REHABILITATION MANUAL 36

LOW VISION CARE MANUAL

- Revised Edition -

Editor
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NATIONAL REHABILITATION CENTER
FOR PERSONS WITH DISABILITIES
JAPAN

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Low Vision Care Manual - Revised Edition -
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PREFACE

Rehabilitation manual No. 36 is a low vision care manual in the field of ophthalmology. Low vision can be caused by various malfunctions related to vision (e.g., visual acuity, visual field, color vision, brightness, fixation, eye movement, and binocular fusion/stereoscopic vision), which hamper activities of daily living that we never pay attention to otherwise, such as cooking, shopping, and reading. Low vision care consists of utilizing the remaining visual function and providing individually tailored support to minimize the impact of these disabilities as much as possible (e.g., enlarging letters, increasing contrast, reducing glare with absorptive lenses, and correcting for diplopia with prismatic glasses).

Low vision care also includes social welfare support (e.g., orientation and mobility support, daily activity training, continued or new employment training, disability pension consultation, and disability certificate applications), school support, and psychological support.

For those whose remaining visual function cannot be utilized, the training should primarily focus on non-visual skills, such as Braille, personal computers with screen reader, and orientation and mobility. Non-visual training may also be conducted separately from low vision care in the form of vision rehabilitation. However, this manual covers full range from low vision care that utilizes the remaining visual function to non-visual training as part of low vision care.

Cataracts and refractive errors are the leading causes of visual impairment globally. The fact that both are treatable diseases highlights the differences in ophthalmological medical conditions between countries. Early detection of diseases and provision of possible treatments are of the utmost importance in protecting visual function. In countries where ophthalmological medical care is not well developed, the concept of "eye care" has been gaining attention from the perspective of preserving the remaining visual function.

Therefore, this manual is divided into two chapters, "Low Vision Care" and "Eye Care."

Medical care should ideally consist of prevention, treatment and rehabilitation in this order of priority. However, ophthalmologists, in many countries, including Japan, do not always follow this order. Currently many Japanese ophthalmologists assign the highest priority to treatment, and only a limited number of ophthalmologists focus on prevention and rehabilitation. This tendency remains deeply ingrained in practice to this day. Recently, however, low vision and eye care have finally been tackled in ophthalmology education for medical students and residents in Japan and now are often listed as the subjects of academic societies and textbooks, resulting in increased interests among ophthalmologists.

Age-related decline in visual functionality starts from middle age. Eye disease-related functionality decline tends to occur in advanced age. They are both included in the scope of low vision care. In Japan, super-aging is currently progressing and many senior citizens have one or more forms of eye diseases, regularly visiting ophthalmologists. However, as some rural areas have fewer ophthalmologists and lower transport infrastructure than urban areas despite the rural areas having more aging population, regular visits are more difficult, especially for elderly low vision patients with difficulty in operating a vehicle.

We hope that this manual will contribute to the development of low vision care in Asian and Western Pacific countries, as well as in Japan.

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Chapter 1. Low vision care

1. General Remarks

1) What is low vision?

According to World Health Organization (WHO), low vision is defined as the corrected visual acuity of the better eye between 0.05-0.3, with blindness being defined as that less than 0.05. In Japan, there is no quantitative definition for low vision; rather, it is a collective term that refers to the state of experiencing inconvenience in daily life due to visual impairment, including narrowed visual field and photophobia.

In 2002, the International Council of Ophthalmology (ICO) distinguished low vision from blindness depending on the availability of visual aids for the visually impaired and recommended the ICO classification adopted in 1978. As shown in Table 1, a part of the visual function clarified as blindness according to the WHO corresponds to low vision in the ICO classification.

Table 1. Comparison of ICO classification and WHO classification

<table>
<tr><td colspan="2">ICO</td><td colspan="2">WHO/ICD-10 (2013 edition)</td><td>Decimal visual acuity</td><td>logMAR</td></tr>
<tr><td colspan="2">Normal range</td><td colspan="2">Normal range</td><td>2.0 to 0.8</td><td>-0.3 to 0.1</td></tr>
<tr><td colspan="2">Mild visual impairment</td><td colspan="2">Mild visual impairment</td><td>0.63 to 0.32</td><td>0.2 to 0.5</td></tr>
<tr><td rowspan="4">Low vision</td><td rowspan="2">Moderate visual impairment</td><td rowspan="3">Low vision</td><td rowspan="2">Moderate visual impairment</td><td>0.25 to 0.125</td><td>0.6 to 0.9</td></tr>
<tr><td>0.1</td><td>1.0</td></tr>
<tr><td>Severe visual impairment</td><td>Severe visual impairment</td><td>0.08 to 0.05</td><td>1.1 to 1.3</td></tr>
<tr><td>Advanced visual impairment</td><td rowspan="3">Blindness</td><td>Blindness</td><td>0.04 to 0.02</td><td>1.4 to 1.7</td></tr>
<tr><td rowspan="2">Blindness</td><td>Same as blindness</td><td>Blindness</td><td>CF, HM, LP</td><td rowspan="2">≧1.8</td></tr>
<tr><td>Blindness</td><td>Blindness</td><td>NLP</td></tr>
</table>

LogMAR: logarithmic minimum angle of resolution

CF: counting fingers, HM: hand motion, LP: light perception, NLP: non-light perception

2) Necessity of low vision care

The inability of a person to fully utilize their eyesight impedes tasks such as reading, writing, and moving and poses difficulties in the person's general life (e.g., studies and work). If the patient still has trouble seeing after medical treatment, low vision care is indispensable in order to alleviate the inconveniences in daily life.

3) Low vision care mindset

“The low vision care mindset” represents the empath that low vision care specialists should have, who consider how to work with vision-impaired patients to improve their quality of life. This mindset is essential for the smooth progress of low vision care. A variety of devices are necessary for low vision care. However, to that, it is more important to understand the low vision care mindset.

4) Psychology of low vision patients

A sense of loss can be harsh when an individual often having been able to see normally in their daily life is afflicted with visual impairments due to some cause. Father Thomas J. Carroll from the U.S. listed 20 types of loss in his book "Blindness" (1961).

1. Loss of physical integrity
2. Loss of confidence in the remaining senses
3. Loss of reality contact with the environment
4. Loss of visual background
5. Loss of light security
6. Loss of mobility
7. Loss of techniques of daily living
8. Loss of ease of written communication
9. Loss of ease of spoken communication
10. Loss of informational progress
11. Loss of visual perception of the pleasurable
12. Loss of visual perception of the beautiful
13. Loss of recreation
14. Loss of career, vocational goal, and job opportunity
15. Loss of financial security
16. Loss of personal independence
17. Loss of social adequacy
18. Loss of obscurity
19. Loss of self-esteem
20. Loss of total personality organization

To recover from or overcome these 20 losses, the individual must first have their symptoms explained by an ophthalmologist, after which they must relearn simple techniques such as eating and putting on clothes, and continue with rehabilitation training.

The psychological responses of visually impaired individuals are thought to follow a process identical to the five stages of grief (Figure 1). It is easier to understand the process when activities of daily living are used as example. The activities that did not require much conscious thought before visual impairment, such as cooking, shopping, and greeting neighbors, become much more difficult due to low vision. The individual first denies own visual impairment, secondly becomes sad at why only he/she is affected, thirdly becomes angry, and then depressed. After some time, the individual gradually begins to accept his/her disability after realizing that there are things that they can do despite the low vision. However, even after the seemingly acceptance, he/she may revert to a previous stage at certain times events. Thus, the emotional stages of the low vision patient could be constantly in flux among these stages.

Understanding the psychology of the patient is extremely important for the low vision care physician because simplistic encouragement is never a solution. The low vision care physician should know that the appropriate introduction of low vision care can help the patient rapidly settle into the acceptance stage.

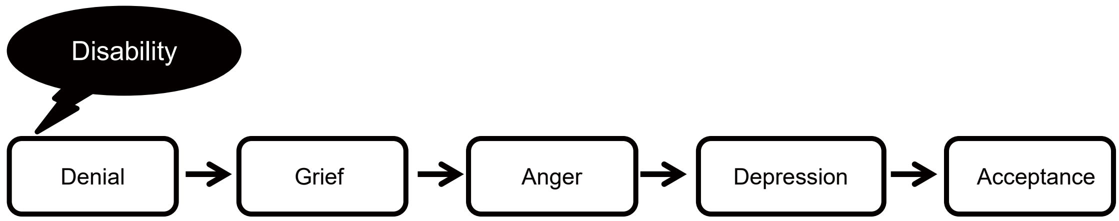


Figure 1. Progression of Psychological responses of visually impaired individuals

5) Current status of ophthalmology in Japan

The current population of Japan is about 130 million, and the number of Japanese ophthalmologists is about 14,000, which means that there are approximately 9,000 people per ophthalmologist. Most ophthalmologists are situated in big cities, resulting in large regional disparities. Approximately 80% of the Japanese ophthalmologists work in ophthalmology clinics. The number of ophthalmologists working per ophthalmology clinic is as little as 0.3, and many ophthalmologists also work at general hospitals. As Japan is a super-aged society, many older adults have some form of eye disease and need to visit an ophthalmology clinic. In rural areas, even though older adults make up the majority of the population, ophthalmologists are few and far. As the transportation infrastructure is inadequate, low vision patients who have difficulty in driving tend to have difficulty in visiting the hospital regularly.

Japan does not have an optometrist system; rather, the certified orthoptist (CO), a national qualification, exists as an alternative occupation. Under the direction of a physician, many Japanese orthoptists perform (i) general ophthalmological tests (general visual function tests related to ophthalmology); (ii) orthoptic correction (training guidance for strabismus, amblyopia, etc.); (iii) medical examination work (group examination visual function screening); and (iv) rehabilitation guidance for the visually impaired. The number of orthoptists in Japan is about the same as that of ophthalmologists, and similarly to ophthalmologists, most of them work in big cities.

Because Japanese universal health insurance system allows people to go to any medical institution, there is a strong tendency of patients to visit directly large and specialized hospitals. To mitigate the congestion in hospitals, the "family doctor system" has recently been introduced as a public initiative, in which a family doctor sees patients first and then refers to a large or specialized hospital when necessary.

In this situation, Japanese ophthalmologists in hospitals are still too busy with daily medical care, both in terms of personnel and time. In addition to fulfilling the ophthalmologist's greatest mission of curing eye diseases, many ophthalmologists have had little opportunity to learn about low vision care, and so often have trouble dealing with patients who have difficulty in seeing. Recently, however, the Japanese low vision care system has been reformed. Low vision care has been incorporated into the curriculums of medical schools and orthoptists education. Low vision care is now often featured in academic societies and textbooks, leading to increased attention among ophthalmologists and orthoptists. However, many ophthalmologists and orthoptists are still unsure how to provide low vision care amidst the demands of routine medical care.

At least 2.2 billion people in the world are visually impaired, and 1 billion of them could be prevented and treated. Cataracts and refractive errors are the leading causes of blindness globally, as many countries face shortage of ophthalmologists and other personnel who handle ophthalmological medical care.

6) Initiatives for individuals with disabilities in Japan

To consider systems related to low vision care, basic initiatives for individuals with disabilities in Japan are essential. In Japan, there is the Basic Act for Persons with Disabilities, which seeks to realize an inclusive society for those with disabilities so that they are equally valued as members of the society, allowing them to participate in a variety of activities or select their preferred communication methods. This act serves as the foundation for other laws related to disabilities, including the Services and Supports for Persons with Disabilities Act and the Act for Promotion of Employment of Persons with Disabilities.

The Fourth Basic Plan for Persons with Disabilities was implemented in the 5 years starting in 2018, with the basic principles of supporting individuals with disabilities to participate in social activities based on their decisions and fully utilizing their abilities for self-actualization. The four basic directions of this plan included “enforcing the removal of social barriers with the 2020 Tokyo Paralympics;” “valuing the concepts behind the Convention on the Rights of Persons with Disabilities and ensuring compliance;” “actively promoting the removal of discrimination against individuals with disabilities;” and “fulfilling our objectives for secure yet effective implementation.” The Convention on the Rights of Persons with Disabilities is based on the motto “Nothing about us without us”.

