GAVIN PUBLISHERS

OPEN ACCESS

Annals of Case Reports

Ndukuba SO. Ann Case Rep: 14: 430.

DOI: 10.29011/2574-7754.100430

Case Study

Near, Yet Far: Meeting the Intermediate Distance Needs of Individuals with Visual Impairment - Case Report

Dr. Samuel O. Ndukuba

Department of Optometry, Abia state University, Uturu, Nigeria

***Corresponding author:** Samuel O. Ndukuba, Department of Optometry, Abia state University, Uturu, Nigeria

Citation: Ndukuba SO (2020) Near, Yet Far: Meeting the Intermediate Distance Needs of Individuals with Visual Impairment - Case Report. Ann Case Rep: 14: 430. DOI: 10.29011/2574-7754.100430

Received Date: 25 June, 2020; **Accepted Date:** 30 June, 2020; **Published Date:** 07 July, 2020

Abstract

Individuals with visual impairment utilize a variety of solutions to tackle the challenges inherent in carrying out activities of daily living. Optical devices including telescopes, hand, stand and spectacle-mounted magnifiers can be used individually or in combination to tackle the distant and near visual needs of such individuals. There are however difficulties inherent in providing options for visually demanding intermediate tasks. This paper shows how these needs can be met.

The case is of a 27-year old system engineer who was diagnosed with retinitis pigmentosa. She complained of worsening vision and experiencing difficulty working with the computer especially when programming and sharing screens. We describe how a telemicroscope provided satisfactory solution for computer work at an intermediate distance.

The optics of a clip-on telescope, which is a form of telemicroscope makes it possible for individuals to carryout tasks at distances that neither a conventional magnifier nor a distance telescope can provide.

Keywords: Visual impairment, Low vision, Intermediate distance, Telemicroscopes, Vergence amplification

Introduction

Telemicroscopes are telescopic systems for near tasks [1]. This optical property of the telemicroscope is guaranteed by a reading cap which is placed in front of the objective lens of the telescope [1]. The power of the reading cap required is determined by the working distance at which the task will be undertaken. Most manufacturers of near vision telescopes have the dioptric power of the reading cap factored into the telemicroscope to serve at the desired intermediate distance, hence there is no need for reading caps being flipped.

Case report

In a first visit to a tertiary eye care unit in South India, in 1996, XX aged 4 years old presented to the pediatric ophthalmology. Her parents reported of poor vision, especially at night. Unaided visual acuities (VA) were 20/50 in right and left eyes, respectively. Dry retinoscopy and wet retinoscopy using cyclopentolate were recorded as +0.50D and +2.00D in both eyes respectively. On subjective refraction, she did not accept any refractive correction. The evaluation of the anterior segments of both eyes using the slit lamp biomicroscope were within normal limits including the crystalline lens status. Fundus examination revealed mottling of retinal pigment epithelium and arteriolar attenuation in both eyes. Based on the findings, she was diagnosed to have early retinitis pigmentosa. Vitamin A palmitate, twice a week (50,000 IU) was prescribed for management [2]. She was also referred to the low vision clinic for further management.

XX had consulted at the low vision clinic at the same tertiary eye care unit when she was 12 years old, studying in grade 8. She complained of difficulty in managing board work and independent mobility in dim illumination.

High contrast VA using the Sloan chart was 20/100 and 20/126 in the right and left eye respectively Low contrast (5% contrast) acuity was 20/160 in each eye. Near VA was N_{10} at 20 cm with Bailey-Lovie word reading chart (BLWRC). Retinoscopy findings were +1.50DS and +2.00/-0.50D×20 in her right and left eye respectively. There was no improvement in the visual acuity with refraction. Anterior segment evaluation with slit lamp biomicroscope was within normal limits. Visual field assessment using Humphrey's visual field analyzer was within normal limits in both eyes. Trial of assistive devices for distance was given, XX had improved to 20/40 in the right eye with a 4x monocular telescope that offers a visual field of 12.5 degree was prescribed and approach magnification advised for board work. She was also suggested to use approach magnification for watching television. Contrast enhancing measures such as using flash light in dim illumination was suggested.

Another visit of significance in the low vision clinic was when she was 23 years of age in 2015; XX had completed her graduation in Bachelor of Technology in Electronics and was working as an associate systems engineer. She complained of difficulty in working on the computer. Her high contrast VA was 20/126 and 20/160 in the right and left eye respectively. The low contrast VA was 20/200 in each eye. Near VA was N_{10} at 20cm with BLWRC. Retinoscopy values were +3.50/-1.00x90˚ and +4.00/-2.00x45˚ in right and left eye respectively. On subjective refraction, she improved to 20/100 with +1.50/-1.00×90 in right eye and to 20/126 with +3.50/-2.00D×45 in left eye. Demonstration and basic orientation of using assistive software including screen reader software- Job Access with Speech (JAWS) and screen magnification software- Magnification of Icons (MAGic) was given in rehabilitation unit.

