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Original article

Low vision aid—A ray of hope for irreversible visual loss in the pediatric age group

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ABSTRACT

Purpose: To analyze visual acuity (VA) improvement, causes of low vision (LV), and quality of life (QOL) following the use of low vision aids (LVAs) in children with LV.
Methods: A prospective analysis was conducted on children with LV aged between 4 years and 18 years between March 2013 and October 2013. Children were recruited from both urban schools and rural schools. LVAs were tried for visual improvement, and improved VA was noted. All children were trained to use the aid and followed up monthly for 3 consecutive months for VA improvement; QOL through a questionnaire was analyzed after the use of LVAs.
Results: A total of 74 children (148 eyes; 50% male; mean age, 11.8 ± 3.2 years) were analyzed, where 34 children were recruited from rural areas and 40 from urban schools. After LVA use, 101 (68.24%) eyes of 59 (79.72%) children improved for distance with telescope and 81 (54.72%) eyes of 51 (68.91%) children improved for near with magnifiers. LV due to retinal problems, optic atrophy, congenital anomalies, and amblyopia drastically reduced after use of LVA. A statistically significantly higher proportion of children had either "excellent" or "good" QOL, and a significantly lower proportion of children had either "not satisfactory" or "poor" QOL after the use of LVA ($p < 0.0001$).
Conclusion: LVA is essential and effective in improving VA and QOL in children with LV.

1. Introduction

The World Health Organization describes a person with low vision (LV) as one who has an impairment of visual function, even after treatment and/or standard refractive correction, and has a visual acuity (VA) of <6/18 to perception of light (PL), or a visual field of <10° from the point of fixation, but who uses—or is potentially able to use—vision for the planning and/or execution of a task for which vision is essential.[1]

The prevalence of LV in children is > 10 times that of pediatric blindness, with 7 million children worldwide having LV due to ocular disease and 10 million having LV due to uncorrected refractive error.[2] The prevalence of LV in a population-based cross-sectional study in India was reported to be 1.05% in the year 2000, with a burden of 10.6 million people requiring LV services.[3] The magnitude of LV is estimated to be 54.5 million in India (Fig. 1).[4] Many children in schools for the blind often receive formal education using Braille without the need of being actually there, whereas those attending regular schools do so with varying difficulties in coping with their studies and social interaction, and a few others are school dropouts.[5]

LV is characterized by irreversible visual loss, decreased visual field, glare, and contrast, and decreased ability to perform daily activities such as reading or writing, and some people who suffer from this condition may be socially withdrawn. Children with LV can be benefited and have the same quality of life (QOL) as that of normal children if they are provided and guided to use low vision aids (LVAs).[6] The major goals of LV management in children are to increase their functionality (make the most of residual vision), make the children independent, help in their education, and improve their social activities. The most important principle of LVAs (optical) is magnification, which helps in identifying what is being viewed.[7] Prior to dispensing LVAs, one has to collect the following information: ability of the child to visualize, possible viewing distance from the object, duration of activity, whether one or both hands are involved, weight, appearance, ease of handling of

Conflicts of interest: The authors declare that they have no conflicts of interest.

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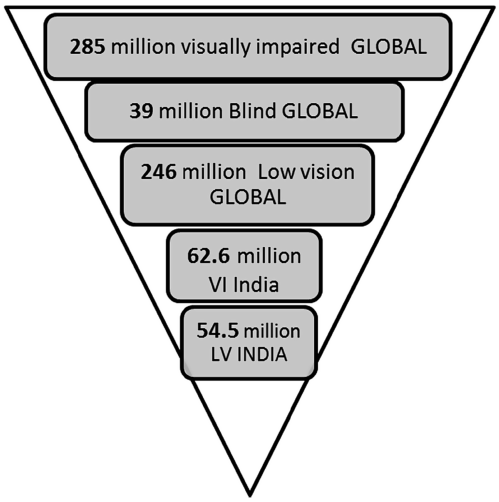

Fig. 1. Magnitude of visual impairment and low vision as per the World Health Organization.

the device, number of devices required for each patient, and most importantly the light factor.

Based on these factors, the present study was designed to analyze VA improvement, causes of LV, and QOL following the use of LVAs in children with LV.