The Convention was ratified in Japan in 2014.

(Tomomi Nishida-Shimizu)

2. Full range of low vision care

1) Summary of full range of low vision care

The basic process of low vision care is as follows: (i) intake of medical history and needs→(ii) evaluation of visual function→ (iii) medical evaluation→ (iv) training and evaluation with low vision aids → (v) social adjustment training→ (vi) returning to society/daily life

These basic process involve a variety of professions, including ophthalmologists, certified orthoptists (COs), orientation and mobility specialists, and social workers. This system has the advantage of allowing each specialist sufficient time to work with the patient. In the past, only a limited number of ophthalmologists provided this full spectrum of low vision care.

Since remuneration for low vision test decision fees (discussed later) was introduced in 2012, a diversity of low vision care methods have become available now that more ophthalmologists have learned this process. While a majority of ophthalmologists worldwide deals with acute cases, low vision care, which requires time and personnel, cannot be responded. Being unable to provide a full-fledged low vision care, ophthalmologists are finding quick low vision care (discussed later), which requires less time and personnel increasingly necessary. Low vision care may be necessary depending on patient conditions, which must be carefully evaluated by experienced ophthalmologists.

(Tomomi Nishida-Shimizu)

2) Evaluation of present visual function

(1) Visual acuity

(i) Definition of visual acuity

Visual acuity is a measure of the ability of the eye to distinguish shapes and the details of objects at a given distance and is an important indicator for determining the level of visual function. Relative to photoreceptor cells in the retina and wave engineering, when observing two points that are spatially separated, they can be discerned separately if the distance between them is sufficiently wide. However, smaller distances may result in the individual failing to discern the two points and seeing them as a single point.

(ii) Visual acuity scale and optotypes

There are many types of charts used to measure visual acuity. Typical examples used in Europe and the United States include the Snellen letter chart (distance, 20 ft, or over 6 m) and the Early Treatment Diabetic Retinopathy Study chart: ETDRS (distance, 4 m).

The Landolt Ring or Landolt 'C' is the most widely used reference optotype for use in the vision-testing clinic in Japan.

The Landolt ring is an interrupted circle whose stroke width and gap width are one-fifth of its outer diameter. This optotype has the advantage that even patients who cannot read letters or characters can be measured by answering the direction of the gap in the circle (up, down, right, or left). The Landolt ring with visual acuity 1.0 at a measurement distance of 5 m has a diameter of 7.5 mm and an opening width of 1.5 mm (Figure 2)

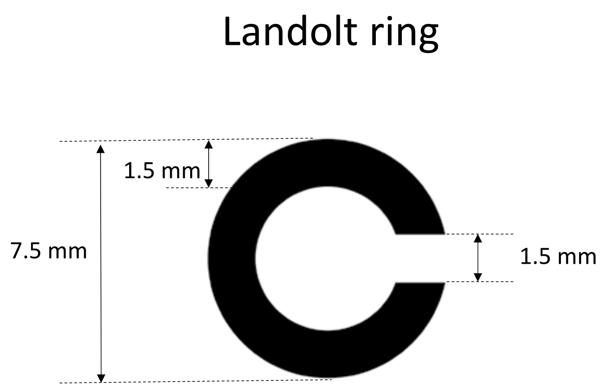


Figure 2. Landolt ring size (in tests, the distance is 5 m; visual acuity is 1.0)

(iii) Visual acuity (VA) notation

In Japan, the decimal vision system is widely used. The angle at which the eyes can perceive the minimum separable threshold (two points or two lines) is referred to as the minimum angle of resolution (Figure 3).The visual acuity expressed by the inverse of this angle (measured in minutes) corresponds to the decimal visual acuity value.

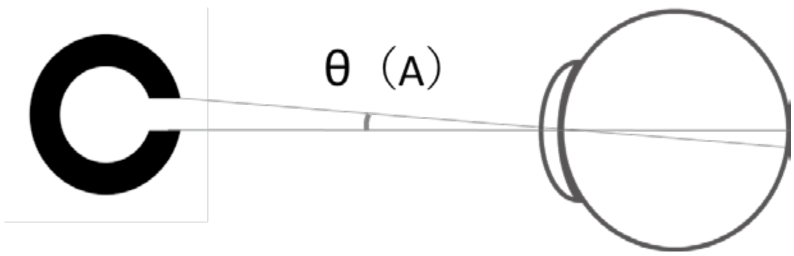
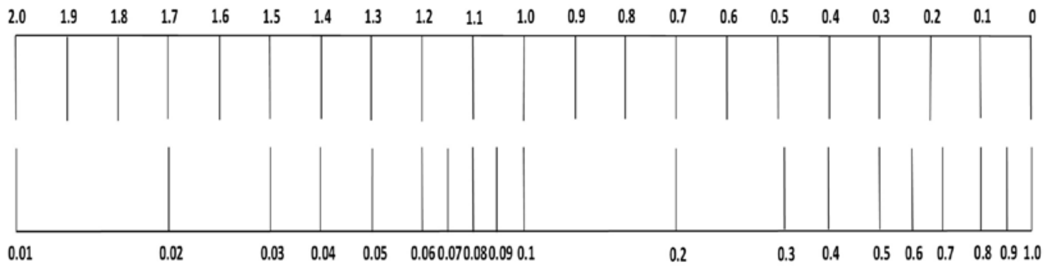


Figure 3. Minimum visible angle θ (A)

The decimal notation is equivalent to VA = 1/θ (θ: arc minute). For example, visual acuity is 1.0 when the minimum angle of resolution of the opening in the Landolt ring is 1 minute, 0.5 when the angle is 2 minutes, 0.2 when the angle is 5 minutes, 0.1 when the angle is 10 minutes. The visual target sequence of a standard decimal visual acuity table for a distance of 5 m is geometrically arranged in such a way that the visual acuity increases from 0.1 to 2.0 in increments of 0.1. Since visual acuity is the inverse of the minimum angle of resolution, this target sequence is not in equal intervals in terms of the visible angle. In other words, there is a difference of one step between decimal visual acuity values of 0.9 and 1.0, and 0.1 and 0.2, whose visual angles are 1.1 and 1 minute for the former, and 10 and 5 minutes for the latter. As the decimal visual acuity is on an ordinal scale. It is not suited for statistical analyses.

LogMAR is a logarithmic scale of identifiable minimum angles of resolution (MAR). The equation of logMAR = $\log_{10}$ (1/decimal visual acuity) is used to convert decimal visual acuity to logMAR. The logMAR optotype has equally spaced intervals of 0.1 logMAR between the visual targets. Thus, parametric statistical analysis of visual acuity is possible because the logMAR is on a standardized interval scale (Figure 4).

Upper row: Log MAR



Lower row: decimal visual acuity

Figure 4. Corresponding relationships between decimal visual acuity and logMAR

An important value for visual acuity is corrected visual acuity. Visual acuity measured with the naked eye, or without any glasses or contact lenses, serves as a reference for visual perception in daily life without glasses. However, corrections for the patients' refractive errors must be sufficiently conducted, and the corrected visual acuity with the clearest possible retinal image should be obtained as the evaluation standard for visual acuity.

In addition , distance and near vision are important. An optotype with letters placed at a test distance of 5 m is used as a visual target for distance vision. If the patient cannot determine visual targets of 0.1 (decimal vision chart) at a test distance of 5 m, the examiner brings the 0.1 visual targets closer to the patient until they can identify it. The visual acuity value is then calculated by applying the following formula from the maximum distance (xm) between the target and the patient where the target can be identified:

0.1× X/5 (Example: 0.1 optotype could be identified at 3 m → 0.1 ×3/5 = 0.06)

If the visual target cannot be identified even at 50 cm (visual acuity less than 0.01), the patient will be asked to identify how many fingers the examiner is holding up the fingers in front of the patient's eyes. (counting fingers). If the patient is unable to complete this task, the examiner will move their hands in front of the patient to test if the patient can identify the movement (moving hands). If the patient is unable to identify the movement of the hand, the pupils of the patient will be examined using a pen light in a dark room to check if the patient is able to distinguish light from dark (light perception).

Near vision involves measurements using a near-distance optotype at a visual distance of 30 cm. The near vision measurement is often prioritized in low vision care.

Refractive tests are first conducted for visual acuity. Normal vision is when a clear image forms in the retina when a parallel ray from infinity is projected into an unaccommodated eye. When there is a refractive error (myopia, hyperopia, or astigmatism), lens-based refractive correction is used to return the eye to normal vision to the fullest extent possible. Refractive error consists of myopia (image formed behind the retina), hyperopia (image formed in the focal point in front of the retina), and astigmatism (image formed in different locations depending on the meridian), and each have their refractive errors. The best-corrected visual acuity (BCVA) can be obtained by accurately correcting the refractive change. The BCVA is also essential for selecting low vision aids such as a magnifying glass.

(2) Visual field

Visual field refers to the range that a single eye can see while focusing on a single point, and it indicates the distribution of visual sensitivity. Additionally, any lesion formed between the eyeball and visual cortex results in a corresponding abnormality in the visual field. Hence, the visual field test is one of the essential ophthalmology evaluation processes, as well as visual acuity. The normal range of the visual field is roughly 60° in the superior side, 75° in the inferior side, 60° on the nasal side, and 90–100° on the temporal side (Figure 5).

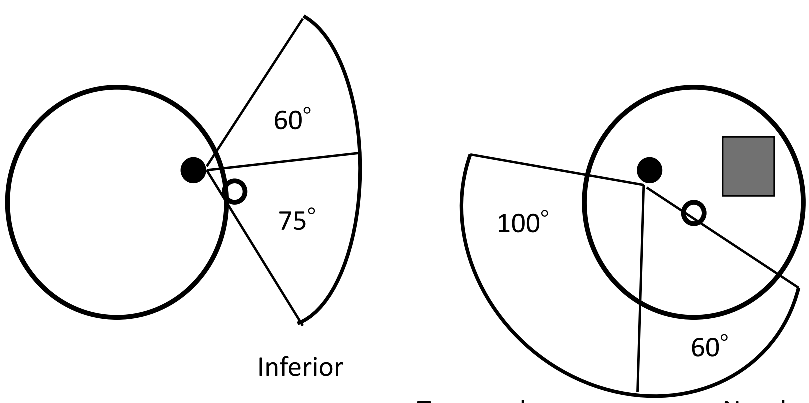


Figure 5. Normal limits of visual field

The methods for visual field measurement are categorized into dynamic and static. Dynamic measurements determine appearance threshold points (moving from a non-visible to visible location) for a light target with a given area and brightness, and record points with equivalent sensitivity as isopters (isosensitive curves), which are suited for determining overall visual field (Figure 5). The Goldmann Perimeter (GP) is representative perimeter for dynamic visual field measurements.

There are six types of light target sizes, V (64 mm^2), IV (16 mm^2), III (4 mm^2), II (1 mm^2), I (1/4 mm^2), and 0 (1/64 mm^2) in the descending order. Visual target brightness is determined by the density of the filter placed in front of the light source expressed in decibels (dB). Measurements are obtained by light dimming after combining those set from 4 to 1 at (5 dB) intervals with a 0.1 log filter (1 dB) of e, d, c, b, and a. The target becomes darker as the number gets smaller, and the alphabet gets brighter in order of a, b, and c. Generally, measurements of the nearby visual field are made with the brightest target “V-4e,” and isopters are measured using “I-4e,” “I-3e,” “I-2e,” and “I-1e”, in that order.

Intermediate isopters using the intermediate target “III-4e” are measured in cases with an interval greater than 20° between the isopters of the “V-4e,” which was used for nearby visual field measurements, and the next target of “I-4e.” However, in recent years, “III-4e” has been increasingly prioritized in low vision care, and so its measurements should be standardized.

Static visual field tests involve changing the brightness of the target to determine the discrimination threshold of light sensitivity.

Confrontation visual field tests allow quick assessment of the visual field, even without special equipment (Figure 6). This procedure is outlined below.