A follow up visit with the low vision clinic at age 27 revealed same complaint of worsening vision and difficulty with working on the computer especially in programming and sharing screens as an associate system engineer. Distant VA was 20/200 in right and left eye respectively. The near VA was N_{12} at 15cm with BLWRC. Both objective and subjective refraction were performed with VA improving by one line to 20/160 in each eye with a subjective refraction of +2.25/-0.75D×150˚ in right eye and +2.50/-1.25D×30˚ in left eye. Management options were discussed with advice to maximize relative size magnification (RSM) and relative distance magnification (RDM) while working on her computer given. XX's response revealed job requirement made both options almost impossible considering that her work (programming) was hampered when the screen was magnified to suit her vision. She also reported that working from a very close distance of 15 cm was difficult as she needed to have a wider range of view of her computer screen per time, hence needed a working distance around 50 cm. Knowledge got from trainings in both JAWS- a screen reader assistive software and MAGic- a screen magnification software (both from Freedom Scientific) could not profit considering her job requirements.

Determining magnification and management

The formula to determine the magnification required for intermediate tasks is as follows:

Magnification = $\frac{Dw}{Dm}$

(where D_w is the closest distance the individual can comfortably use for task and D_m is the closest distance the task has to be brought for the individual to see it clear enough to perform task effectively [3].

The BLWRC was used to determine the D_w and D_m with reference to N_{12} and a computer in the clinic was used to confirm with a reported similar outcome using the font size 12. Note that, the points of the Times New Roman of a computer is equivalent to the N notations of the BLWRC thus; 8 Point = N_8 [4]. So, there are little concerns about discrepancies in her real-world task and the test card used in evaluation in the clinic.

Hence, Magnification = $\frac{50}{15}$ = 3.3x

With the magnification determined, trials were made with the following available forms of telemicroscopes; 2.8x spectacle mounted binocular telemicroscope, 2.1x Galilean spectacle type telescope (Max Detail glasses) and 2.1x Galilean type clip-on telescope (Max Detail clip).

2.1x Galilean type clip-on telescope (Max Detail clip) was preferred as XX reported it was more comfortable and cosmetically suitable for her.

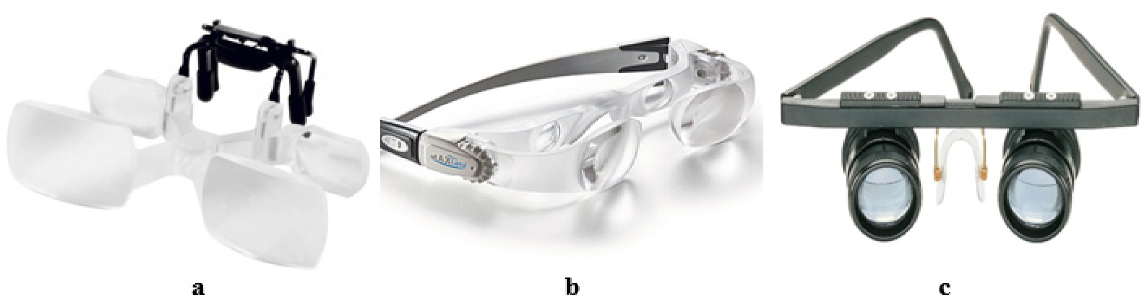

Figure 1: a: Galilean type clip-on telescope (Max Detail clip); b: Galilean spectacle type telescope (Max Detail glasses); c: spectacle mounted binocular telemicroscope.

Telemicroscope options/ forms	Field of view	Ease in binocularity	Size/ bulkiness	Variability/ flexibility
Clip-on	Good field	With IPD range of 62-70mm and variable positioning, binocularity is easy	Light weight	Fixed objective and eye piece lens do not support a range of WD. Limited to around 40cm. Comfortable for flip on distant correction
Spectacle form	Restrictions in field	Good IPD range, its variable focus can be a limitation	Light weight	Variable focus but for a limited range
Spectacle mounted binoculars (with caps)	Significant restrictions	Could be clumsy most times. When you start adding different caps they will create increasing binocular vision problems unless telescope convergence is adjusted.	Quite bulky, detachable reading caps can make it even more	Can be used for a wide range of WD using the appropriate reading caps

(Sourced and summarized from product descriptions www.eschenbach.com)

Table 1: Comparing three forms of telemicroscope.

