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Research Article

Comparison of Reading Speed in Low Vision Patients Using Different Types of Low Vision Devices Having Same Magnification Power

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Abstract

Aim: To assess the reading speed of low vision patients using different types of low vision devices having same magnification power for reading purpose.

Study Design: Prospective, cross-sectional study.

Method: This study was done on 30 patients, who were visited to Shri C.H. Nagri eye hospital (Tertiary eye care) and diagnosed as a low vision patients were enrolled in this study. Objective and subjective refraction performed. Objective refraction with Retinoscopy and subjective refraction for distance with Log MAR chart and near with MN READ chart has been performed. Patients having low vision will be compared with different type of magnifiers having same magnification power in respect to patients reading speed and comfort level with the help of MNREAD acuity chart.

Result: 30 low vision patients were enrolled in this study, who visited tertiary eye care center, among mean age of patients including was 44.3 ± 23.8 (11 - 80) years. Out of 19 (63.33%) were male population and 11 (36.66%) female population.

In most of the patients, low vision was caused due to retinal detachment (17%), Age related macular degeneration (14%), Retinitis pigmentosa (14%), Macular dystrophy (14%), and coloboma (10%).The low vision device including spectacle magnifier, stand magnifier and hand held magnifier with same magnification power of 2.5x, 3x, and 4x. Mean near visual acuity was (0.6 - 1) and maximum reading speed was 156 ± 78.49 (100 - 500) with spectacle magnifier.

Conclusion: It was found that reading speed with spectacle magnifier was maximum in all visual acuity size.

Keywords: Reading Speed; Reading Ability; Low Vision Aids (Spectacle Magnifier, Stand Magnifier, Hand Held Magnifier); MNREAD Acuity Chart

Abbreviations

ARMD: Age Related Macular Degeneration; RD: Retinal Detachment; RP: Retinitis Pigmentosa; DR: Diabetic Retinopathy; ROP: Retinopathy of Prematurity; ETDRs: Early Treatment Diabetic Retinopathy Study; BNA: Best Near Acuity; TD: Testing Distance; TNA: Target Near Acuity

Introduction

Globally, it is estimated that approximately there are 285 million people live with vision impairment, of whom 39 million are blind by WHO (World Health Organization) in 2010. In India, there are 12 million people are blind which is almost to one third of global blindness [1]. "A person with low vision is one who has impairment of visual functioning, even after treatment and or standard refractive correction and has visual acuity of less than 6/18 to light perception in better seeing eye or visual field of less than 10 degrees from the fixation point, but who uses or is potentially able to use vision for planning or execution of task" [2].

Coloboma: It is a congenital notch that is the result of a defect in the closure of the embryonic cleft. The optic nerve, choroid and retina can be involved posteriorly, anteriorly, the defect can extend forward and affect the iris [3].

Retinitis pigmentosa: It is the name given to a group of diseases characterized by progressive visual field loss, night blindness, and abnormal ERG recording. It is the most common of the hereditary retinal dystrophies [4].

Retinal detachment: It results from accumulation of fluid between the sensory retina and the RPE. This fluid collection occurs in three ways:

- Rhegmatogenous retinal detachment.
- Exudative retinal detachment.
- Tractional retinal detachment.

Diabetic retinopathy: It is an optic neuropathy caused by reduced blood flow to the optic nerve resulting in peripheral visual field loss progressing to central vision loss when severe.

Nystagmus: It is an involuntary, rhythmic, to and fro oscillation of the eyes. It is described by amplitude, frequency and wave form.

Cataract: Cataract formation is defined as opacification of the crystalline lens, which is classified by anatomic locations of the opacity. The types include anterior and posterior sub capsular, anterior and posterior cortical, equatorial, and nuclear.

Glaucoma: Glaucoma is an optic neuropathy caused by reduced blood flow to the optic nerve resulting in peripheral visual field loss progressing to central vision loss when severe. This disorder is classified as open angle or angle closure glaucoma. In addition, each type may be sub classified as primary or second.

Macular hole: A macular hole appears as a round red lesion in the fovea, usually from one-third to two-thirds of a disk diameter in size, with a gray halo of surrounding (marginal) retinal detachment [3].

Birth to 19yr	20 - 44 yr	45 - 65 yr	65 - 74 yr	75yr and older
Congenital cataract	Albinism	Diabetic retinopathy	Macular degeneration	ARMD
Optic atrophy	Cone-Rod dystrophy	Glaucoma	DR	Glaucoma
Albinism	Myopia	RP	Glaucoma	Cataract
ROP	RP, Macular degeneration	Macular degeneration	Cataract	DR
Cone-Rod dystrophy	Optic atrophy	Cataract	RP	

Table 1: Shows leading causes of legal blindness [3].