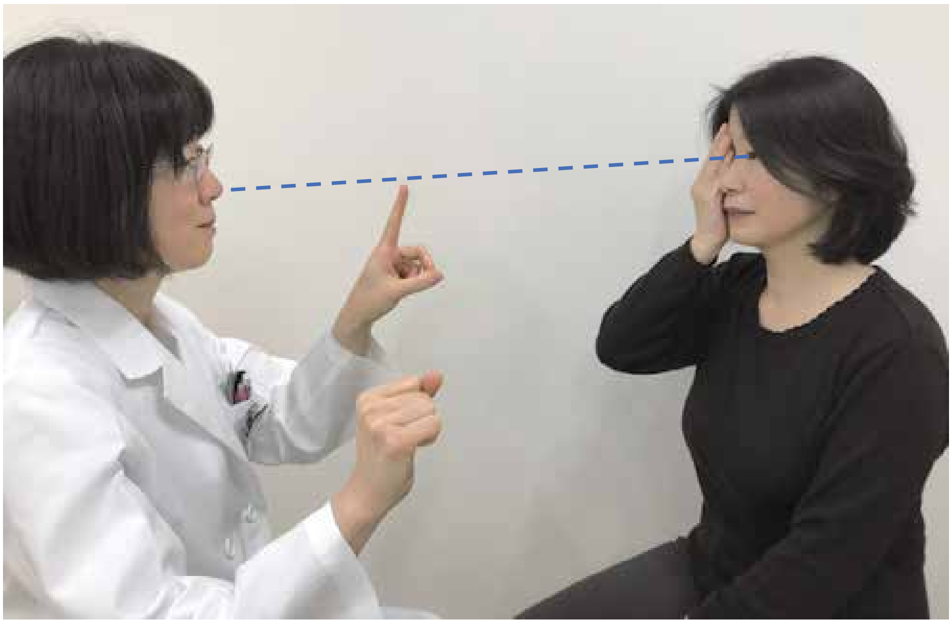


Figure 6. Confrontation visual field testing

The following procedure is used for confrontation tests:

1. The examiner faces the patient.
2. The patient covers one eye with his/her hand (the eye must be completely covered to prevent the patient from seeing between fingers).
3. The patient is directed to use the inspector’s nose or another object as a fixed target.
4. The inspector holds his/her hand (or object) at the upper-right, upper-left, lower-right, and lower-left corners of own visual field in the virtual plane between the inspectors and the patients, and checks to see whether the visual field range is normal.

(3) Others

Contrast sensitivity is visual function that cannot be characterized by visual acuity values alone.

The contrast sensitivity function test measures contrast sensitivity (inverse of contrast threshold) using a variety of spatial frequencies (sizes) and plots the relationship with spatial frequency on the horizontal axis and contrast sensitivity on the vertical axis.

Contrast sensitivity measurements are closely related to daily activity. Discrimination of objects becomes easier with increased contrast of the reflectivity between the object and background surfaces.

Color spectrum arrangement tests, which are a type of color vision test, may also be conducted on low vision patients. This test consists of color targets whose hues are slightly different from each other and arranged in the order of dissimilarity, starting from a discrete state.

(Marie Miwa)

3) Low vision aids

(1) Optical devices

(i) Correction of refractive errors

Refractive errors, such as hyperopia, myopia, and astigmatism are treated using eyeglasses or contact lenses. Since the image on the retina enlarged by a magnifier for low vision is still blurry for eyes with refractive errors, refractive errors must be treated. The right type of eyeglasses are selected to help the patient appropriate for the tasks they want to perform. There are a variety of glasses to choose from such as eyeglasses with single vision lenses for distance, intermediate, or near vision; eyeglasses with progressive or multifocal lenses for near and far, intermediate and near, or intermediate and near with a larger viewing area; and spectacle mounted magnifiers. The degree of refraction of a lens is indicated in diopter (D) and is the reciprocal of the focal length (m).

For those who have difficulty reading with eyeglasses with the additional power of +3.50 D or less, a high plus add could be an alternative (Figure 7). Trial lenses for a vision test could be used to determine the required power. It should be noted that a person wearing high power plus glasses could face the following problems when they start reading:

1. Unavailability of high magnification
2. Short working distance
3. Difficulty in keeping working distance due to the shallowness in depth of focus

For persons having difficulty in convergence, the use of prism or monocular reading may be an option. Spectacle mounted magnifiers are available in magnifications from 2× to 3× (Figure 8). With the addition of a lens cap, magnification as high as 10× is possible. As this type of magnifier allows the user to have both hands free, it is suited for manual work or playing an instrument with sheet music.

(ii) Magnifiers

Variations include a spectacle type, handheld type, and stand type (Figure 7).

When choosing a magnifier, it is important to consider the characteristics of the task that the magnification is wanted for. The higher the magnification, the larger the image obtained. When reading text, for example, the larger the image, the smaller the number of letters that can be viewed at once. Therefore, the magnification should accommodate both needed appropriate size of letters and a wide field of view. The characteristics of the magnification devices are shown in Figure 7.

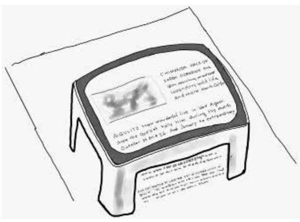
Type	Strengths	Weaknesses
Spectacle type  High power plus glasses	Hands-free. Inconspicuous.	Only low magnification available. Easily fatigued from viewing at close distance.
Handheld-type  Handheld magnifier	Easy to use. Many kinds and wide range of magnification (1.5 – 20× magnification) available. Convenient and portable. Illuminated handheld magnifier available	Requires some skill in focusing. Must be held by a hand. Persons with shaky hands may find it difficult to use. Different magnifiers needed for different tasks. Requires some skill in adjusting the focal point.
Stand type  Stand magnifier	Constant and accurate working distance (distance between lens and object). Useful for persons with shaky hands. Relatively easy to use for a long period of time. Easy to use for seniors or children. Illuminated stand magnifier available.	Necessary to correct refractive errors. Difficult to maintain viewing posture for some people.

Figure 7. Types of magnifiers

* A strong plus lens used with an ophthalmoscope can be used as a magnifier
(Example: A 20 D condenser lens is used when performing a fundoscopy in ophthalmological medical care. When the focal length of 25 cm is used as the reference distance, 4 D becomes 1×(no magnification), and a 20 D condenser lens has a magnifying power of 20 D ÷ 4 D = 5 times.)

Type	Strengths	Weaknesses
	Both hands can be used. Longer working space (distance between eyes and object) than magnifying glass. Magnification is variable depending on the combination of the primary mirror and the reading cap. High magnification is possible with glasses type.	Depth of focus is shallow. Somewhat heavy. Conspicuous. Expensive.

Figure 8. Spectacle mounted magnifier

(iii) Monocle/binocular

Monocle/binocular magnifies an object at intermediate or far distance.

A monocle has a single eyepiece. It is designed for use with one eye—the better-seeing eye (Figure 9). Binoculars are used by those with similar visual acuity in both eyes (Figure 9). By holding the device in both hands, device shakiness can be kept to a minimum.

A binocular is used for viewing distant objectives, such as blackboards, movie screens, traffic signs, and traffic lights. An adequate magnification should be selected for the patient's tasks and activities. Products with various magnifications are available. The easiest options are about 3-10×. The field of view and brightness of lenses vary depending on the size of the aperture. Criteria for selection include ease of focusing, holding, and carrying the device. Training improves skills, such as spotting (localization and focusing), tracing (e.g., around an object), tracking (following a moving object), and scanning (searching for an object) while steadying the binocular keeping the elbows in.

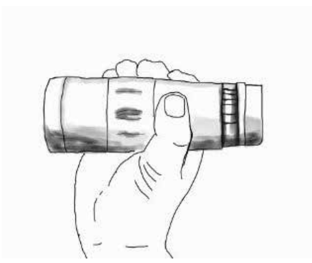
Type	Strengths	Weaknessess
 Monocle	Portable because of its small size. Possible to focus on a shorter distance than binocular glasses. Small ones can be attached to eyeglasses. Accommodation for myopia available.	Narrow visual field. Difficult-to-grasp perspective and three-dimensional effect. Hard to catch fast-moving objects. At high magnification, the image of the target is greatly blurred by a slight movement at hand. Large ones are heavy.
 Binocular	Can be used with both eyes. Can magnify distant places at high magnification. Less shaking than monocles.	Difficult to focus at short distances. Slightly heavy and bulky. At high magnification, the image of the target is greatly blurred by a slight movement of the hand.

Figure 9. Monocles and binocular glasses

(iv) Reduction lens

Individuals with peripheral field loss can have a wider visual field by viewing through a concave lens. However, since the image size will decrease it is not applicable for individuals with profound low vision. Using a monocle upside down has the same effect as a concave lens.

(v) Absorptive lenses

Improving photophobia is the primary goal of low vision care; absorptive lenses can be used to reduce photophobia. As photophobia is often hypothesized to occur when short-wavelength light collides with molecules and small particles in the eye, light-shielding glasses are prescribed in order to absorb short-wavelength blue light that can scatter most in the ocular media. Sunglasses that uniformly cut all lights result in poor visibility, but absorptive lenses maintain bright and clear vision while relieving glare.

Absorptive lenses can be inserted into regular eyeglass frames. Also available are clip-on types that can be affixed in front of the eyeglasses (Figure 10), side-shield protection types, and types designed to fit over prescription glasses (Figure 11). Some users carry one or more of these to adapt to a variety of lighting conditions in their environment. Absorptive lenses can be used for -those with dark adaptation disorders. The use of wide brim hats, visors, or parasols also reduce discomfort from glare.

Figure 10. Absorptive lenses (clip-on)

Figure 11. Absorptive lenses (over-glass)

(2) Non-optical devices

(i) Magnifying reading devices

If the patient experiences visual problems in reading and writing even with a magnifying glass, using a magnifying reading device may make it easier. Choices depend on what the patient wants to see: documents held in the hand, expiration date of food, or a blackboard in the distance.

Typical magnifying devices include electronic vision enhancement system (EVES). Video magnifiers (Figures 12–14) and CCTV (Closed Circuit Television) magnifiers. A video magnifier uses a video camera to capture and project a magnified image onto a monitor. There are two types: desktop and handheld. Recently, the handheld type with 4- to 13-inch monitors have become available with a variety of designs on the market.

For the patients with photophobia, it may be easier to see white letters written in the black background (i.e., reversed contrast). A magnifying reader that allows contrast reversal may be useful even without the magnification function.

< Basic functions >

(i) Continuous magnification power from approximately 2× to several dozen times

(ii) Increased contrast, either displaying black text on a white background or vice versa

< Other useful functions >

These include a line marker feature that puts lines into the display to underline the text read, masking feature that masks all the text but the text that the patient wishes to read, and position locator to place items at the center of the camera view.

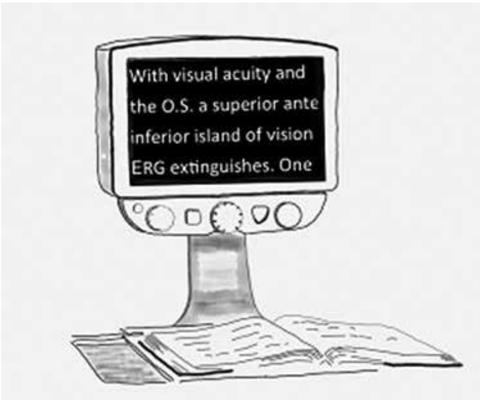


Figure 12. Video magnifier (desktop type)

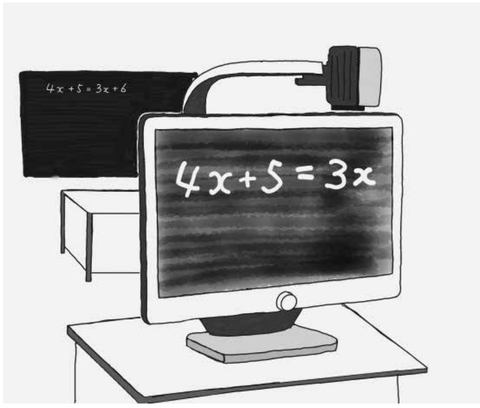


Figure 13. Video magnifier (the type for both near and distance viewing)

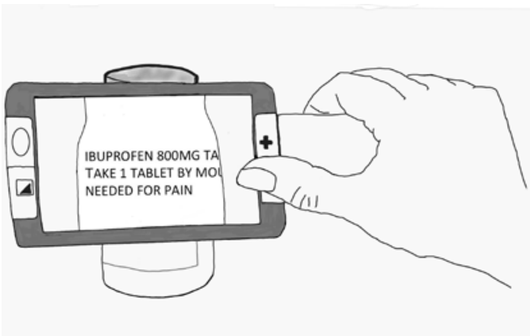


Figure 14. Video magnifier (handheld type)

(ii) Smartphones and tablets (Figures 15 and 16)

Smartphones and tablets have a built-in camera that can magnify and enhance text on the screen. Changing the settings also allows people to use the color inversion and text-to-speech functions. As shown in Figure 16, by inverting the text and background colors and increasing the magnification on the screen with two fingers, it is possible for patients to enlarge the screen to a size that they can easily read. Recently, a wide variety of free or paid apps for magnification and text-to-speech have been developed.