2. Methods

This was a prospective analysis of LV in 74 children (148 eyes) with best corrected visual acuity (BCVA) of <6/18 (20/60) in the better eye using the Snellen chart. Children (aged between 4 years and 18 years) were recruited from urban schools (who attended our outpatient department), rural schools (through our school screening program), and rural camps between March 2013 and October 2013. Oral informed consent was obtained from the parents, and parents were counseled and explained about the use of LVAs (Table 1 and Fig. 2). Children who could not understand and handle the telescope and who could not come for follow-up were excluded from the study. The study adhered to all the principles outlined in the Declaration of Helsinki.

The Snellen chart was used to assess VA for distance and for near vision. For all cases, BCVA was determined after refraction. Color vision, contrast sensitivity, electrophysiological tests, and visual field were done, wherever possible. LVA telescopes (4 × or 2.8 × ; uniocular or binocular) for distance vision and magnifiers (5D spectacles or hand lens 4 × or 10 × or 13 ×) for near vision were tried for VA improvement in each eye separately. Magnification required was determined as "required VA/present VA" for each patient. Children were given aid for "distance and near," "distance only," or "near only," depending on their requirement and improvement.

The improved VA and the eye that showed maximum improvement were noted. All children were trained to use the aid; they were also followed up monthly for 3 consecutive months for VA improvement, child's comfort with use of the LVA, daily activities, and their degree of dependency. QOL for each child was assessed with a short questionnaire (5 questions) given to their parents 3 months after the use of an LVA. Each question was based on the ability to see the blackboard, watch television, read books, their overall school performance, and social behavior. For each activity, a score of +1 was given if the answer was better after using an LVA at the end of 3 months, and 0 if the answer was "no". If the score was 100% (i.e., 5 points), the grade was evaluated as "excellent," 80% (i.e., 4 points) as "good," 60% (3 points) as "better," 40% (2 points) as "not satisfactory," and 20% (1 point) as "poor." The *p* value was calculated using Wilcoxon signed rank test for change in QOL after using LVAs.

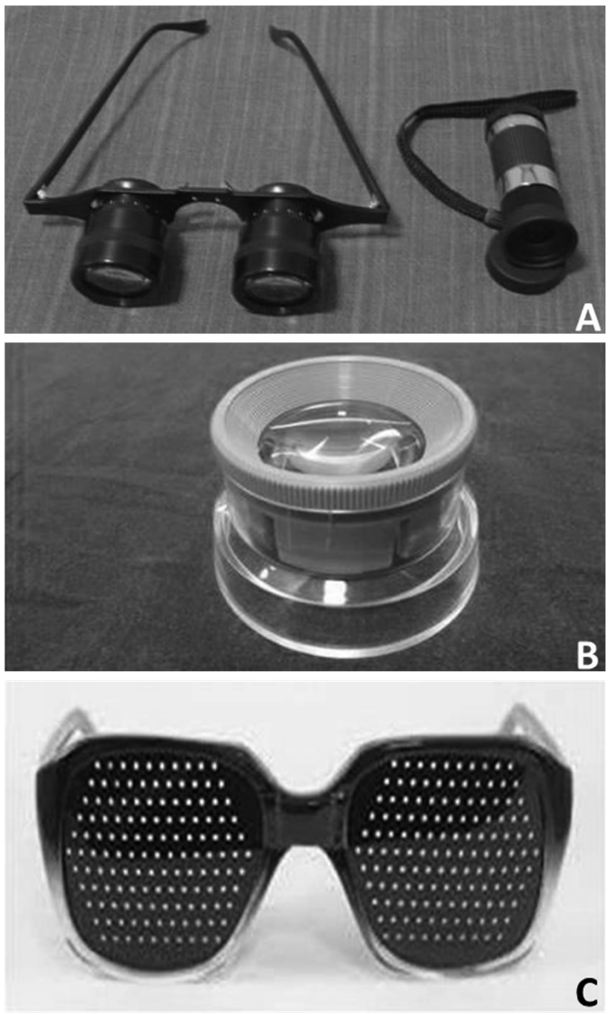

Fig. 2. Low vision aids. Optical devices: (A) telescopes and (B) dome magnifier. Nonoptical device: (C) pinhole spectacles.

Table 1
Low vision aids.

Optical devices
Telescopes (uniocular or binocular 2.8 × , 4 × , 5 ×)—for distance
Spectacle microscope, handheld lenses, pocket and dome magnifiers, and stand magnifiers—for near
VES autofocus—all distances (12 inches to ∞), wide field, and less weight
Nonoptical devices[a]
Filters, pinhole spectacles, accessory devices such as talking watches, clocks, mobiles, reading, and guides
Contact lenses—for albinism and aniridia
X chrome lens—for color blindness
Electronic devices
Mouse magnifier and electronic magnifier
Computer-assisted devices—for higher magnification (both hardware and software are available)
Field enhancement devices

VES = visual enhancing system.
[a] Nonoptical devices have large print reading materials, better illumination, black felt tip pen, typoscope, glare reduction, and contrast enhancement devices.