Myopic degeneration: Degeneration myopia occurs when there is excessive stretching and expansion of the posterior segment of the eye associated with increasing axial length. Gradual degeneration changes occur as the sclera, choroid, and retina become thinner [3].

Age related macular degeneration: ARMD is an acquired retinal disorder that is caused by degenerative changes in the RPE with subsequent degeneration of the overlying cones and rods. ARMD results in progressive, irreversible loss of central vision from fibrous scarring or geographic atrophy of the macular area [3].

Log MAR chart

A log MAR chart or bailey-lovie chart or ETDRS chart comprises rows of letters and is used to estimate visual acuity. Each line of

the Log MAR charts comprises the same number of test letters. The sloan font is used letter size from line to line varies logarithmically, as does the spacing between lines (making the chart easy to use at nonstandard viewing distances).

- When using the Log MAR chart, visual acuity is scored with reference to the Logarithm of the minimum Angle of Resolution. An observer who can resolve details as small as 1 minute of visual angle scores Log MAR 0, since the base-10 logarithm of 1 is 0.
- The snellen chart is also commonly used to estimate visual acuity. A snellen score of 6/6 (20/20), indicating that an observer can resolve details as small as 1 minute of visual angle corresponds to a Log MAR of 0.
- A snellen score of 6/12 (20/40), indicating an observer can resolve details as small 2 minutes of visual angle corresponds to a Log MAR of 0.3.
- Each letter has a score value of 0.02 log units. Since there are 5 letters per line, the total score for a line on the Log MAR chart represents a change of 0.1 log units. The formula used in calculating the score is: Log MAR VA=0.1+ Log MAR value of the best line read-0.02X (number of optotypes read).
- Given that each line has 5 optotype, the equivalent formula is: Log MAR VA=Log MAR value of the best line read+0.02X (number of optotype missed).

Magnification: It is the ratio of the size of the image and the size of the object.

Methods of determining the appropriate near magnification

Several methods can be used to determine the amount of magnification or equivalent power for near [3].

Lebensohns "reciprocal of vision" rule calculates the needed magnification by using the patients best corrected distance acuity and a near target acuity by dividing the denominator of the distance. Snellen fraction of the estimated target acuity, the required magnification is obtained.

To convert the resultant magnification to diopters, the magnification number can be multiplied by (1x=4D).

Kestenbaum's rule: Kestenbaum's rule also uses distance acuity to predict near magnification using the snellen fraction of best corrected distance acuity, the denominator is divided by the numerator to obtain the dioptric power needed to achieve 1M or 20/50 reduced snellen chart.

- Equivalent viewing power.
- Near magnification can also be determined by using a simple ratio comparing near VA to target acuity. This method involves the following steps.
- The patient's best near acuity (BNA) is determined with a single character acuity card and the testing distance (TD) is recorded.
- A target near acuity (TNA) is determined and a ratio is set up (BNA/TNA=TD/?).
- The unknown number (?) is the new reading distance that the reading material must be brought to obtain the appropriate magnification.

The reciprocal of this new reading distance (?) will provide the practitioner with the power of the lens required to read the target acuity.

Reading speed: It is an objective measure of reading performance. Research has shown that patients (with either normal or low vision) often require letters that are two or three times larger than their acuity limits before they can achieve their maximum reading speed [6].

The MNREAD acuity charts can be used to measure reading speed at different print sizes, and hence, can be used to determining the print size which supports the patient's maximum reading speed [6].

Testing procedure

Measuring reading speed can be combined with the reading acuity measurement. Instruct the patient to read each sentence aloud, as quickly and accurately as possible.

Use a stopwatch to record the time taken to read each sentence. Make a note of the times on the score sheet and mark any words that are missed or read incorrectly [6].

Calculation of reading speed

Reading speed is measured word per minute with the MNREAD acuity chart the reading speed calculation is simplified because each sentence has the same length: 10 standard length words. Reading speed is given by:

Reading speed= 60* (10-errors)/ (time in seconds).

Error= words that were missed or read incorrectly.

Name	Method	Examples
Relative size magnification	Increasing the actual size of the object being viewed	Large print material
Relative distance magnification	Reducing the distance between the object and the eye	Move object closer to the eye
Angular magnification	Increasing angular subtense of the image being viewed	Telescope, magnifier

Table 2: Three types of magnification in low vision.