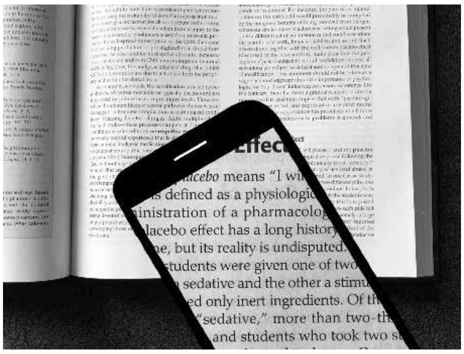


Figure 15. Smartphones

Figure 16. Tablet

(iii) Digital camera/video: The camera's zoom function allows patients to zoom in on the target. Children may also use this function for social studies visits, science observations, etc.

(iv) Reading stand (Figure 17): This prevents a bent-forward posture and allows adequate posture for reading. It is recommended to use a reading stand with a handheld or desktop video magnifier. It is possible for patients to make on their own.

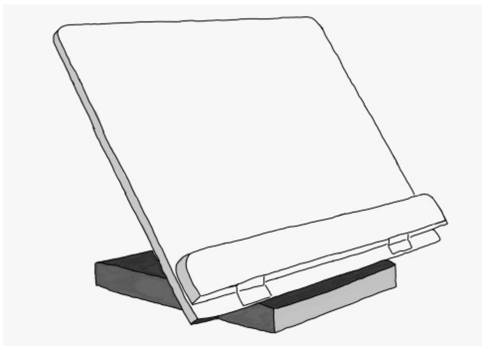


Figure 17. Reading stand

(v) Typoscope (Figure 18): A piece of thick paper with a slit that can help track the reading line and track back to the beginning of the next line, when reading or writing text. By reducing reflections from the paper surface and/or hiding the surrounding area, a typoscope shows the reading area clearer and enhances ease of reading. Some are sold, but patients can also make on their own.

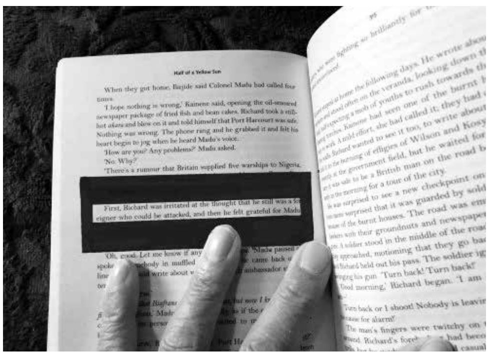


Figure 18. Typoscope

(vi) Handwriting guide (Figure 19): Writing in slits makes it easier to write even long paragraphs. It is possible for patients to make on their own.

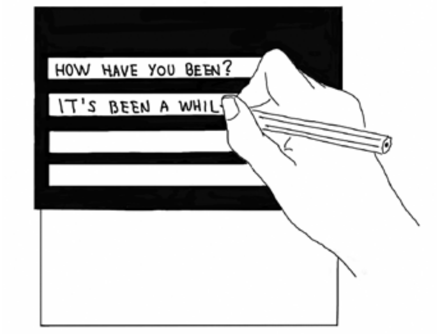


Figure 19. Handwriting guide

(vii) Signature guide: The line space for signature is outlined by a cutout space. Patients can sign while checking the slit width only by touch or by sight and touch. It is possible for patients to make on their own.

(viii) Black or dark-colored larger-tip pens: Water-based pens can write with less bleeding through the paper.

(ix) Writing with white ink pen on low vision black paper notebook (Figure 20): Visibility increases when writing with a white ink pen on low vision black paper notebook.

Figure 20. Example of writing with a white ink pen on low vision black paper notebook

(x) Large-size notebooks, wide-ruled, and bold-lined notebooks (Figure 21): Patients can write or read letters more easily.

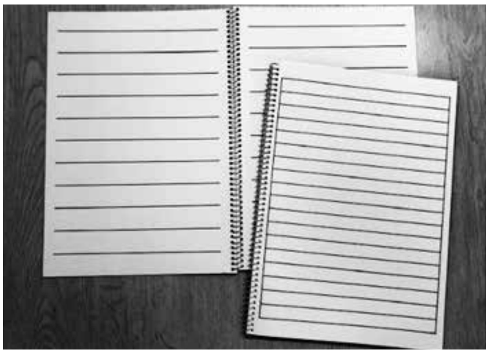


Figure 21. Example of a wide-ruled and bold-lined notebook

Large print book, enlarged textbooks: Reading books in large print formats or enlarged textbooks requires no optical devices or least magnification. It is the same with reading an enlarged copy of text.

(3) Other products and tips

(i) Lighting (Figure 22): Without sufficient light, it is difficult to see even with magnification. Patients should adjust the lighting so as not to let their shadow block their view.

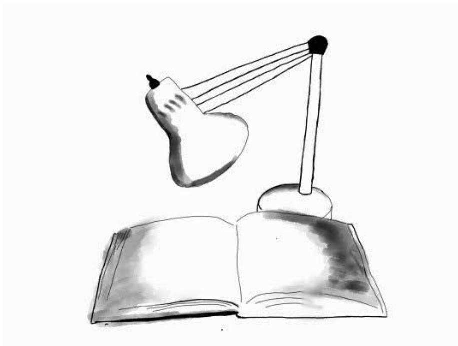


Figure 22. Lighting

(ii) A dark card with a small hole in it: Objects are in focus when viewed through a small hole (pinhole) measuring about 1 mm. The field of view is narrow and dark, but the patient can see things close to their eyes without using a lens.

(iii) Using contrast in household items and objects around the house (Figure 23): the greater the contrast, the easier it is to find and use objects. Examples are dark colored food on white dishes (Figure 33), contrasting colored tape on edges of steps, etc.

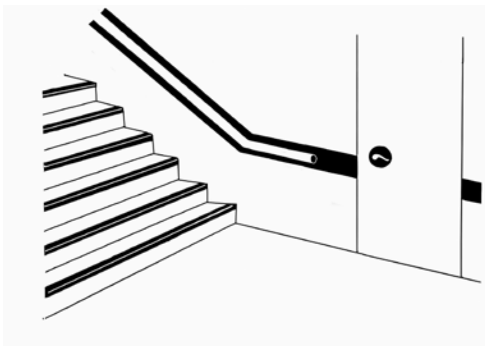


Figure 23. Example of using contrast in a house

Other useful equipment and devices to help patients accomplish their everyday household tasks include money organizer wallets, talking watches, talking calculators, screen reader software, and reading devices. By making effective use of touch and hearing, daily tasks and activities become easier and smoother.

(Yuki Nishiwaki)

4) Social adaptation

(1) Schools

(i) Schools in Japan

Students with visual impairments in Japan have the option of attending either special needs schools or regular schools. As of 2018, there are a total of 67 private and public special needs schools for visual impairments in Japan.

Municipal education committees comprehensively evaluate students with visual impairments and determine whether they should attend a special needs school for visual impairments or a regular elementary/middle school.

In some elementary/middle schools, special needs classes for weak eyesight classes are also provided in addition to regular classes. There the students can choose between regular and special need class in any properties as the needed.

Some students with visual impairments enrolled in regular elementary or middle schools may attend special needs schools for visual impairment or specialized classes to supplement class content or to be trained for handling visual impairment.

Special needs schools for visual impairment include the kindergarten, elementary, middle, and high school levels. The objective for the students to attend these classes is to get education comparable to the regular schooling systems and obtain the necessary knowledge and skills to mitigate the academic and everyday life difficulties and to become independent. Education and training for independent activities include orientation and mobility, braille, and computer training. Classes are divided between regular and vocational courses at the high school level. The vocational courses include physiotherapy (anma/massage/shiatsu, acupuncture, and moxibustion), physical therapy, judo therapy, and music-related education.

Textbooks are either written in braille and those with enlarged font or figures. Digital textbooks using a tablet terminal are now available. Large-print textbooks typically use 18-, 22-, or 26-point fonts. However, if there is no textbook with a suitable font size for a student, a custom-made textbook needs to be made by volunteers.

(ii)Tools and innovations

The use of tools and innovations can facilitate learning of students with visual impairments. In order to increase the visibility of objects magnification and contrast enhancement are applied. Details on magnifiers, EVES, enlarged copies, smartphones, tablet terminals, and typoscopes are described in the Low vision aids section.

(a) Personal computer (Figure 24): Personal computers with a Windows OS have a variety of user support functions including icon/pointer enlargements, black/white inversion where the background is made black and letters are made white, and screen magnification.

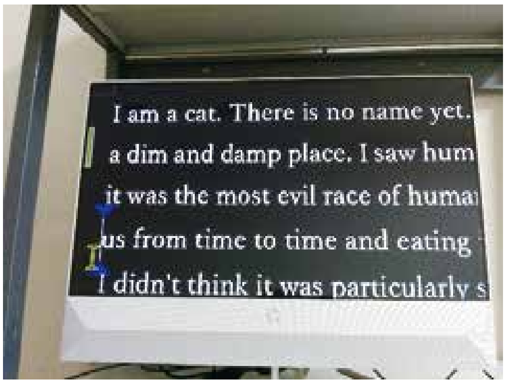


Figure 24. Example of contrast reverse by PC accessibility and magnifying letters by screen magnification software

(b) Screen reader/screen magnification software: Software that provides voice-overs for input letters or letters on a screen and enlargement software that increases screen displays are available in personal computers.

Accessibility features are built into modern personal computers and smartphones. These include a function to read out text on the screen. Depending on the user, this function of the operating system may be sufficient, without a specialized text-to-speech software.

Tactile tools are useful for individuals who are nearly or entirely blind.

(a) Surface drawing device (a raised-line drawing kit) (Figure 25): Tactile images form when letters or figures are drawn on a plastic transparent sheet with a ballpoint pen. Tracing these images with a finger can help the individual confirm images such as maps.

Tactile images are produced on the surface of the sheet that is affixed to a specialized board. The raised area can be traced by touching with fingers. It is useful when explaining maps or the shapes of objects.

Figure 25. Surface drawing device (a raised-line drawing kit)

(b) IC recorder: Can be used when recording audio input instead of writing letters.

(c) Braille: Braille consists of a total of six dots, aligned in three vertical columns by two horizontal lines, which comprise a single unit.

Letters and symbols and other special function braille units are expressed by combination of these points. Convex dots in braille can be read by tracing with finger.

(d) Slate and stylus (Figure 26): Braille units are made by pushing a stylus through the holes in the guiding plate to make individual dots. Dots are made on braille paper from top to bottom. Therefore, they are output in a downward direction. They are written from the right-hand side, and when read, the paper is flipped around and read from left to right.

(e) Braille typewriter (Figure 27): Braille units can be rapidly written by simultaneously pressing keys that correspond to the six dots in a single unit. Braille units can be individually touched for confirmation on the spot after it is produced.

