

Definition of low vision
“A person with low vision is one who has impairment of visual functioning even after treatment, and/or standard refraction correction, and has a visual acuity of less than 6/18 to light perception or a visual field of 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.” VI was defined in the study based on recommendations by the World Health Organization relating to 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 visual acuity worse than 6/18–6/60; category 2: severe VI with visual acuity worse than 6/60–3/60; categories 3 and 4: profound VI with visual acuity worse than 3/60 to perception of light, and category 5: blindness with no perception of light.[3,7,8]

Low-vision devices used
Distance optical devices were used to magnify objects up to 3 m or 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 low vision: 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 the users to read and write.[9] Handheld magnifiers (Low Vision Resource Centre [LVRC]-Hong Kong Society for the Blind [HKSB]) are magnifiers that are more comfortable for spotting and give a better working distance and portability. Stand magnifiers (LVRC, HKSB) are magnifiers that give a comparatively wider range of magnification with a limited field of view. Dome magnifiers (LVRC, HKSB) are those which are more comfortable for continuous reading tasks with a convenient working distance. Pocket magnifiers (LVRC, HKSB) are those with a wide range of magnification and mostly used for spotting. Additional illumination was suggested in most cases for comfortable reading. Portable video magnifiers (Freedom Scientific Company, USA) with closed-circuit television (CCTV) have a wide range of magnification from X2 to X25, offer the option of contrast change, and freezing of images.

The following formula was used to calculate the equivalent viewing power (EVP):

\[ \text{EVP} = \text{Presenting near visual acuity/target visual acuity} \times \frac{100}{\text{working distance (cm)}}. \]

On the basis of the EVP formula, the required magnification was calculated and appropriate magnifiers were given to the patients for trial based on their visual demands. The patients were given a trial of single or combination of low-vision optical and nonoptical devices depending on their presenting visual acuity, and the maximum improvement in the visual acuity with the LVD was noted. A detailed explanation of the use of the device and adaptation training with the preferred device was given to patients to enable them to handle the device independently. In addition to the LVD prescription, the instruction manual of the prescribed device was provided to help the patients.

Statistical analysis
Frequency distributions were used to analyze the demographic characteristics of the study population. Continuous variables were presented as median with interquartile range. Distance visual acuity and near visual acuity were documented in logMAR notation and group differences were analyzed using Wilcoxon sign-rank test. We processed and analyzed data using SPSS 20.0 (IBM Corporation, Armonk, NY, USA).

Results
The mean age of patients was 71.03 ± 10.66 years ranging from 43 to 91 years. Out of 91 cases, 64 (70.3%) were male. Among the subjects, 40 (44.0%) were retired, 25 (27.5%) were employed, 24 (26.4%) were homemaker, and 1 had (1.1%) discontinued job. The mean duration of ARMD during the first visit was 4.19 ± 4.48 years. Of the 91 cases which were referred, 36.26% had severe VI, 32.96% had moderate VI, 28.57% had mild VI, and 5.49% had profound VI. The most commonly associated refractive error was myopia in 57 (62.6%) people, hyperopia in 25 (27.47%), and 9 (9.89%) were pseudophakic as showed in Table 1. Of 182 eyes, 97.80% eyes were diagnosed with dry ARMD and 2.19% eyes had wet ARMD. The majority of the patients (86.8%) had difficulty in near work and 31.8% had difficulty in distance vision.

The subjects were divided into three groups based on age 40–65 years, 66–75 years, and above 75 years. SEE TV

| Demographic variable | Categories | Frequency (%) |
|----------------------|------------|---------------|
| Age                  | 40-65 years | 26 (28.6)     |
|                      | 66-75 years | 32 (35.2)     |
|                      | >75 years   | 33 (36.3)     |
| Gender               | Male       | 64 (70.3)     |
|                      | Female     | 27 (29.7)     |
| Occupation           | Employed   | 25 (27.5)     |
|                      | Discontinued job | 1 (1.1) |
|                      | Homemaker  | 24 (26.4)     |
|                      | Retired    | 40 (44.0)     |
| Type ARMD            | Dry        | 89 (97.8)     |
|                      | Wet        | 2 (2.2)       |
| Duration of visual impairment | 0-13 years | 86 (94.5) |
|                      | 13-25 years | 6 (6.59)     |
| Refractive error     | Myopia     | 57 (62.63)    |
|                      | Hyperopia  | 25 (27.47)    |
|                      | Pseudophakic | 9 (9.89)   |

LVC: Low-vision care
binocular telescope was the most commonly prescribed device for viewing distance, 3 (9.37%) in both groups II and III. The most commonly prescribed LVD for the near device was half-eye spectacles 20 (60.60%) followed by stand magnifier 5 (15.62%) in group II. The overall most commonly preferred magnifier was half-eye spectacle (56%) followed by stand magnifier (9.9%), and portable video magnifier (9.9%). Group I patients preferred more of handheld and pocket magnifier 4 (15.4%) when compared to older age groups. Single vision spectacles were prescribed for 30 (32.96%) individuals, bifocal glasses with higher add was given for 38 (41.75%) patients, and separate reading glasses were given to 4 (4.39%) people which is shown in Table 2. Though there was no statistically significant difference in terms of distance visual acuity, there was a statistically significant improvement (P < 0.01) in near vision with the help of LVDs in all three groups which is shown in Table 3.

Patients who had difficulty in using a computer (3.29%) were explained in-built modifications. Amsler testing picked central scotoma in 15.38% of the patients and distortions were reported by 2.2%. Low-contrast acuity was tested using Bailey-Lovie 10% contrast chart for 39 patients. It was found that contrast acuity was impaired for all of them and the mean low-contrast acuity was found to be 1.08 logMAR. These participants were advised to do contrast enhancements and environmental modifications to improve their functional visual performance.