Low vision management

Three types of low vision aids were prescribed:

1. Optical devices.
2. Non optical devices.
3. Computer assistive devices.

Optical Devices	Non-Optical devices	Computer assistive devices
For distance; Monocular and binocular telescopes, Binocular telescope, Spectacle mounted telescope	Large print books, Bold line notebooks, Felt tip pen, Reading lamp, Reading stand, Talking clock, Signature guide, Peaked caps, Filters, Tinted lenses, Torch	Closed-circuit television (CCTV), Head-Mounted Devices (HMD) 1-Low vision enhancement system (LVEs) 2- V-Max
For Near: Spectacle magnifier, Stand magnifier, Bar magnifier, Dome magnifier, Hand held magnifier, Illuminated stand magnifier		

Table 3: Low vision devices.

For near:

1. **Stand magnifiers:** A stand magnifiers is a convex lens that is mounted at a fixed distance from the reading material.

Advantages:

1. Extended working distance.
2. Portability.

3. Good for patients with tremors or poor motor control because of its stable base.
4. Large range of powers available.
5. Available with or without an illumination source.

Disadvantages:

1. Field of vision is reduced.
2. Too close reading posture is uncomfortable for the patients.
3. Blocks good lighting unless self illuminated.

2. Spectacle magnifiers: A low vision microscope can be described as a spectacle mounted convex lens. Microscopes enable the patient to take advantage of the principle of relative magnification.

Advantages:

1. Largest field of view of any near device.
2. Allows both hands free.
3. Good for patients with hand tremors or poor dexterity.
4. May sometimes be used for writing tasks.
5. Astigmatic correction can be incorporated in most lenses.

Disadvantages:

1. Working distance, depth of focus, possibility and binocularity decreases.
2. Higher the power, closer the reading distance.
3. Patients with eccentric fixation are unable to fix through these glasses.

3. Hand held magnifiers: Is a convex lens that a patients holds by means of a handle at various distances from the spectacle plane.

Advantages

1. Portability.
2. Relatively inexpensive or easy to prescribe or also illumination available.
3. Widely available with many shapes and sizes.
4. Allows for an extended working distance and hand movement.
5. Binocularity possible in lower powers with large lens diameter.
6. Work well with patients with eccentric viewing.

Disadvantages:

1. It occupies both hands.
2. Patients with tremors, arthritis etc. have difficulty holding the magnifier.
3. Field of vision is limited.

Importance of reading speed

Speed reading is a useful and valuable skill can save your time. Through speed reading a better understanding of any argument or discussion can be possibly done which can ultimately help in benefiting your work and career as because through speed reading a “clear and bigger” picture understanding can be done speedily.

Purpose of this Study

As there are many magnifiers available in Indian market which can be confused by low vision practitioner for prescribing to patients. So, the purpose of this study is to evaluate the magnifiers of same magnification and measuring reading speed.

Aim of the Study

The aim of this study is to assess the comparison of reading speed in low vision patients using different types of Low vision devices having same magnification power.

Review of Literature

Aurelia Calabrese, Paymon Rafian., *et al*. conducted a study of “comparing performance on the MNREAD ipad application with the MNREAD acuity chart” and found that 165 participants with normal vision and 43 participants with low vision tested. Results the ipad provides significantly slower estimates of maximum reading speed than the chart, with a greater difference for faster readers. The difference was an average 3% at 100 words per minute, 6% at 150 wpm, 9% at 200 wpm, and 12% at 250 wpm. For low vision maximum reading speed, reading accessibility index and critical print size are equivalent on the ipad and chart only the reading acuity is significantly smaller when measured on the digital [8].

Gale R., *et al*. studied "comparison of low vision reading with spectacle mounted magnifiers" they found that patient's reading ability and satisfaction were more with hybrid diffractive spectacle magnifiers as compared to refractive aspheric spectacle magnifier and aplanatic spectacle magnifier [9].

Nhung Xuan Nguyen., *et al*. conducted a study of "improvement of reading speed after providing of low vision aids in patients with age -related macular degeneration" and found that of 530 patients with different stages of AMD and resulted mean reading was 20 ± 33 wpm before and increased significantly to 72 ± 35 after provision of low vision aids for the whole group [10].