Figure 26. Slate and Stylus

Figure 27. Braille typewriter

(iii) Global situation in school and education

Inclusive education is being promoted worldwide for children with disabilities. Inclusive education is a system in which children with and without disabilities learn together. Inclusive education can be classified into several categories. In Japan, various services are provided by two systems: general and special needs education. As mentioned in (i), various learning venues such as special needs schools, special needs classes, guidance by special classes, and regular classes are available according to the needs of children and students. However, in some countries, visually impaired students go to regular schools, indicating that children with disabilities can attend and succeed in regular schools. They are cases like lack of division between students with and without disabilities encourages better growth for each student.

(Tsutomu Nakanishi)

(2) Employment

Among the employed individuals with visual impairments in Japan, 40% of them are self-employed. Contrastingly, full-time employees comprise 20% and are increasing. Most of the self-employed individuals are professionals with national licenses in anma/massage/shiatsu, acupuncture, and moxibustion therapy. As advances in personal computer technology have improved accessibility for those with visual impairments, the number of visually impaired clerical workers has increased. Although few, some individuals with visual impairment do work as lawyers or physicians.

Vocational training include clerical work using a personal computer, telephone exchange, anma/massage/shiatsu, acupuncture, and moxibustion. Clerical work training involves learning how to use business software such as word processor and spreadsheet software. Also included are courses for acquiring bookkeeping knowledge and other relevant credentials, and courses for transcription of recorded voice. Training is provided at publicly supported organizations, vocational ability development schools for persons with disabilities, and social welfare facilities. Training for anma/massage/shiatsu, acupuncture, and moxibustion therapy is conducted at national or social welfare corporation facilities. Facilities of vocational training are concentrated in urban areas. Some training facilities may dispatch job coach to provide support for the workplace accommodation.

As mentioned in the "Schools" section, vocational education is conducted in special needs schools for visual impairments and a national university of technology. Education on anma/massage/shiatsu, acupuncture, moxibustion therapy, physical therapy, judo therapy, and music is conducted at the high school level in at least one special needs school for visual impairments in each prefecture. Adult individuals with visual impairments may also attend anma/massage/shiatsu, acupuncture, and moxibustion therapy courses in these schools. Furthermore, Tsukuba University of Technology, a national university, is designated for students with visual and hearing impairments. The university offers courses in anma/massage/shiatsu, acupuncture, moxibustion, physical therapy, and information systems.

(Tsutomu Nakanishi)

(3) Others

(i) Information services

Patients who have recently been affected by low vision often lack access to information relevant to their situation. It would be ideal for them to receive information from their ophthalmologist. However, not all patients can receive due information from their ophthalmologist yet.

It is important to switch the patient's mindset from "I cannot do anything if I cannot see" to "I can still manage without seeing." Simply providing patients with necessary information can be beneficial such as how to apply for a physical disability certificate and an intractable disease and what can be done after obtaining those certificates; about patients' associations and dealers handling convenient tools. Those in charge of low vision care should sort out related information and provide them to patients as needed.

(ii) Orientation and mobility

An individual can use a cane to keep themselves from danger while walking. Individuals with visual impairments in Japan are required by law to use white canes (safety canes for the persons with visual impairment). The white cane is a symbol for the visually impaired, and individuals who have a visual disability certificate can request them as assistive devices. Orientation and mobility training programs are conducted at rehabilitation facilities. However, they are virtually unknown currently to the general public.

Various long canes are available; a rigid cane, a folding cane, a support cane, and a symbol cane. (Figure 28) The rigid and folding canes are for walking alone. The support cane is used by elderly individuals and people with physical disabilities. The symbol cane is a short cane and signals to others that the individual is visually impaired. Individuals in countries where white cane use is not widespread should rather use bamboo or plastic pipe-style canes as a replacement when walking outdoors alone. They desirably have some degree of strength, but not be too heavy, and be cut at user breast height. The cane should be used while walking by swinging it side to side with keeping the tip of the cane on the ground to search in front of the individual. This allows the individual to determine the conditions of their walking path.

Rigid cane　　Folding cane　　Support cane

Figure 28. White cane types

Walking while swinging the cane from side to side allows the individual to detect steps, gutters, or holes. Obstacles can also be detected and holding the cane diagonally while walking, preventing the individual from directly colliding with the obstacle. The swing width of the cane should be around the shoulder width. Walking at a speed with which the individual can stop immediately ensures safe walking. The individual should walk using necessary information (e.g., one's footing, the upper area in front of the individual, nearby circumstances, sounds, and scents), while using a pole, tree, bush, house, etc. as a landmark (an easy-to-identify object using non-visual clues that are constant in the environment). Determining the numbers of footsteps to the routine destinations as a metric for distance are also effective. Individuals can use the sole of their shoe (sensation of the sole of the foot) to determine road conditions (e.g., along the edge of a road and roads that are inclined downwards) while walking.

Individuals should repeat the steps they took using the landmarks when walking back home. Designated landmarks can be used along the roads or intersections to find paths and to find out where one needs to go. When crossing a road, the individual needs to stop and determine the car's direction, listen to engine sounds, and carefully walk across the road.

It is also useful to follow the footsteps of others. It is useful to confirm steps with a cane when ascending or descending staircases. When moving between rooms or down the hallway, the individual is recommended to walk with their hand (preferable the back of their hand) on the wall in order to walk to their desired destinations safely and securely. In these cases, walking with posture of protecting upper or lower parts of the body using the other hand can help protect the individual from collisions with physical objects, walls, or poles. For night blindness, the patient may use the light from their smartphone while walking.

Example: Moving from home to the florist (target location).

"I start by exiting the door. I walk straight along the smooth ground surface using the cane tip. Next, I feel a rough asphalt section, so I know I am on the road. I head to the street corner to the left. As there is an electrical pole right before that, I walk to it while swinging my cane on the left as I walk. Once I reach the pole, I turn left, to enter a wide road. As I walk, I hear a dog barking, as I always do. The shopping district starts from around here. It is lunchtime and shops are busy.

People's voices inside the shop can be heard outside. I can smell some food as well. The florist is on the left side of the road, and there should be a door mat in front of the store; hence, I walk on the left side of the road. My cane also hits the door mat in front of the florist. I manage to reach the florist."

(iii) Sighted Guide

Depending on the degree of visual impairment and mobility ability, another person may well guide the patient instead of walking alone. It is important to know the correct guide method because the wrong guide method may endanger the patient (Figure 29). The guiding person must be a half step in front of the visually impaired person who is being guided. It is important to never push the visually impaired person from behind. Instead, the visually impaired person should hold on to the arm above the elbow of the guiding person. Alternatively, the visually impaired person may also hold on to the guiding person's wrist or shoulder if there is a considerable difference in height.

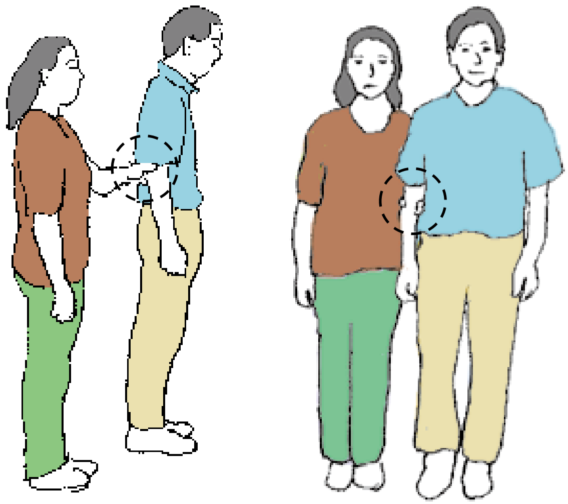


Figure 29. Basic Sighted Guide

(iv) Techniques in daily living

During daily life, the individual should consciously place objects in locations where they would not forget. The people around the individual do not have to do everything. The patient should practice while learning each location and make a habit of finding objects on their own. For example, the positional relationship between oneself and things can be explained with the clock face, e.g., “cup at the 12:00 position, wallet at the 3:00 position, and house keys at the 9:00 position.” Additionally, if an IC recorder is used instead of writing when making notes, the individual can replay them when necessary.

(v) Hobbies

Without using their sight Individuals can use branches, wool, or wicker to engage in the manual production of craft products (mats, textiles, beads, knitted items, baskets). Crafting can be enjoyed as part of everyday life (Figure 30).

Figure 30. Textiles and assembled paper products that were made without vision

(vi) Communication

Setting up enlarged fonts or black-white inverted fonts on smartphones or screen reader-installed personal computers enable individuals to read e-mails and other information by themselves.

There are individuals who use personal computers with screen readers for work, as well as those who use their smartphones for online shopping and obtain information by using the enlargement functionalities.

(vii) Recreation

Individuals will likely feel better and refreshed after stretching their bodies by practicing yoga or light stretching and can be supported by a person who can explain actions with words. Marathons, walking, and hiking are also performed (e.g., with a supporter and holding a short rope to ensures the person with visual impairment knows the movement and directions.).

Sports designed for visually impaired individuals include goalball, ground softball, floor volleyball, blind boxing, blind skiing, blind soccer, and track and field, etc. Actually, some of these sports are designed so that both people who can and cannot see can play together. And some of these sports are played with using a ball with a bell inside to roll it around and identify its location by sound.

(Azusa Okazaki, Tsutomu Nakanishi)

5) Multi-disciplinary collaboration

Although low vision care is often associated with ophthalmologists and their staff, they cannot provide the full range of low vision care alone. Collaboration with other disciplines is often necessary.

Ophthalmology alone is insufficient because of the diversity of issues depending on the onset period of visual impairment. These issues include economic factors (guardian/individual salaries, retirement money, and support from children), non-medical support (special needs education, workplace environment accommodations, and support system for elderly persons), and support for visual functions (enlarged font textbooks, magnification reading devices, voice-reading computers, and correction eyeglasses). Therefore, the goal should be to provide and propose best possible care that is suitable for the specific needs of each visually impaired individual in collaboration with professionals who specialize in each type of support. To achieve this goal, the patient's stories should be listened to also in a setting outside the ophthalmology clinic. Training should be conducted also outside the clinic as well. Professionals to be involved in low vision care are listed below.

(1) Ophthalmologist

An ophthalmologist determines the condition of the eye and whether continued treatment is necessary. The ophthalmologist also decides whether treatment is possible, listens to the chief complaints of the visually impaired individual, provides necessary medical information, and manages the creation of a secure care environment. If needed, glasses prescription is issued by ophthalmologist.

(2) Nurse

A nurse guides the visually impaired individual within the ophthalmology clinic. A nurse serves an essential role in ensuring that the individual receives treatment in a secure manner, as well as being the point of entry for low vision care. It is often the case that a nurse introduces low vision care to the individual and obtain the related information during conversation pre and after medical consultation.

(3) CO and optometrist

COs and optometrists conduct visual acuity, visual field, and color vision tests. They evaluate visual functions of the individual quantitatively and propose optimal methods for utilizing the remaining visual function. They manage the selection or prescription of eyeglasses or optical low vision aids (note: COs can only select, but optometrists can both select and prescribe). Hence, they ask the individual what they specifically would like to be able to see and propose the optimal aids for the needs.

(4) Orientation and mobility specialist/occupational therapist

An orientation and mobility specialist/occupational therapist guides walking with a white cane, provides daily life training, and introduces aids for daily life. Walking training with a white cane is not like gait training for individuals with leg paralysis or seniors, but rather is conducted to help a visually impaired individual learn the skills for walking with a white cane. In some cases, they also teach patients to use voice-reading personal computers.

(5) Social welfare specialists

Multiple staff members such as social skills training specialists and staff members with knowledge of social security and welfare system for people with disabilities are often assigned in the social welfare facility. Collaborations are easy to form in the facility. They provide advice in the home life and workplace of visual impaired individuals. They are knowledgeable about the use of magnification reading devices, magnifying glasses, and voice-reading personal computers.

(6) Officer of municipal social welfare office

The social welfare office provides information on social security and welfare system for people with disabilities. Since social services may be different according to residence place or income of individual, collaboration with social welfare office is necessary to provide accurate information on social security and welfare system. Additionally, these social welfare offices are places where individuals can go directly, and low vision care referrals can be made over the counter.