3. Results

Seventy-four children (148 eyes; 50% male) aged between 4 years and 18 years [33 (44.5%) were aged 4–11 years and 41 (55.4%) were aged 12–18 years] were analyzed. The mean age was 11.8 ± 3.2 years. Out of 74 children, 34 (46%) were recruited from rural schools and 40 (54%) from urban schools (Fig. 3). None of them had previously used an LVA. Mild developmental delay was observed in two (2.7%) children but because they could handle LVAs, they were enrolled in the study. Twenty-two (29.72%) children were prescribed spectacles. For distance vision improvement, 4 × telescopes was given to 44 children, 2.8 × telescope to 14 children, and 5 × telescope to one child. For near-vision improvement, a 5D spectacle was dispensed to 35 children, 3 × and 7 × stand magnifier to each of three children, and 5 × and 2 × stand magnifiers and 13D, 12D, and 10D hand lenses to each of two children.

3.1. BCVA for distance vision after receiving LVA

Prior using LVAs, 109 (73.64%) eyes of 58 (78.4%) children had BCVA as PL + to < 6/60, 36 (24.32%) eyes of 22 (29.7%) children had 6/60 to 6/24, two (1.35%) eyes of two (2.7%) children had no PL, and one (0.67%) eye of a child (1.35%) had a BCVA of 6/18 to 6/6 (Fig. 4A). After using LVAs, 101 (68.24%) eyes (52 right eyes and 49 left eyes) of 59 (79.72%) children had improved vision after using aids for distance; 39 (26.35%) eyes (22 were right eyes and 17 were left eyes) of 23 (31.08%) children had improved vision with LVAs 6/60 to 6/24, 61 (41.21%) eyes (29 were right eyes and 32 were left eyes) of 35 (47.29%) children had improved vision with LVAs 6/18 to 6/6, and one right eye (0.67%) of a patient (1.35%) had improved vision with <6/60. Two right eyes (1.35%) of two children (2.7%) had no PL prior to and after using LVAs. Forty-five (30.4%) eyes (20 were right eyes and 25 were left eyes) of 28 (37.83%) children did not show any vision improvement for distance (Fig. 4B). There was an improvement in distance vision after using LVAs.

After use of LVAs, the maximum vision achieved was 6/9 in a child with macular dystrophy who had a BCVA of 5/60.

3.2. BCVA for near vision after receiving LVA

The BCVA prior to using LVA was categorized as N36–N18 in 80 (54.05%) eyes (38 right eyes and 42 left eyes) of 46 (62.16%) children, N12–N8 in 61 (41.21%) eyes (34 right eyes and 27 left eyes) of 38 (51.35%) children, < N36 in three (2.02%) left eyes of three (4.05%) children, N6 in two (1.35%) left eyes of two (2.7%) children, and no PL in two (1.35%) right eyes of two (2.7%) children (Fig. 5A).

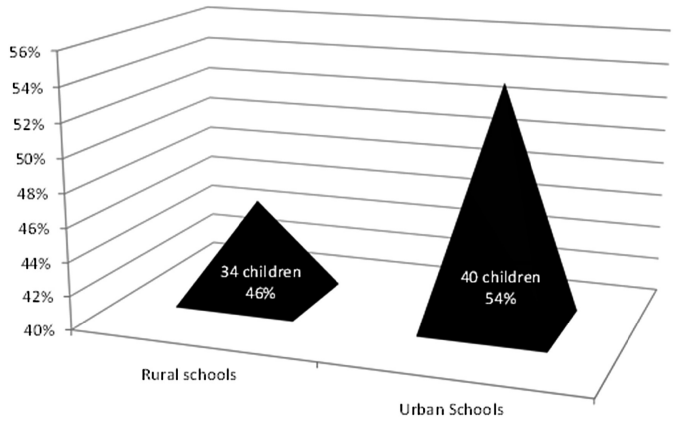

Fig. 3. Rural schools versus urban schools.