Henry L Feng., *et al*. in their study "the impact of electronic reading devices on reading speed and comfort in patients with decreased vision" compared reading speed of low vision patients with black illuminated and non illuminated electronic reading devices. Reading speed in words per minute was recorded and it was observed that text magnification minimized losses in reading due to low vision. They found that black illuminated devices may increase reading speed and comfort level relative to non illuminated devices [11].

Aurelie Calibers, Allen M. Y. Cheong., *et al*. conducted a study of "baseline MNREAD measures for normally sighted subjects from childhood to old age" participants ranging in age from 8 to 81 years and resulted first increasing from 8 to 16 years (MRS: 140 - 200 wpm), 16 to 40 years (MRS: 200 - 25 wpm) and decreasing to 175 wpm and 0.88 by 81 years Log MAR reading acuity improved from -0.1 at 8 years to -0.18 at 16 years, then gradually worsened to -0.05 at 81 years [12].

Michael D, Cross Land., *et al*. conducted a study of "Fixation stability and reading speed in patients with newly developed macular disease and found that the difficulty in reading speed in patients with macular disease can be partially attributes to impairments in fixation stability [13].

Materials and Methodology

Patients visited to Shri C. H. Nagri Eye hospital (Tertiary eye care hospital) and diagnosed as low vision patients were enrolled in this study.

Inclusion criteria:

- Low vision patients who is suitable for LVDs.
- Age group 11 to 90 years.

Exclusion criteria:

- Normal person.
- Blind person.
- One eyed patients.
- Illiterate patients.
- Intellectually disabled persons.

Materials

- Torch.
- Retinoscopy.
- Trial set.
- Log MAR chart for distance.
- MN Read chart for near.
- Near magnifiers - spectacle, stand and handheld magnifiers.
- Stop-watch.

Methodology

Following steps were included for thorough eye examination:

- Demographic data were taken which included age, gender and detail history of patients like ocular history, family history, and functional, occupational and vocational history.
- Visual acuity, objective and subjective refraction, colour vision, visual field were assessed. After the provision of LVA, reading speed with different type of LVDs having same magnification power is evaluated using MNREAD chart.

Steps of low vision assessment

1. **Review of the medical record:** Medical and Surgical record both systemic and ocular record.
2. **Observation:** Observing the patient's behavior and his physical status can provide an insight to the severity of the problem.
3. **Interview:** Interviewing is important in order to understand the emotional status and individual needs of the patient. The interview starts with the case history with emphasis on the visual problem. This is followed by the individual's personal

history that includes occupation, education, living status and specific functional aspects, like independence, orientation, mobility and activities of daily routine.

4. **Visual acuity assessment (Distance):** The procedure involves showing the patient large size numbers on sheets from a certain distance and asking him or her to identify them. Opto types, Single-letter chart gratings and crowded letters of different sizes may be shown to the patient alternatively. Log MAR visual acuity chart was used to assess distance vision.
5. **Near acuity assessment:** In this step the patient identifies or reads certain typeset of a smaller size from a nearer distance. The distance is accurately recorded. The typeset size is denoted in M size. Reading acuity is the patient's ability to read more congested and complex typeset prints from a measured distance. MN-read acuity chart was used to record near visual acuity.
6. **Equivalent viewing power:**

Magnification:

1. Equivalent power the patients best near acuity (BNA) is determined with a single character acuity card and the testing distance (TD) is recorded.
2. A target near acuity (TNA) is determined and a ratio is set up (BNA/TNA=TD/?)
3. The unknown number (?) is the new reading distance that the reading material must be brought to obtain the appropriate magnification.

The reciprocal of this new reading distance (?) will provide the practitioner with the power of the lens required to read the target acuity.

Reading speed:

Reading speed were assessed using MNREAD chart after providing low vision aid. Stop watch was used to record the time taken to read one sentence.

Reading speed = 60* (10- errors)/time in seconds.

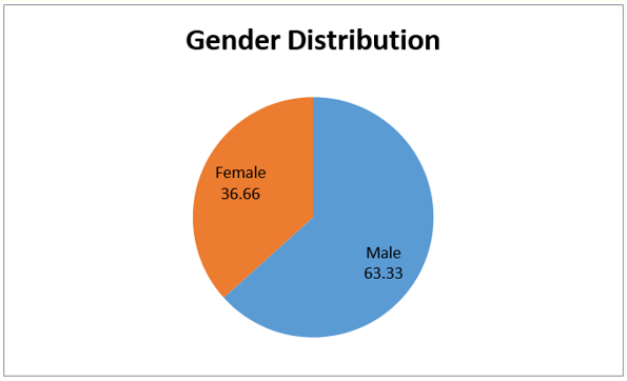
7. **Pinhole acuity assessment:** Pinhole acuity test used to assess the presence or absence of a refractive error improvement in vision through indicates that the person may benefit from refractive correction.
8. **Assessment of visual fields:** There are many techniques and equipment to measure the visual fields. The visual field test helps to evaluate central scotoma mid, long and peripheral constrictions.