New distance glasses were prescribed for constant wear (Right eye: +2.25/-0.75D×150˚, Left eye: +2.50/-1.25D×30˚). A 2.1x Galilean type clip-on telescope was prescribed for computer work. Clip-on telescope was advised to be used with a plano lens rather than own refractive lens prescription. This is because Galilean telescopes provide better magnification for an uncorrected hyperope [5]. With required magnification as 3.3x and available magnification as 2.1x, this optical outcome was beneficial. Contrast enhancing measures such as adequate lighting at home and work and appropriate choice of font when using computer were suggested. In the subsequent visits, the visual fields will be reassessed as retinitis pigmentosa causes peripheral visual field loss and is a progressive condition [6].

Discussion

Relative size magnification and RDM are sometimes effective options in meeting some visual needs of individuals with visual impairment including some intermediate tasks such as playing cards and sewing [7]. However, with conventional near and distance optical low vision devices and other forms of RSM and RDM, some other intermediate tasks may be unattainable. Tasks at intermediate distances such as working on a computer, reading music while playing a musical instrument or playing board games, often require longer working distance (it is near but distant), hands free magnification and need for scanning across the visual field [8,9]. They may require a different approach.

Telemicroscopes are distance telescopes that can be focused from infinity to near range or that can be modified by putting a reading cap over a distance unit. Telemicroscopes usually are more difficult to use because of their smaller visual field, critical depth of focus and apparent displacement of the material to be viewed. However, they allow individuals to perform tasks at a greater distance than spectacles or hand magnifiers at the same power [10,11]. Appropriate adjustment based on inter-pupillary distance is critical to achieve binocularity.

In the presented case, XX required a 3.3x magnification for her computer work at 50 cm. To provide for this magnification through RDM otherwise called approach magnification, it would be required that she worked as close as 8 cm before her computer screen; given that Magnification = $\frac{\text{Equivalent power}}{4}$ and that the reciprocal of the equivalent viewing power is the equivalent viewing distance [12]. Even low power spectacle magnifiers of 1.5x and 2x magnifications would require using the spectacle magnifier at distances of 16.7 cm and 12.5 cm respectively. Such would be uncomfortable and difficult distances considering the nature of her task.

It would have required a lot of accommodation for an afocal telescope with fixed lens positions to be used at intermediate distance such as the 50 cm in this case. Afocal telescopes with fixed lens positions are unable to be used for close work (unless the patient has ample accommodation) due to the vergence amplification effect, in which divergent light rays that enter the telescopic system from a near object emerge from the system with increased divergence [13]. The emergent vergence from an afocal telescopic system when used at a finite distance is approximately given by: $L'_2 = M^2 L_1$ (where L'_2 is the emergent vergence from the system (at the first principal plane of the eyepiece), L_1 is the incident vergence (at the second principal plane of the objective), M is the magnification of the afocal telescope [13,14]. If the required magnification of 3.3x were to have been given as a fixed lens-position afocal telescope, the emergent vergence to view an object at 50 cm would approximately be 22D. Therefore, to view the object clearly at this distance without adjusting the length of the telescope, the patient requires; an additional 22D of accommodation for reading. This would be too much to require for anyone let alone a 27-year old, whose average amplitude of accommodation is approximately 7D given that the near point of accommodation recedes with age [15]. However, with a reading cap placed in front of the objective to ensure the incident vergence is zero for the corresponding distance, the demand on accommodation is relieved [16].

Visual needs change with time as we get involved in varying tasks at different stages of life. From using the eyes to recognize faces to reading finger prints to more complex visual tasks of threading needles and writing computer programs, our visual demands tend to change [17]. Providing the adequate assistive devices to help individuals with visual impairment at each stage in life is an integral part of low vision rehabilitation [18]. This is clearly seen in the different stages of consultation in the case presented. It has been advocated that management of patients should be tailored to meet the specific needs of the individual. Optical devices are not to be prescribed just because of their magnification outcomes but in consideration of other factors that relate to the individual, lest, dispensing them would leave the patients unsatisfied. Factors such as cosmesis, comfort, simplicity and even cost should be considered to match the individual's needs, vision, job environment, social status and educational status [18]. Though there may not always be a wide range of options to explore, efforts at taking care of these must be made. Despite the magnification given by screen magnifiers (RSM), the job requirements of the case presented made it inapplicable. With computer screen to be kept within a given limit, there is a barrier to the use of RSM in the required tasks. Low vision management should always put these unique task demands into consideration. One of the key factors in the success of low vision rehabilitation is early intervention. Lower magnification optical devices can be prescribed at an early stage in management and it is easier for patients to learn how to use them, with their wider fields of view. Even if the individual progresses to more serious vision loss as is the case here, with the experienced success in low vision rehabilitation he/she is more likely to be motivated to continue with higher scales of management [19]. With the subject being managed for a span of 23 years, it is easy to see how this affects adjustments to the different stages in vision rehabilitation.