(7) Teacher of special needs school

Teachers of special needs school manage the education, physical fitness, and life support of visually impaired children in the school. These teachers can also collaborate with low vision care members as a guide for visually impaired children before schooling. Discussions must be held with the individual, their guardian, teacher for cases, and low vision care specialists where the individual is struggling to decide whether they should attend regular classes or whether they need to go to a special needs school.

Other professions besides the abovementioned, may need to be collaborated. The important element is that, for example, an ophthalmology clinic collaborates with related specialists to provide optimal low vision care for visually impaired individuals. However, there are cases where facilities or even specialists are limited in number in some regions. Thus, the low vision care specialists need to devise the method, such as specialist dispatches and teleconsultation using email, online or telephone to provide the care even in such regions.

(Tomomi Nishida-Shimizu)

3. Quick low vision care

1) Necessity of quick low vision care

As previously mentioned, low vision care in Japanese ophthalmology clinics has been increasingly highlighted. The vast majority of ophthalmologists still cannot provide the full range of low vision care. However, at the minimum quick low vision care, which requires less time and personnel, is necessary to be implemented for the entire ophthalmology field. The entire field must shift from a mindset of “not doing it because it cannot be done in full” to “doing whatever can be done first.” Patients can be rehabilitated faster if the ophthalmologist responses to low vision care differently. Visual impairments inhibit information acquisition so much they these are also referred to as informational impairments. Ophthalmologists providing even the minimum amount of information as to rehabilitation can potentially enable patients to determine their next step forward. These initiatives in quick low vision care are vital for the patient.

2) Low vision care provided by busy ophthalmologists

Reading and writing are among the chief struggles of low vision patients. Low vision aids that can be provided by an ophthalmologist include high-power plus lens eyeglasses, sign guides, typoscopes, and ruled line plates. Details of those devices are discussed in the section on low vision aids. (2-3), p10).

Immediately available non-specialized tools are also useful to low vision patients, such as stickers, rubber bands, and tape. Even slight ideas of tools used in daily living can help alleviate the burdens accompanying low vision.

Examples are:

A tactile sticker affixed on eye dropper for identification (Figure 31).

A rubber band on the toothbrush is used for identification (Figure 32).

Rice is easier to see in a black bowl than in a white bowl (Figure 33).

Figure. 31
Tactile sticker (silver color)
on the lid of eye dropper (left)

Figure. 32
Rubber band
(red color)

Figure. 33
use of contrast for food (right bowl)

3) Smart sight

“Smart sight” is a system introduced for ophthalmologists in the U.S. in 2005 and was introduced in Japan in 2007 by Dr. Haruhiko Nagai. It involves the distribution of leaflets that include information on nearby low vision care facilities for patients with either i) corrected visual acuity of less than 0.5 for the better eye; ii) scotomas or deficiencies in their visual field; or iii) low contrast sensitivity. This program helps low vision patients who have trouble obtaining necessary low vision-related information despite regularly visiting an ophthalmologist. It also can be incorporated by any ophthalmologist. It has become widespread at the prefectural level following its introduction as “Tsubasa” (Wings) in Hyogo Prefecture, Japan, in 2010. This initiative was taken up by the Japanese Ophthalmologists Association in 2017. The Smart sight system has been implemented in all Japanese prefectures in May 2021.

(Tomomi Nishida- Shimizu)

4. Spread of low vision care and human resource development in ophthalmology clinics in Japan

1) Low vision test decision fee

Low vision test decision fee refers to the medical insurance points in the national healthcare policy of Japan introduced in 2012. Prior to this, there had been no medical insurance points specialized for low vision care. Some ophthalmologists had conducted low vision care on a volunteer basis as an extension of their regular examination. However, physicians are now able to receive remuneration for low vision care following the designation of the low vision test decision fee. Prerequisite is that the facility must have a full-time physician who has completed training at a Physicians’ Seminar for Determining Low Vision Aids, hosted by the National Rehabilitation Center for Persons with Disabilities. Remuneration is based on specific conditions: the care for the patients with physical disability certificates can be tallied once per month following the evaluation of their present visual functions, selection of low vision aids that are appropriate for those conditions, and the implementation of instruction and management related to medical treatment (including the collaboration with facilities that conduct life and vocational rehabilitation). Conducting low vision care previously required giving attention to the management aspects of ophthalmology.

Establishment of low vision test decision fee addressed the management issue and has also served as an opportunity for many ophthalmologists to be aware of low vision care.

(Tomomi Nishida-Shimizu)

2) Physicians’ Seminar for Determining Low Vision Aids

The Physicians’ Seminar for Determining Low Vision Aids is a seminar hosted by the National Rehabilitation Center for Persons with Disabilities since 1991. It received considerably more recognition after being included as part of the insurance claim conditions for low vision test decision materials. The program is currently hosted two times a year for 2.5 days, with both classroombased learning and practical skill for low vision care (Table 2). The seminar has a capacity of 50 individuals. As applicants have increased in recent years, applications have been chosen via lottery since 2018. This seminar has become one of a few opportunities for ophthalmologists to intensively learn about low vision care. It was canceled in 2020 due to the COVID-19 pandemic, but it was held online for 2 days in 2021. We plan to continue this way for the time being.

Table 2. The 2021 program for the Physicians' Seminar for Determining Low Vision Aids

	Morning	Afternoon
Day 1 (Fri)	Orientation 1. Support for visual impairment 2. Workshop (incl. lecture) (High-plus spectacle, absorptive lenses) 3. Workshop (incl. lecture) (Guide, mock experiments)	4. Workshop (incl. lecture) (Eccentric vision, magnifying glass, weak vision eyeglasses, magnification reading device) 5. Daily life tools 6. IT devices (tablet terminals) 7. Sports for the visually impaired
Day 2 (Sat)	8. Workshop (incl. lecture) (weak vision eyeglasses, magnifying glass, artificial eyes, magnification reading device, daily life tools, IT devices [voice-reading PC]) 9. General remarks on collaboration 10. Opinions and Wishes of patients	11. Particulars on collaboration 12. Writing medical certificates 13. Workshop (Mock cases) Closing the seminar

(Tomomi Nishida-Shimizu)

3) Low Vision Care Seminar for Certified Orthoptists

Until recently, the only low vision care seminar for COs has been conducted by Low Vision Clinic of the National Rehabilitation Center for Persons with Disabilities associated with related society. Newly, the Low Vision Care Seminar for COs has been hosted from 2019 onwards as part of the training programs conducted by the National Rehabilitation Center for Persons with Disabilities. In the future, the Physicians' Seminar for Determining Low Vision Aids and the Low Vision Care Seminar for COs are anticipated to be developed with consistency even further. Programs that cover the basics of eyeglass and magnifying glass selection while teaching quick low vision care methods that can be implemented by ophthalmology clinics that work with acute cases are scheduled to be included in the Low Vision Care Seminar for COs. It was canceled in 2020 due to the COVID-19 pandemic, but it was held online for 2 days in 2021 as well as the Physicians' Seminar. We plan to continue this way for the time being.

(Marie Miwa)

Chapter 2. Eyecare

1. Ophthalmological tests for children

According to World Health Organization (WHO), approximately 80% of visual impairment cases could have been prevented with early treatment (Fact Sheets, Blindness and Vision Impairment). It is crucial to detect illnesses related to visual impairment in early childhood and implement appropriate treatment.

Infancy (birth to 6 years of age) is a crucial period for visual development and on focusing the retina during this time is essential for visual development.

Visual acuity rapidly develops from 3 to 6 months of age, after which it gradually develops until 8 years of age. This period is referred to as the visual sensitivity period (Figure 34). Refractive error (e.g., strong myopia/hyperopia/astigmatism), illnesses that inhibit the focusing on the retina (e.g., cataract) and eye misalignment (heterotropia) during the visual sensitivity period can prevent the normal development of visual acuity and induce amblyopia. Because the development of visual acuity after the visual sensitivity period has elapsed is difficult, the illnesses need to be detected and treated as early as possible during or before the visual sensitivity period.

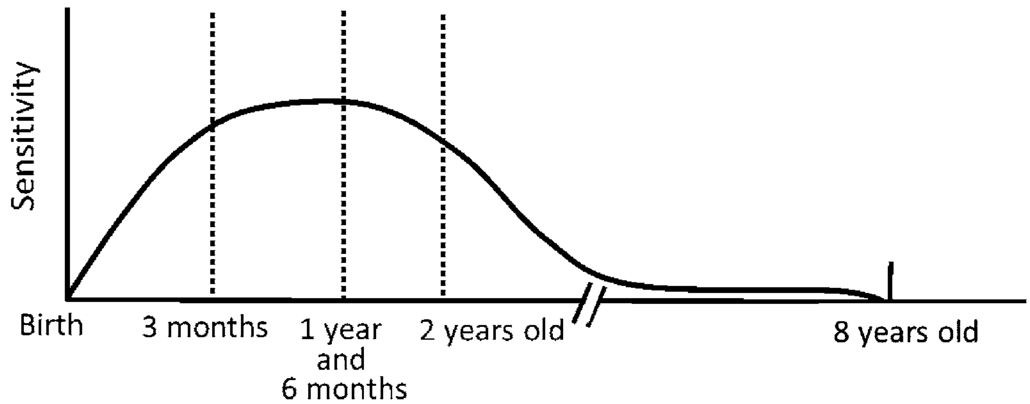


Figure 34. Visual sensitivity period in humans

1) System of ophthalmological tests for children in Japan

Japan has introduced the “3-year-old ophthalmology health checkup” and “school-age medical checkup for 6-year-old in the previous fiscal year to admit elementary school”, respectively, as initiatives to screen eye diseases as early as possible during the visual sensitivity period. In particular, introduction of the “3-year-old ophthalmology health checkup” have allowed for the detection and treatment of illnesses in the early stages of the visual sensitivity period.

(1) Three-year-old ophthalmology health checkup

Japan implemented the "3-year-old ophthalmology health screening services" (henceforth referred to as "3-year-old ophthalmology checkup") through the Maternal and Child Health Law in 1991. The objective of this law is the early detection and treatment of refractive errors (e.g., hyperopia, myopia, and astigmatism) and illnesses that inhibit visual acuity development (e.g., heterotropia). Initiatives was first overseen at the prefectural level, but it was transferred to the municipal level in 1997. Though checkup methods depend on the municipality, the primary health checks in most municipalities consist of visual acuity tests conducted by guardians at home and screening tests based on questionnaires, with follow-up health examinations at health centers when primary health checks conclude that a child needs careful examination.

(i) primary health checks

Primary health checks in many municipalities comprise visual acuity test indicators as well as tests conducted at home using an eye-related questionnaire mailed to each household.

Ministry of Health, Labour and Welfare in Japan presents a basic guideline, and all municipalities follow to create the questionnaire questions. As can be seen in Table 3, questions are designed to detect illnesses that inhibit visual acuity development (e.g., refractive error and heterotropia), as well as illnesses that inhibit focusing of the retina.

Table 3. Questionnaire questions (example)

Question categories	Objectives
1. Does your children's eyes ever lean inwards? 2. Does your children's eyes ever lean outwards? 3. Does your children's eyes ever vertically misalign?	Detection of esotropia, exotropia, vertical strabismus
1. Does your children's pupils (center of the iris) ever look white?	Detection of retinoblastoma or cataract
1.Does the size of your children's irises ever look different?	Detection of congenital glaucoma or microophthalmia
1. Does your children's eyelids ever droop?	Detection of ptosis
1. Does your children ever tilt his/her head when looking at something? 2. Does your children ever look at things with a side glance while tilting your head?	Detection of ocular palsy or nystagmus
1. Do you ever squint your eyes when looking at something? 2. Do you ever try to get closer or struggle to see far away when looking at things?	Detection of visual acuity problems
1. Does your children ever struggled to see in dim-light areas?	Detection of night blindness

(ii) follow-up health examinations

Follow-up health examinations are conducted for children who need examinations following primary screening health checks.