The most commonly done test is the confrontation test. It is a screening test, in that examiner compares the patients' visual fields with his or her own visual field size. It gives an estimation of visual field losses in different quadrants. Amsler's grid test is a simple test, which helps in measuring any visual field losses in the central field by using a special grid.

9. **Refraction:** Objective refraction of low vision persons are not too different from the normal refraction procedure. In objective refraction done with the help of radical retinoscopy. Subjective refraction is done with the help of bracketing technique. Subjective refraction was performed using trial frame, full aperture trial lenses and vision chart.
10. **Glare sensitivity:** In certain conditions, glare can significantly reduce the visual acuity of patient of the patient. Sensitivity to glare should become obvious during the interview and it can actually be assessed by taking visual acuity after exposing the patient to the glare source and noting the reduction in vision.
11. **Low vision devices:** Trials for Low vision devices were given and then prescribed according to patient needs.

Results

30 low vision patients who met the eligibility criteria were included in this study. Among these, 19 (63.33%) were male patients and 11 (36.66%) were female patients.

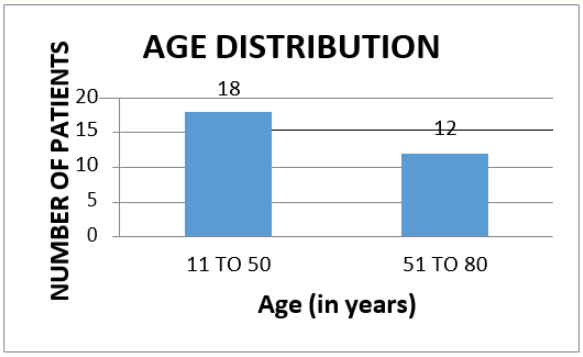


Graph 1: Shows ratio of male and female patients who were included in the study.

Out of 30 patients 19 (63.33%) patients were male and 11 (36.66%) patients were female.

Gender	Number of patients	Percentage %
Male	19	63.33
Female	11	36.66

Table 4: Gender distribution.



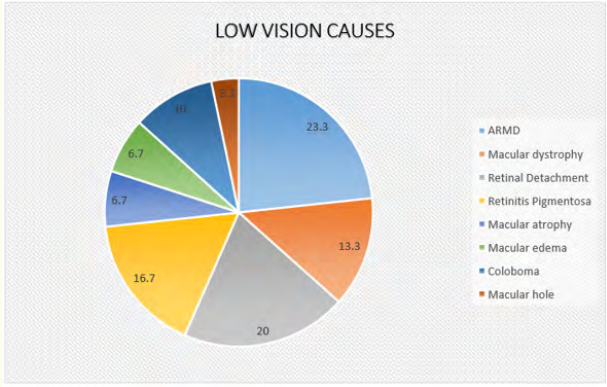
Graph 2: Shows ratio of age distribution of patients.

The age of low vision patients which were included in this study was between 11 to 80 years with mean age was 44.3 ± 23.8 (11 - 80) years.

Among these, highest number of low vision patients were found in age group between 11 to 50 years. This shows that younger patients were more affected with low vision. They require more reading speed for their work to benefit their career.

Group	Age (in years)	Number of patients
Group-1	11 to 50	18
Group-2	51 to 80	12

Table 5: Age distribution.

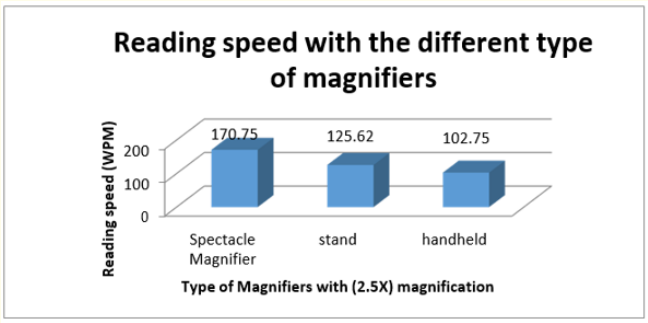


Graph 3: Shows distribution of patients according to causes of low vision.