**Table 2: Low-vision management in patients with ARMD**

| Low-vision devices                  | 40-65 years | 66-75 years | Above 75 years |
|-------------------------------------|-------------|-------------|----------------|
|                                     | n=26 (%)    | n=32 (%)    | n=33 (%)       |
| Distance                            |             |             |                |
| See TV                              | 0 (0)       | 3 (9.37)    | 3 (9.09)       |
| New Rx                              | 12 (46.15)  | 11 (34.37)  | 7 (21.21)      |
| Near                                |             |             |                |
| Separate reading glasses            | 2 (7.69)    | 0 (0)       | 2 (6.06)       |
| New Rx with higher add              | 12 (46.15)  | 14 (43.75)  | 12 (36.36)     |
| Half eyes spectacle                 | 11 (42.30)  | 20 (62.5)   | 20 (60.60)     |
| Dome magnifier                      | 2 (7.69)    | 2 (6.25)    | 2 (6.06)       |
| Stand magnifier                     | 1 (3.84)    | 5 (15.62)   | 3 (9.09)       |
| Hand magnifier                      | 4 (15.38)   | 1 (3.12)    | 1 (3.03)       |
| Pocket magnifier                    | 4 (15.38)   | 1 (3.12)    | 0 (0)          |
| Portable video magnifier            | 1 (3.84)    | 4 (12.50)   | 4 (12.12)      |
| Computer difficulty                 | 1 (3.84)    | 2 (6.25)    | 0 (0)          |
| Other advice                        |             |             |                |
| Contrast enhancement                | 6 (23.07)   | 5 (15.62)   | 7 (21.21)      |
| Mobility training                   | 1 (3.84)    | 4 (12.50)   | 3 (9.09)       |
| Vocational training                 | 0 (0)       | 3 (9.37)    | 1 (3.03)       |

**Table 3: Visual acuity improvement in patients with ARMD in different age groups**

| Age distribution | Distance (logMAR) | Near (N notation) |
|------------------|-------------------|-------------------|
|                  | Pre LVC | Post LVC | P     | CI     | Pre LVC | Post LVC | P     | CI     |
| 40-65 years      | 0.79    | 0.76     | 0.007 | (0.0-0.06) | 16.54   | 6.08     | <0.0001 | (4.74-14.1) |
| 66-75 years      | 0.89    | 0.86     | 0.26  | (-0.16-0.57) | 18.16   | 6.31     | <0.0001 | (5.36-12.75) |
| Above 75 years   | 0.84    | 0.83     | 0.27  | (0.0-0.02) | 16.76   | 7.03     | <0.0001 | (4.56-10.85) |

LVC: Low-vision care; CI: Confidence interval

**Discussion**

The study reports preponderance of severe VI (36%) in people with ARMD which was similar to Kulkarni et al.’s study. The majority benefited from half-eye spectacles (56%), followed by stand magnifier and portable video magnifier. Handheld and pocket magnifiers were preferred by comparatively younger age groups, whereas spectacle magnifier was preferred by older age groups which could be due to handling reasons. There was significant improvement in the near visual acuity in almost all the age groups of ARMD because of the latest available electronic portable devices (CCTV) with a higher range of magnification (more than ×20) and with options of reverse contrast which were comfortable for patients with low vision.

India is projected to be the world’s most populous country by 2025 with the rapidly increasing aging population.[11] As the general health of the elderly continues to improve, life expectancy has increased and ARMD has become more prevalent. In this study, male preponderance was noted wherein few studies show that females had higher risk for ARMD which would vary depending on the geographical location. Older age people are more prone to ARMD as observed in other studies,[11-13] which is also noticed in the current study. The vision loss associated with ARMD is associated with a substantial decrease in patient’s quality of life and reading ability,[2] which is reported in the current study also that majority of the patients with ARMD (86.8%) had difficulty in near work.

Hooper et al. demonstrated that low-vision aids available for individuals with ARMD range from being task-specific to those designed to improve visual functioning, which is similar to the current study. The patients with ARMD preferred handheld magnifier for spotting bills, whereas spectacle magnifier was preferred for reading continuous text. Both optical and electronic devices are often necessary for individual to continue their daily activities. The preference for electronic devices will be increased further in the future. Though there was no statistically significant improvement in distance visual acuity, the patients reported improvement in clarity of vision after refractive correction and with the preferred LVD while recognizing faces and objects in the room. For patients with low vision, even a small improvement in quality of vision can make positive difference in their visual performance and thereby improves the quality of life. However, patients in all three groups had statistically significant improvement in near visual acuity after low-vision intervention with P < 0.001.
The strengths of the study are the reasonable good sample (91 patients) and standard procedures at the LVC clinic. To the best of our knowledge, the correlation between different age groups in ARMD and consequent improvements by LVDs has not been done before. There are some limitations to this study. The fundus photographs, contrast sensitivity, and field of vision assessment were not performed in all the participants. LVDs improve the quality of vision and therefore will help in better performance of visual tasks of patients with ARMD.

**Conclusion**

Low-vision rehabilitation may be necessary for geriatric patients due to severe ophthalmological and physiological issues. The visual abilities of partially sighted patients can be enhanced making their day-to-day activities easier, increases quality of life, and allows them to continue to be self-confident, productive, and independent individuals. Therefore, we would like to emphasize the importance of referring patients with ARMD for low-vision rehabilitation services to improve their residual functional vision.

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**Conflicts of interest**

The authors have no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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