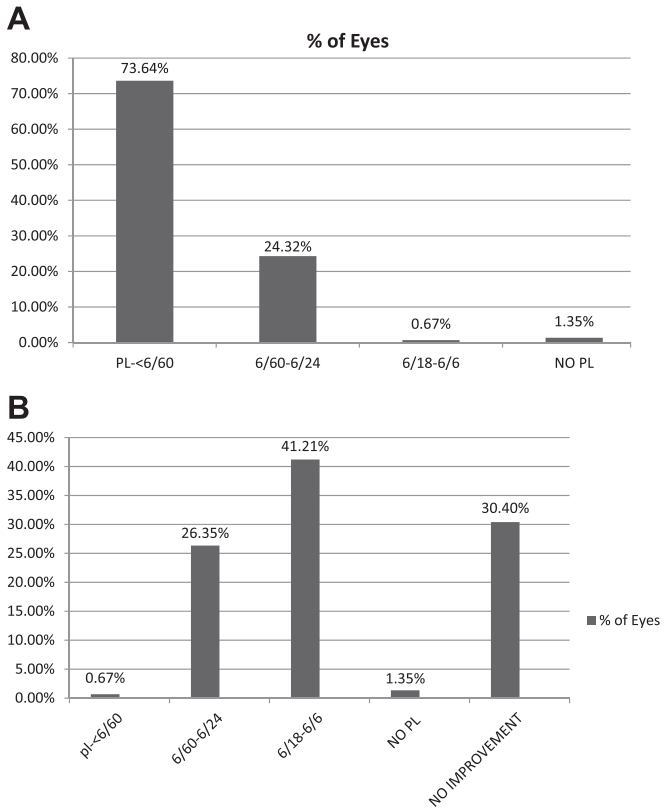

Fig. 4. Best corrected visual acuity (BCVA)—distance. (A) Prior to low vision aid (LVA). (B) BCVA after LVA.

After using LVA for near vision, the BCVA of 81 (54.72%) eyes (42 right eyes and 39 left eyes) of 51 (68.91%) children improved, where seven (4.72%) eyes (2 right eyes and 5 left eyes) of seven (9.45%) children had BCVA categorized as N36–N18 and 74 (50%) eyes (40 right eyes and 34 left eyes) of 44 (59.45%) children had BCVA categorized as N12–N8. Two right eyes (1.35%) of two (2.7%) children had no PL, two (1.35%) left eyes of two (2.7%) children had BCVA categorized as N6, and 63 (42.56%) eyes (30 right eyes and 33 left eyes) of 35 (47.29%) children had no improvement (NI) (Fig. 5B). There was an improvement in near vision after using LVAs.

The uniocular improvement for "only distance vision" was reported in 11 (14.86%) children, for "only for near vision" in four (5.4%) children, and for "both distance and near vision" in three (4.05%) children. The binocular improvement for "only distance vision" was reported in 88 (59.45%) eyes of 44 (59.45%) children, for "only for near vision" in 74 (50%) eyes of 37 (50%) children, and for "both distance and near vision" in 46 (31.08%) eyes of 23 (31.08%) children. Overall, 13 (17.56%) children did not show any improvement in either distance or near vision.

3.3. Eye disorders with LV

The major cause of LV was a retinal problem [27 (36.5%) children] followed by amblyopia [20 (27.0%) children], optic atrophy [14 (18.9%) children], and congenital anomalies [13 (17.6%) children]. After the use of LVAs, LV due to optic atrophy, congenital anomaly, retinal problem, and amblyopia drastically reduced.

3.4. QOL after receiving LVA

A statistically significantly ($p < 0.0001$) higher proportion of children had "excellent" (36.48%), "good" QOL (28.37%), and "better"

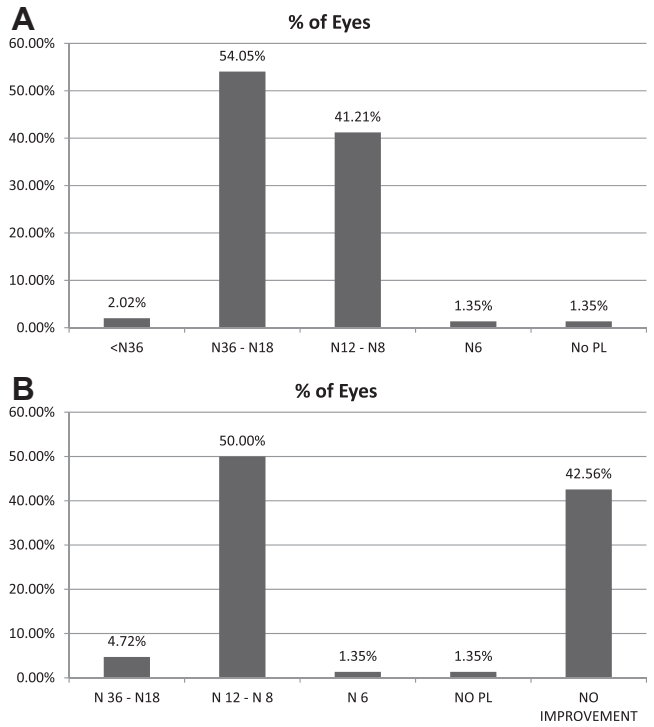

Fig. 5. Best corrected visual acuity (BCVA)—near. (A) Prior to low vision aid (LVA). (B) BCVA after LVA.