Age related macular degeneration (23.3%), retinal detachment (20%), retinitis pigmentosa (16.7%), and macular dystrophy (13.3%) were found to be most commonest causes of low vision.

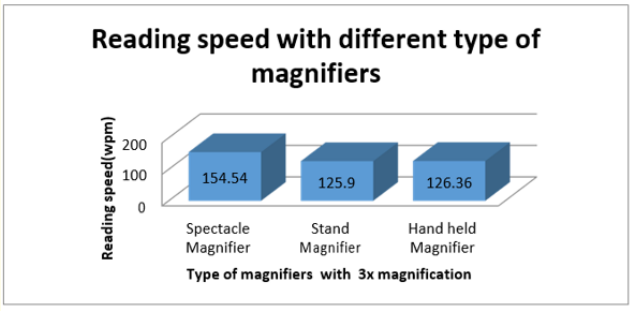
Causes of low vision	No of patients	Percentage
ARMD	7	23.3
Macular dystrophy	4	13.3
Retinal Detachment	6	20
Retinitis Pigmentosa	5	16.7
Macular atrophy	2	6.7
Macular edema	2	6.7
Coloboma	3	10
Macular hole	1	3.3

Table 6: Low vision causes.



Graph 4: Comparison of reading speed with different type of magnifiers with 2.5x magnification power.

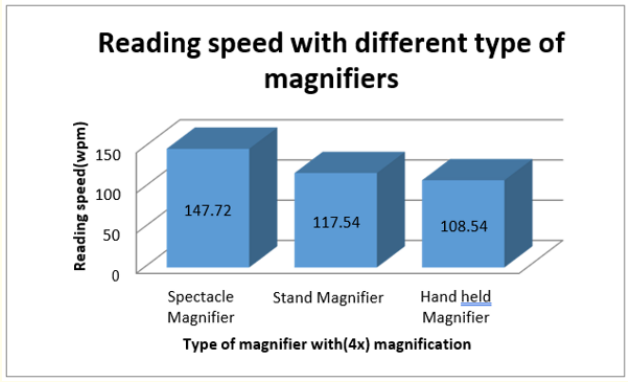
This graph shows that with 2.5x magnification, reading speed with spectacle magnifier was 170.75 wpm, stand magnifier was 125.62 wpm and handheld magnifier was 102.75 wpm. So, it has been seen that with spectacle magnifier, patients were showing more reading speed as compared to other magnifiers having same magnification power.



Graph 5: Comparison of reading speed with different type of magnifiers with 3x magnification.

This graph shows that for 3x magnification, reading speed with spectacle magnifier was 154.54 wpm, stand magnifier was 125.9 wpm and hand held magnifier was 126.36 wpm. This also shows that reading speed is more in spectacle magnifier as compared to other magnifiers.

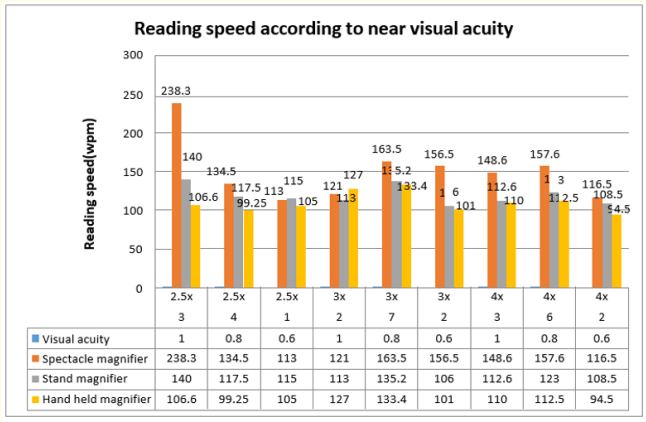
This graph shows comparison of reading speed with different magnifiers 4x magnifications.



Graph 6: Comparison of reading speed with different type of magnifier with 4x magnification.

For 4x magnification, reading speed with spectacle magnifier was 147.72 wpm, stand magnifier was 117.54 wpm and handheld magnifier was 108.54 wpm.

In this also, it shows that reading speed is more in spectacle magnifier as compared to other magnifiers.



Graph 7: Reading speed according to near visual acuity with same magnification power between spectacle magnifier, stand and hand held magnifier.

For visual acuity of 1M, reading speed of three patients with 2.5x magnification in spectacle magnifier was 238.3 wpm, with stand magnifier was 140 wpm and handheld magnifier was 106.6 wpm.