Conclusion

The demand to meet the intermediate distance needs of individuals with vision impairments would only increase especially with the increasing usage of computers and information technology in our society. Giving low vision individuals more ways to remain engaged in their passions and work remains a motivating factor in the practice of low vision. The optics of a clip-on telescope, which is a form of telemicroscope makes it possible for individuals to carryout tasks at distances that RSM, RDM, conventional magnifier nor a telescope cannot provide.

Declaration of Conflicting Interests

The author declares no potential conflicts of interest with respect to the case, authorship, and/or publication of this article.

Funding

The author acknowledges that he did this work in a clinical engagement in LV Prasad Eye Institute, Hyderabad India; through a sponsored capacity building project in low vision facilitated by Brien holden vision institute as funded by Standard chartered bank.

References

1. Vasconcelos G, Fernandes L.C (2015) Low vision aids.

2. Zhao, Y, Feng K, Liu R, Pan J, Zhang L et al. (2019) Vitamins and Mineral Supplements for Retinitis Pigmentosa. *Journal of Ophthalmology* 2019: 8524607.

3. Lewerenz, D (2010) *In the Middle - Helping Visually Impaired Patients with Their Mid-Range Needs*. Paper presented to America Academy of Optometry, San Francisco, CA. https://fliphtml5.com

4. Radner, W (2017) Reading charts in ophthalmology. *Graefes Arch Clin Exp Ophthalmol*. 255: 1465-1482.

5. Bailey, I.L (1981) Distance telescopes and ametropia. *Optometric monthly* 22-27.

6. Herse, P (2005) Retinitis pigmentosa: visual function and multidisciplinary management. *Clinical and Experimental Optometry* 88: 335-350.

7. Minto, H. and Butt, I.A (2004) Low vision devices and training. *J. Comm Eye Health* 17: 49.

8. Corn, A.L. and Erin, J.N (2010) *Foundations of low vision: clinical and functional perspectives, 2nd Edition*. AFB Press American Foundation for the Blind, 2 Penn Plaza, Suite 1102, New York. P. 775-776.

9. D'Andrea, F.M. and Farrenkopf, C (2000) *Looking to learn: promoting literacy for students with low vision*. AFB Press American Foundation for the Blind, 11 Penn Plaza, Suite 300, New York. P. 127-128.

10. Moore, J.E., Graves, W.H. and Patterson, J.B (1997) *Counseling with persons who are blind or visually impaired.* AFB Press American Foundation for the Blind, 11 Penn Plaza, Suite 300, New York. P. 98.

11. Hyvarinen, L. and Jacob, N (2011) What and How Does this Child See? Assessment of Visual Functioning for Development and Learning. Helsinki, Finland: Vistest Ltd; 174.

12. Jackson A.J, Wolffsohn J.S (2007) *Low Vision Manual. 1st edition*: Butterworth Heinemann Elsevier, 210-240.

13. Bailey, I.L. (1978) New method for determining the magnifying power of telescopes. *Am J Optom Physiol Opt* 55: 203-207.

14. Fried, A.N (1977) Telescopes, light vergence, and accommodation. *Am J Optom Physiol Opt* 54: 365-373.

15. Hashemi H, Pakbin M, Ali B, Yekta A, Ostadimoghaddam H, *et al.* (2019). Near points of convergence and accommodationin a population of university students in Iran. *Journal of Ophthalmic & Vision Research* 14: 306-314.

16. Vincent S.J (2017) The use of contact lens telescopic systems in low vision rehabilitation. *Contact Lens and Ant Eye* 40: 131-142.

17. National Research Council (2002) *Visual impairments: Determining eligibility for social security benefits*.

18. Dewang A Rebika D, Sneha A Rohit S, Radhika T (2007) Current perspectives in low vision and its management. *J Ophthalmol* 2: 125.

19. Whittaker S.G, Scheiman M, Sokol-McKay D.A (2016) *Low vision rehabilitation- a practical guide for occupational therapists. 2nd edition*: SLACK Incorporated New Jersey, USA: 143-160.