(13.51%) QOL, and a significantly lower ($p < 0.0001$) proportion of children had either "not satisfactory" (4.05%) or "poor" (0%) QOL after using LVAs (Fig. 6). There was no improvement in QOL in 17.50% of children. The youngest child who has benefited with LVA was 4 years old.

4. Discussion

Visual impairment is a global concern and likely to increase with advances in science and technology, and increased life span.[8] Studies have advised to focus on improvement in existing eye health services for visually impaired children in urban and rural areas via proper vision assessment, eye health education, and associations. Hence, input from the general public, community health workers, and governmental and institutional support is required to achieve Vision 2020 objectives to decrease childhood blindness.[9–11] The present study focuses on the need for regular screening programs in schools and in areas where there is no approach to detect LV in children, and evaluate the LVA in improving VA and QOL of children with LV.

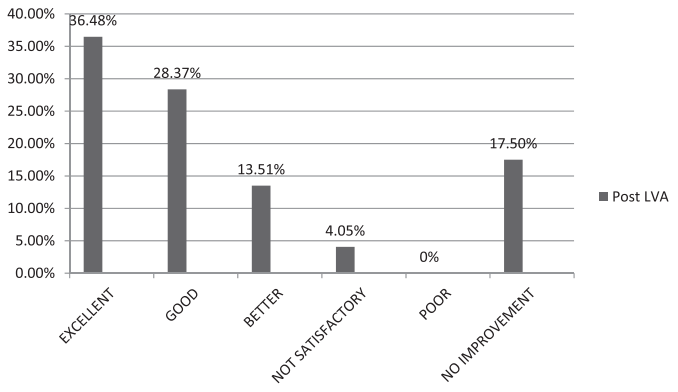

Fig. 6. Quality of life.

The predominant causes of decreased vision in our study were retinal diseases (37%), amblyopia (27%), optic atrophy (19%), and congenital anomalies (chorioretinal coloboma/microphthalmos/microcornea and nystagmus) (18%). Our results were in concordance with earlier studies where the major causes of LV were reported as corneal problems (36%), cataract (31%), retinal disorder (21%), macular degeneration (21%), congenital glaucoma (20%), retinitis pigmentosa (20%), iridofundal coloboma (18%), optic atrophy (17%), nystagmus (15%), and albinism (12%).[2,5,9,12]

Visual impairment results in an overall reduction in QOL.[13] Various studies have emphasized the need for visual rehabilitation and improvement in QOL in "incurably blind children" by use of spectacles and LVAs.[12,14–18] The improvement in BCVA < 6/60 (for distance amounting to legal blindness) helps the children in seeing the blackboard better and hence an overall improvement in school performance. In the present study, the youngest child who benefited with LVA was 4 years old and had heredomacular dystrophy with 5/60 in both eyes. After he was prescribed with 4 × telescopes, his BCVA improved to 6/9 and to N8 with magnifiers, implying the positive role of LVAs in enhancing the VA of children with LV. A similar result was observed in Skillen's[19] study, where improvement in a 6-year-old child's VA was facilitated by the early introduction of LVA.

In our study, there was an improvement in VA for distance (68% eyes of 80% children) and near vision (55% eyes of 69% children) after the use of LVAs, thereby enabling children to see the blackboard better and improving their overall school performance. Our results were in sync with earlier published findings where LVAs were found as an effective means of providing visual rehabilitation.[7,12,14–17]

In addition, a statistically significantly higher proportion of children had improved QOL (excellent/good) after using LVAs. Our results are in parallel with earlier reports, where significant improvements were observed in the users' routine activities after use of LVAs.[9,18,20,21]

In conclusion, LVAs are highly effective in improving VA and QOL in children who have impaired vision with eye disorders, including congenital anomalies, optic atrophy, retinal problems, and amblyopia. Hence, screening of children in rural areas as well as preschool screening is of utmost importance and can help in early identification of children with LV.

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