For visual acuity of 0.8M reading speed of four patients with 2.5x magnification in spectacle magnifier was 134.5 wpm, with stand magnifier was 117.5 wpm and handheld magnifier was 99.25 wpm.

For visual acuity of 0.6M, reading speed of 1 patients with 2.5x magnification in spectacle magnifier was 113 wpm, with stand magnifier was 115 wpm and handheld magnifier was 105 wpm.

Reading speed of two patients with 3x magnification, visual acuity of 1 M in spectacle magnifier was 121 wpm, with stand magnifier was 113 wpm and handheld magnifier was 127 wpm.

For visual acuity of 0.8M, reading speed of seven patients with 3x magnification in spectacle magnifier was 163.5 wpm, with stand magnifier was 135.2 wpm and handheld magnifier was 133.4 wpm.

For visual acuity of 0.6M, reading speed of 2 patients with 3x magnification in spectacle magnifier was 156.5 wpm, with stand magnifier was 106 wpm and handheld magnifier was 101 wpm.

Reading speed of 3 patients with 4x magnification, visual acuity of 1M in spectacle magnifier was 148.6 wpm, with stand magnifier was 112.6 wpm, and hand held magnifier was 110 wpm.

For visual acuity of 0.8M, reading speed of 6 patients with 4x magnification in spectacle magnifier was 157.6 wpm, with stand magnifier was 123 wpm and handheld magnifier was 112.5 wpm.

Reading speed of two patients with 4x magnification, visual acuity of 0.6M in spectacle magnifier was 116.5 wpm, with stand magnifier was 108.5 wpm and handheld magnifier was 94.5 wpm.

Statistical analysis was done with help of ANOVA test. P value of spectacle magnifier, stand magnifier and handheld magnifier were calculated by Anova single factor showing statistically significant ($p = 0.0039$).

Discussion

30 low vision patients who met the eligibility criteria were included in this study. Among these, 19 (63.33%) were male patients and 11 (36.66%) were female patients.

Reading ability is not only an important function in daily living tasks but also a complex psychophysical measure, including two related dimensions, reading speed (RS) and reading acuity. Visual acuity (VA), as the worldwide standard measure of vision function, is a simple criterion for assessing the need for referral, but reduced VA predicts only in part the level of reading impairment in low vision people and particularly, has a poor correlation with reading speed.

The age of low vision patients which were included in this study were between 11 to 80 years with mean age was 44.3 ± 23.8 (11 - 80) years. Among these, Highest number of low vision patients were found in age group between 11 to 50 years. This shows that younger patients were more affected with low vision. They require more Reading speed for their work to benefit their career.

It was found that age related macular degeneration (23.3%), retinal detachment (20%), retinitis pigmentosa (16.7%), and macular dystrophy (13.3%) were found to be most commonest causes of low vision.

Average near visual acuity for all patients with retinitis pigmentosa was 0.9 ± 0.13 (0.6 - 1) with mean reading speed with spectacle magnifier was 144 ± 45.97 (100 - 300) wpm, stand magnifier 111 ± 23.41 (91 - 171) wpm, Hand held magnifier 106.2 ± 16.53 (83 - 136) wpm.

Average near visual acuity for all patients with ARMD was 0.75 ± 0.13 (0.6 - 1) with mean reading speed with spectacle magnifier was 169.5 ± 92.22 (100 - 500) wpm, stand magnifier 160.7 ± 43.34 (91 - 250) wpm, hand held magnifier 156.5 ± 54.17 (75 - 315) wpm.

Average near visual acuity for all patients with macular dystrophy was 0.8 ± 0.13 (0.6 - 1) with mean reading speed with spectacle magnifier was 142.7 ± 44.51 (100 - 300) wpm, stand magnifier 125 ± 25.35 (78 - 171) wpm, hand held magnifier 117.5 ± 19.61 (74 - 150) wpm.

Average near visual acuity for all patients with retinal detachment was 0.86 ± 0.12 (0.6 - 1) with mean reading speed with spectacle magnifier was 127.6 ± 46.53 (100 - 300) wpm, stand magnifier 104.6 ± 23.55 (91 - 171) wpm, hand held magnifier 106.2 ± 17.48 (75- 136) wpm.

Average near visual acuity for all patients with coloboma was 0.8 ± 0.11 (0.6 - 1) with mean reading speed with spectacle magnifier was 123 ± 49.3 (100 - 300) wpm, stand magnifier 91.33 ± 28.39 (78 - 171) wpm, hand held magnifier 84.66 ± 22.31 (74 - 150) wpm.