Many municipalities involve public health nurses or registered nurses for follow-up health examinations. However, recently the participation of ophthalmology-related staff such as ophthalmologists or COs has been recommended. Tests on refraction, visual acuity, and eye position, as well as other health examinations, are conducted during the follow-up health examinations. In 2017, the Maternal Child Health Division of the Equal Employment, Children, and Families Bureau, Japanese Ministry of Health, Labour and Welfare (at that time), promoted the visual acuity tests at the 3-year-old health checkup and drafted a document entitled "Implementation of visual acuity tests during 3-year-old health examinations" for the departments responsible for maternal and child health of municipalities. Guardians of children who cannot correctly see the 0.5 visual targets, as well as those who cannot complete the tests, are advised to refer their children to ophthalmology clinics.

The Japanese Association of Certified Orthoptists created a "3-year-old ophthalmology health examination manual" for COs who often participate in the follow-up health examinations, so that they may be able to conduct standardized and accurate 3-year-old ophthalmology health examinations. The manual is published on the association's website (in Japanese only).

(2) "Health checkup for children starting school age"

"Health checkup for children starting school age" were stipulated by the School Health Act of 1958 (revised to School Health and Safety Act in 2008) and conducted by municipal educational committees for children preparing to start school. Its objectives are to assess the psychosomatic conditions of school-age children accurately, inform and advise their guardians on possible health problems before admitting to school, and to suitably prepare children for schooling.

Ophthalmology medical examinations during "Health checkup for children starting school age" comprise visual acuity tests to detect amblyopia issues that were not identified at the 3-year-old health checkup. Ophthalmology medical examinations and health examinations are also aimed to detect eye illnesses and eye position abnormalities (e.g., heterotropia/strabismus). The Japanese Society of School Health created the "Health checkup for children starting school age manual," which provides details on specific test methods. Referrals to ophthalmology clinics are advised for children who scored less than 1.0 during visual acuity tests in the "Health checkup for children starting school age".

(Akiko Yamada)

2) Standard tests during pediatric ophthalmology medical examinations

(1) Refraction tests

Tests that check for refractive errors such as myopia and hyperopia should be conducted.

Measurement methods include those with an auto refractometer which can automatically detect refractive conditions and retinoscopy which uses eye test lenses.

Because children have strong accommodation during infancy, refraction tests should be done using cycloplegic agents in order to obtain reliable results. However, tests are conducted without drugs during medical examination. Accommodation intervention is reduced as much as possible by telling infants not to stare too intently during the test.

Careful examinations using cycloplegic agents (atropine sulfate or cyclopentane hydrochloride) are needed in cases with possible refractive errors.

(i) Auto refractometer

The auto refractometer can automatically measure refractive conditions. They come as either stationary or handheld (Figure 35).

Figure 35. Auto refractometer

(ii) Retinoscopy

Retinoscopy uses a retinoscope (Figure 36) to project divergent light onto the pupil, which then detects refractive conditions using the movement of the light in the pupil. It allows for refraction tests without the use of an auto refractometer.

Plane mirrors or medical examination lights can be used for the same tests if a retinoscope is not available.

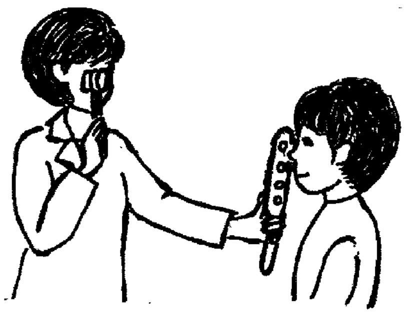


Figure 36. Retinoscope (retinoscopy and lens bar)

<Test methods>

1. Retinoscope is adjusted, so that the divergent light and the longitudinal light fluxes are emitted.
2. Light flux is directed into the pupil of the patient from the retinoscope at a distance of 50 cm in a semi-dark room.
3. Light movement in the pupil is observed through the central viewfinder of the retinoscope while moving it horizontally.
4. Reflex movements are observed, with refractive conditions evaluated according to the methods shown below.

   No reflex movement (neutral) →myopia with −2.00 D

   Reflex moves in the same direction (with the motion) → weaker myopia than −2.00 D, normal vision, hyperopia

   Reflex moves in the opposite direction (against the motion) → stronger myopia than −2.00 D, normal vision, hyperopia
5. A lens correction that corresponds to neutral conditions is determined by placing the eye test lens in front of the eye.
6. Once the neutral lens correction has been determined, the correction value is substituted into the following formula to determine the refractive correction.

   horizontal refraction = neutral lens – 2.00 (= 1/test distance [m]) D
7. Refraction for both the horizontal and vertical directions is found by moving the device in respective directions.

The observed light in the pupil is faint when the intensity of refractive error is high. On the other side, the light becomes darker when its intensity is low; thus, rough estimates of refractive error can be made even in clinics without the appropriate lenses.

The “3-year-old ophthalmology medical examination manual,” published by the Japanese Association of Certified Orthoptists, proposes screening methods using only a +3.5 D lens for tests during follow-up medical examinations.

<Astigmatism>

A patient is diagnosed to have astigmatism when there is a difference in the refraction extent between the horizontal and vertical directions. The patient is thought to have oblique astigmatism in cases where shadows move in an oblique direction when moving a retinoscope in the horizontal direction. The method for determining refractive correction in cases of astigmatism is shown in Figure 37.

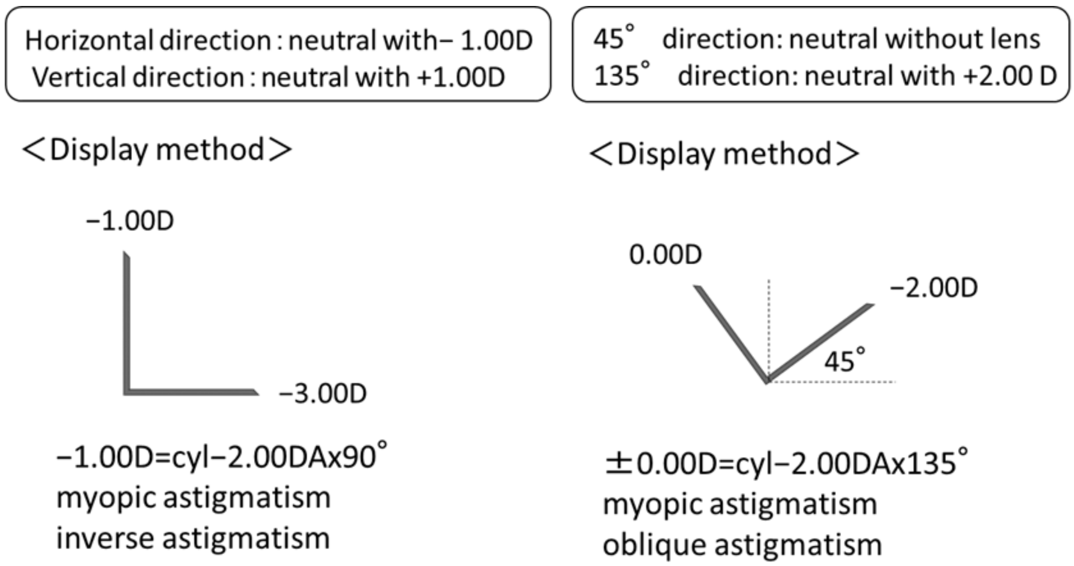


Figure 37. Displaying retinoscopy results (example of a case with astigmatism to the right)

(2) Visual acuity tests

Children have a short attention span; therefore, tests must be conducted rapidly and in a short time. Staff should take care to remove distraction and create an environment where the child can concentrate on the test. A practical method for increasing concentration is to reduce the test distance. Test results with this decreased distance should be converted to those under standard test distances. For example, if a visual target of 0.6 was observed at 2.5 m instead of standard distance of 5 m, this would be converted to a visual target of 0.3 at 5 m.

If the patient cannot respond with words, tests should use models that have the same shape as the visual acuity test targets, in which the patient moves the model in the same direction as that of the visual target that has to be seen. Finger-pointing and gesturing can be used as responses as well.

If the patient refuses to wear an optometry frame or an eyepatch, the accompanying guardian can cover the patient's eye with a towel.

The following tests can be conducted for children who do not fit for the standard visual acuity charts designed for adults.

(i) Preferential looking method

This method uses the psychophysical characteristic that one prefers to follow and fix one's gaze on stripes surface than a uniform surface. Methods based on the eye gaze (forced-choice method) or reactions such as finger-pointing (yes or no method) are available. The method based on the eye gaze can be used for the measurement of visual acuity even in infants, who struggle with voluntary responses. Currently, Teller Acuity Card (TAC, Figure 38) is available for use in the test. This type of tests is advantageous in that they can be conducted in a bright room or a confined space.

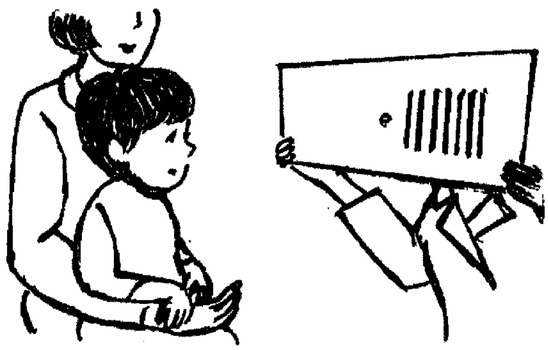


Figure 38. Teller Acuity Card (TAC) ®

(ii) Optokinetic nystagmus test

This method observes whether nystagmus is induced by spinning a vertically striped pattern on the surface of a rotating drum. Rapid phase nystagmus occurs in the direction of the drum rotation when the stripes are visible. Contrastingly, slow phase nystagmus occurs in the direction opposite to that of the drum rotation. The visual acuity of the child can be estimated by changing the width of the stripes.

(iii) Picture visual acuity chart and test procedure

Picture visual acuity charts are used in cases whose responses to visual acuity charts designed for adults are difficult to obtain (Figure 39).

The patient is asked to identify what illustration are drawn on the visual target. If the patient does not know the name of the illustration, the same picture or model is placed on top of the table, and they are asked to select the same illustration.

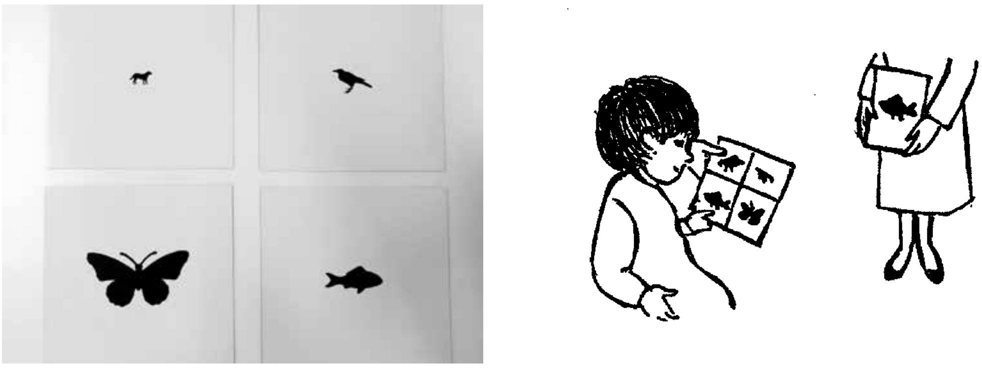


Figure 39. Picture visual acuity chart and test process

(3) Eye position test

This test is necessary for determining heterotropia, which is one of the causes of amblyopia.

(i) Corneal reflex test

1. Head position abnormalities are checked.
2. A penlight is directed at both eyes from a distance of 30 cm, and the positions of the corneal reflexes are observed. As shown in Figure 40, the inspector determines whether the corneal reflexes shifts to an inner, outer, or vertical directions. Evaluations is conducted with the head position straightened in cases whose head position abnormalities are detected.

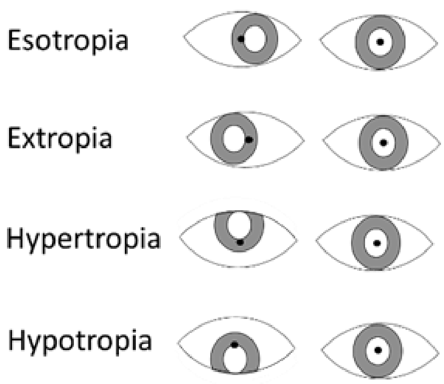


Figure 40. Type of heterotropia

(ii) Cover test (Figure 41)

1. A penlight is directed toward both eyes from a distance of 30 cm, and the patient is asked to keep his/her gaze on the light.
2. One eye is covered with a panel, and the movement of the uncovered eye is observed.
   The patients with heterotropia will move the uncovered eye when the other eye is covered.
   The eye does not move when the patient does not have heterotropia or phoria.

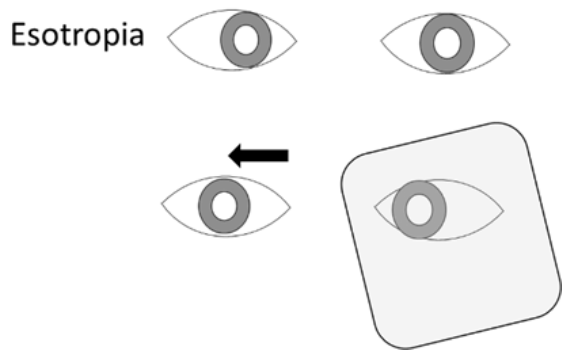


Figure 41. Cover test (in the case of esotropia)

(iii) Cover – uncover test (Figure 42)

1. One eye is covered with a panel, and the patient is asked to look at a visual target with the uncovered eye.
2. The movement of the covered eye is observed after the cover is removed.
   The patient is judged to have phoria when the eye moves.

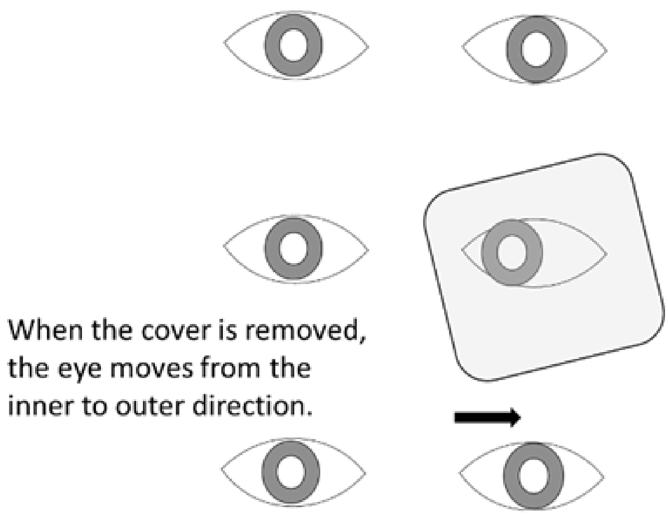


Figure 42. Cover – uncover test (in the case of esophoria)

(iv) Alternating cover test (Figure 43)

1. The patient is asked to alternate covering their left and right eyes while looking at a visual target.
2. The inspector checks the movement of the covered eye after the panel is removed.
   The patient is judged to have heterotropia or phoria when the eye moves.

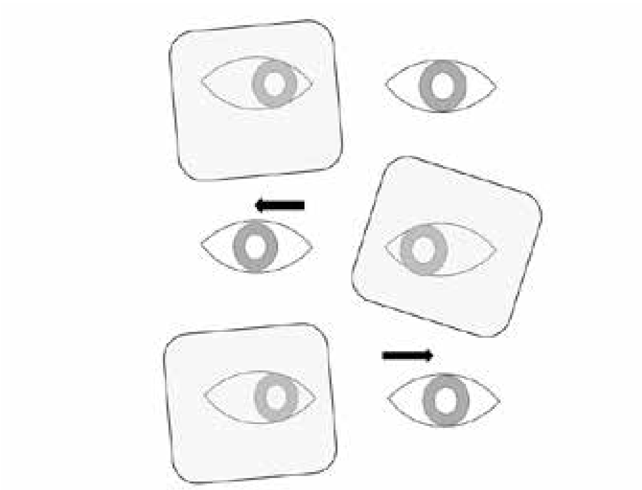


Figure 43. Cover – uncover test (in the case of esotropia/esophoria)

In Japan, the “3-year-old ophthalmology health checkup” and “Health checkup for children starting school age” are publicly conducted to detect and treat amblyopia, which can lead to future visual acuity disorders. However, these medical screening programs are meaningless unless it results in a comprehensive ocular examination by ophthalmologists. With this in mind, the Japan Ophthalmologists Association has published a public awareness pamphlet called “recommendations for 3-year-old ophthalmology health checkup.”

The Japanese Association of Certified Orthoptists has also published “Eye health checklist – infant edition” pamphlets, in the effort of raising public awareness of the 3-year-old ophthalmology health checkup as well as the methods to check eye conditions at home in infants before the age of 3, promoting the detection of eye diseases at early stages.

(Akiko Yamada)

2. Ophthalmological tests in adults

The eye is a small organ measuring roughly 25 mm in diameter. However, it comprises many parts and is a vital organ for vision. Humans obtain 80% of information from vision; thus, maintaining eye health and knowing eye conditions are essential. Here common diseases that cause low vision or blindness are brightly explained. The most common diseases that cause vision disorders in Japan include glaucoma, retinitis pigmentosa, and diabetic retinopathy, in descending order. Macular degeneration incidence has increased in recent years and ranks fourth in terms of causative diseases.

1) Glaucoma

Its symptom begins with a narrowing visual field on the periphery, eventually progressing to the central portion of the visual field, causing visual acuity disorders. Many cases become chronic, and there are few subjective symptoms in the initial stages. It is not uncommon for the illness to be considerably advanced by the time the patient has subjectively realized symptoms.

The causes of glaucoma are not clear. However, ocular tension control is the only intervention known to slow visual field disorders and is therefore the focus for treatment. Eye drop application is the primary method for controlling ocular tension, and surgical treatment is conducted if it is not controlled with medication. Control of ocular tension at the initial stage is crucial for treatment.

Another form is acute glaucoma, caused by rapid increases in ocular tension. Headaches, nausea, eye pains, hyperemia, and decreases in visual acuity occur within a short time. Eyesight can be lost very rapidly if left untreated; therefore, rapid ophthalmology treatment to reduce ocular tension is necessary.

2) Retinitis pigmentosa

Retinitis pigmentosa is a representative illness cause of vision disorders, with typical subjective symptoms including night blindness, photophobia, and narrowing of the visual field.

Since genetic mutations are thought to be the cause, it has been classified as a hereditary disease. However, the types of causative genes are wide-ranging, and not all types are fully understood. Approximately 30% of retinitis pigmentosa cases among the Japanese population are known to be caused by the EYS gene mutation. The onset period can vary widely from childhood to middle age. Ophthalmology consultations are made if such symptoms are noticed as unsteady walk in areas perceived by the patient to be dark, not being able to see objects in bright areas, stumbling, or running into people. As it is a progressive disease, the progressively narrowing visual field influences the central visual field first, ultimately resulting in severe vision loss. Many patients stop visiting the ophthalmologist due to the lack of treatment. However, it is crucial to conduct regular fundoscopy and visual field tests, as well as to provide low vision care as appropriate.

3) Diabetic retinopathy

Diabetic retinopathy is a complication of diabetes that often occurs in patients with uncontrolled blood glucose level. There are no subjective symptoms in the initial stages, and patients notice the disease after progressive symptoms like eye hemorrhaging or macular edemas have occurred.

Disease progress can be controlled with laser treatment, intraocular injections, and vitreous surgery. However, the complication is recurrent if the blood glucose levels are not control properly, resulting in diabetic retinopathy. Decreases in visual acuity can further occur when this stage is reached, with no recovery even after surgery, and the patient is often left with visual acuity disorders. Complications of neovascular glaucoma can also occur, resulting in severe vision disorders. Therefore, the most important factor is blood glucose control. However, the progress of retinal illness must be managed through regular check-ups of the eyeground as well.

4) Macular degeneration

This is a type of illness where the central visual field appears distorted or non-visible. The illness hits the macula, which has the highest sensitivity within the retina. Most cases today are age-related. However, there are various other types, such as macular degeneration, due to high-strength near vision. Decreased visual acuity and difficultly in written information retrieval occur with the deteriorated central visual field. However, the peripheral visual field is not damaged, so that most patients do not report issues with mobility. Disease progress can be controlled with intraocular injections. However, these effects are often temporary, and multiple injections are sometimes necessary. As smoking is said to be a cause, and abstaining from smoking may abate disease progression.

5) Optic neuropathy, optic neuritis

Optic neuropathy is an illness that causes inflammation or alteration in the optic nerves for any reason. With scotomas formed in the central visual field, the patient experiences decreases in visual acuity. Its causes are various, including inflammation, autoimmune, and genetic. Improved symptoms are observed in some forms with medical treatments such as drip infusion, hemodialysis, and plasma exchange therapy. However, in some cases it becomes recurrent, or in others no treatment effects are observed. It is a central vision disorder and thus likely induces reading and writing problems. However, the patient is often able to move independently with remaining vision.

6) Cataract

Cataract is a condition where the crystalline lens becomes progressively white and cloudy. Most cases are age-related; however, it can also be congenital, injury-based, part of other syndromes, or drug side effects. Symptoms are often gradual but can also progress rapidly. Although visual acuity can be restored with surgical treatment. severe visual disorders can occur if the disease is left to progress without surgery. Cataracts are the main cause of blindness in regions where surgery cannot be conducted.

7) Retinal detachment

Retinal detachment is a condition where a hole is formed in the retina for some reason, which then causes the retina or part of it to detach from the eyeground. Common causes include age, retina atrophy, and injuries. Patients are made aware of the illness through subjective symptoms like myodesopsia, photopsy, and deficient visual field. Once detached, the retina rarely reattaches naturally, and as such, laser treatment or surgery is necessary. If the issue is ignored despite subjective symptoms, retinal detachment can worsen and increase the range of visual field deficiency. In this case, it could render the visual field disorder permanent even if the retinas are restored with surgery. The absence of surgical treatment ultimately results in blindness.

8) Ocular injury

Several scenarios fall under this category. It can occur as a result of external injury, which can ultimately lead to blindness if left untreated. A hole can form in the eye in cases where a sharp object stabs the eye. When an intense, blunt pressure is applied, it can rupture the eyeball. Emergency surgery is necessary for such cases, as those conditions can lead to blindness when left untreated. However, as the primary objective of surgery is the preservation of the eyeball especially in severe cases, vision disorders often remain after surgery.

9) Brain disease

Cerebral infarction, cerebral hemorrhage, and head trauma can damage the region of the brain that process vision, interfering the effective transmission of visual information obtained by the eye. It often manifests itself as visual field disorders or deficit, with half- or quarter-blindness often observed in these patients. There are no problems with the eyeball in such cases because the brain is the cause of this disorder. Brain treatment is prioritized, after which low vision care is introduced if necessary, with guidance provided to the patient for returning to daily life.

10) Ocular infection

Infectious diseases in the cornea are often resistant to eye drop treatment and can result in white cloudiness in the cornea and visual acuity disorders even often the infection is controlled. Visual acuity can be recovered with corneal transplantation. However, it is conducted only in limited facilities. Thus, most patients must live with cloudiness remaining in their corneas.

It is important for patients who have observed changes in their everyday vision to seek an ophthalmology evaluation. Since many other visual illnesses also have no subjective symptoms in the initial stages, regular medical examinations should be conducted for the eyes, if possible, as other health medical check-ups. Early treatment is the most crucial element in extending the lifespan of vision.

(Tomoshige Hayashi)

Conclusions

This low vision manual was written with contributions from staff members of the Ophthalmology Low Vision Clinic in the hospital of the National Rehabilitation Center for Persons with Disabilities. Although some of the items written here may not be directly applicable in other countries, we do hope that more physicians will be able to incorporate as many low vision care methods as possible in their practice, with the low vision care mindset for the patient. We hope to improve the lives of low vision patients by expanding low vision care throughout the world and that this manual can contribute to this ongoing effort.

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