In this study the mean near visual acuity was 0.8 ± 0.17 (0.6 ± 1) according to reading speed with same magnification power. Reading speed with spectacle magnifier is 149.94 ± 38.16 (113-238) wpm. Reading speed with stand magnifier is 118.97 ± 38.16 (113-238.3) wpm. Reading speed with hand held magnifier is 109.9 ± 12.82 (94.5- 133.4) wpm.

While comparing reading speed with 2.5x magnification with the different type of magnifiers including a spectacle magnifier, stand magnifier and hand held magnifier. Mean reading speed was 133.04 ± 34.60 (102.7-107.7) wpm.

The comparison of reading speed with 3x magnification with different type of magnifiers including a spectacle magnifier, stand magnifier and hand held magnifier. Mean reading speed was 135.6 ± 16.40 (125.9 - 154.5) wpm.

In the study on comparison of reading speed with 4x magnification with spectacle magnifier, stand magnifier and hand held magnifier. Mean reading speed was 124.6 ± 20.52 (108.5 - 147.7) wpm.

Among all the subjects included, for different visual acuity size the maximum reading speed was found with 2.5x spectacle magnifier. It was also observed that among all other magnification level (3x and 4x) reading speed was more with spectacle magnifiers as compared to that with handheld or stand magnifier.

Gale R., *et al*. studied "comparison of low vision reading with spectacle mounted magnifiers" they found that patient's reading ability and satisfaction were more with hybrid diffractive spectacle magnifiers as compared to refractive aspheric spectacle magnifier and aplanatic spectacle magnifier. Similarly, when compared spectacle magnifiers to handheld and stand magnifier in our study, reading speed was found more with spectacle magnifiers.

Henry L Feng., *et al*. in their study "the impact of electronic reading devices on reading speed and comfort in patients with decreased vision" compared reading speed of low vision patients with black illuminated and non illuminated electronic reading devices. Reading speed in words per minute was recorded and it was observed that text magnification minimized losses in reading due to low vision. They found that black illuminated devices may increase reading speed and comfort level relative to non illuminated devices.

It is important to prescribe such magnifier which will increase the reading speed for near. This study proved that with same magnification power, different magnifiers will give different reading speed in same patient. So, to provide accurate magnifier to each and every patient; it is must to measure reading speed with magnifiers. From the study, it has been seen that spectacle magnifier is best to accept by the patients in terms of reading speed and comfortness.

Conclusion

It is important to prescribe magnifier in which patient has maximum reading speed for near reading purpose. So, from this study, it was found that reading speed with spectacle magnifier was maximum regardless of visual acuity as compared to other type of magnifiers. Spectacle magnifiers increases reading speed and comfort of low vision patients as compared to handheld and stand magnifiers.

Bibliography

1. WHO (world health organization) criteria.
2. Definition of low vision by WHO (2012).
3. Richard L Brillant, O.D., F.A.A.O Associate professor of optometry.
4. AK Khurana comprehensive ophthalmology fourth edition.
5. Bailey IL, Lovie JE. "Visual acuity testing. From the laboratory to the clinic". *Vision Research* 90 (2013): 2-9.
6. MN READ acuity chart.
7. Importance of reading speed.
8. Aurelie Calabrese GE. "Comparing performance on the MNREAD ipad application with the MNREAD acuity chart". *Journal of Vision* 18.1 (2018): 8.
9. Gale R Watson., *et al*. "Comparison of low vision reading with spectacle mounted magnifiers". *Journal of Rehabilitation Research and Development* 42.4 (2005): 459-470.
10. Nhung Xuan Nguyen., *et al*. "Improvement of reading speed after providing of low vision aids in patients with ARMD in 2009". *Acta Ophthalmologica* 87.8 (2009): 849-853.

11. Henry L Feng., *et al*. "The Impact of electronic reading devices on reading speed and comfort in patients with decreased vision". *Journal of Ophthalmology* (2017): 3584706.

12. Aurelie Calabrese., *et al*. "Baseline MNREAD Measures for normally sighted subjects from childhood to old age". *Investigative Ophthalmology and Visual Science* 57.8 (2016): 3836-3843.

13. Michael D Crossland., *et al*. "Fixation stability and reading speed in patients with newly developed macular disease". *Ophthalmic and Physiological Optics* 24.4 (2004): 327-333.

14. MNREAD ACUITY CHARTs continuous- text reading acuity charts for normal and low vision, Regents of the university of Minnesota (1994).