Arch. Soc. amer. oftal. optom. (1959) - II - 237

TELESCOPIC AND MICROSCOPIC SPECTACLES

BY

J. I. RODGIN, O. D.

Bluefield, U. S. A.

The correction or improvement of subnormal vision by means of special optical devices is now receiving more attention than ever before. Persons from seven to ninety years of age who are almost blind, are being rehabilitated with these special visual aids, enabling them to live normal and useful lives. Many devices such as contact lenses, telescopic spectacles, microscopic spectacles, pinhole spectacles, hand magnifiers, and projection devices are being used in cases of subnormal vision assistance. This paper, however, will be confined to the consideration of two of these optical aids — telescopic and microscopic spectacles.

Small Galilean telescopes for the correction of high myopia were first used in the seventeenth century. However, no practical and satisfactory results were realized until about 1910, when Von Rohr designed for Zeiss in Jena the modern compact form of telescopic spectacles. The use of these telescopic spectacles became wide spread after World War I, for soldiers whose eye injuries during the war had resulted in subnormal vision. This was especially true in Germany where many men were able to continue their work by use of these telescopic spectacles.

The most practical telescopic system used is a miniature Galilean telescope mounted in a sturdy frame and worn like ordinary spectacles. It consists of a positive objective and negative eyepiece separated by the difference in their focal lengths, which produces a relatively flat field without much astigmatism. The erect magnified image is equal to $-f_1/f_2$ when f_1 is the focal length of the objective and f_2 is the focal length of the eyepiece. The angular size of the image is increased without affecting vergence of the incident light so that the system has no refracting power. The purpose of the telescopic system is to enlarge the retinal image, thereby increasing the number of nerve receptors used. The optical aberrations can be reduced so that they do not produce too much interference. The spherical and chromatic aberrations are inconsequential. Coma, oblique astigmatism, curvature, and distortion can be minimized by the proper curvatures and dispersion of the lenses used.

A case of subnormal vision is indicated when the visual efficiency of the patient with ordinary lenses is insufficient for his needs. However, it must be remembered that intelligence and environment also play an important part in determining visual efficiency. Subnormal vision is a relative term and must be applied to each individual case for proper analysis with regard to prognosis before any attempt is made to prescribe telescopic spectacles.

Anomalies and diseases responsible for a condition of subnormal Vision are numerous, including irregular astigmatism, keratitis, corneal scars, glaucoma, retinitis pigmentosa, detachment of the retina, central chorio-retinitis, primary and secondary optic nerve atrophy, posterior uveitis. Various physical anomalies, such as coloboma of the iris, lens and choroid, congenital cataracts, and dislocation of the lense are also factors in reducing vision. It is essential that the basic cause of the subnormal vision be known — that is, whether the reduction is due to an irregularity of the refracting surface or to the media not being homogenous (isotropic and transparent) or to a reduction of the nerve receptors (rods and cones). The use of the peripheral retina is essential with telescopic spectacles to that magnification can be meaningful. The differentiation of those pathologies causing a loss of central vision from those resulting in a loss of peripheral vision, is therefore and important factor.

The psychological factor involved in subnormal vision is one which deserves special consideration. Pathological changes causing optical abnormalities usually come to a standstill after a certain amount of damage has been done. However, a further loss of visual perception is imposed upon this immediate loss of visual acuity. A psychological factor is then superimposed, causing the patient to see more poorly as time goes on.

The question of what optical device should be used for the correction of subnormal vision is one which should be carefully analyzed by the examiner. Telescopic spectacles are used primarily in cases of retinal involvements, although they are sometimes used in cases of media involvement, and in those cases where there is both a media and retinal involvement. Before prescribing telescopic spectacles for near, it is advisable to first try aspheric microscopic lenses to see whether this will take care of the patient's needs. Often a high plus "add" may be more advantageous. It is very difficult to walk with telescopic spectacles because of the apparent displacement and the reduced field of vision. Telescopic spectacles are ideal for viewing TV or any form of entertainment where the patient is seated. They can also be used to great advantage for near visual tasks where magnification is so important.

The magnification of telescopic spectacles for distance usually varies from 1.8X to 2.2X. For example, the telescope of 1.8X magnifies the retinal image 1.8.

This means that a patient with 20/200 visión or 10% visual acuity with regular spectacles, would have 18% visual acuity for distance with 1.8X telescopic spectacles. The field of vision obtained with telescopic spectacles for far and near decreases with the magnification. This is an important fact to remember in the selection of the proper telescopic spectacle.

Microscopic spectacles used for near are theoretically simple microscopes, designed in such a way that markedly diverging light from the printed page is made to leave the microscope as parallel light. Since the patients who require this type of lense for reading usually have eccentric fixation or nystagmoid movements, it was imperative to design the system with a large aperture. These microscopic spectacles magnify the retinal image an amount equal to the magnifying power of the microscope. The microscopes are designed with magnification from four to sixteen times. The triple lense microscopic spectacle both optically and cosmetically has proven the most satisfactory type.

The actual working distance with microscopic spectacles is usually only from five to seven centimeters from the eye. The greater the magnification, the shorter this working distance becomes. The useful field, however, remains relatively large even with the highest magnification. The microscopic spectacle was originally designed to care for those patients who had chiefly rod vision.

The fact must be recognized that in using a telescopic spectacle, the external illumination must be varied according to the amount of light that passes through the device and the type of nerve receptors left in the retina. If the patient has the maximum of cone vision present, then the external illumination must be high. When, however, the remaining is rod vision, the intensity of the external illumination must be low.

Since the microscopic spectacle is generally used in cases where rod vision predominates, and since rod vision is most sensitive under low illumination, it is important to keep the illumination on the printed page as low as possible. Usually, the intensity should be reduced to one to three foot candles.

The fitting of telescopic spectacles is more than a mere optical problem, because interwoven with this problem are outstanding psychological factors. This situation must be understood even before one undertakes to examine such a patient. There is usually a definite relation between the duration of the subnormal vision and the extent of the improvement desired. For example, persons who have had poor vision for a short time are usually not interested in having their visual acuity just improved, but are interested in having their vision improved to the normal visual acuity they had before the pathological condition set in. The examiner must do his best to overcome this attitude, since the patient

with such an attitude will never consent to undergo the necessary training that is absolutely required before he can properly use telescopic spectacles. Persons who have "lost" their vision for a period of one, two, or five years, have the same attitude, psychologically at least, towards an improvement in vision as those whose loss of vision was only recent.

In contrast to those patients who have had their condition for only a short time, are those who have had subnormal vision for five, ten and twenty years. As the years have passed, they have become resigned to the condition of their eyes and have stopped trying to see, or to develop a new interest in vision. The "desire to see" is of paramount importance, and telescopic spectacles are psychological as well as optical aids for subnormal vision. The doctor should adopt the attitude that the patient may be governed in his reactions by conditions that have nothing to do with the optical problem of visual acuity. He should always realize that patients with subnormal vision are subjet to changes in attitudes towards themselves and the rest of society. The extent of these changes insofar as the visually handicapped are concerned, depend for the most part on the nature of the affliction, the time of onset, and the age of the patient.

The examination of the subnormal vision cases consist of the following salient parts: (1) case history; (2) objetive examination (retinoscope, ophtalmoscope, ophthalmometer, slit lamp); (3) field test; (4) subjetive examination at distance with simple lenses; (5) subjective examination at distance with telescopic spectacles; (6) subjective reexamination at near with telescopic or microscopic spectacles.

The psychological factors influencing a patient's attitude should be always kept in mind during the examination. The case history should include age, duration of subnormal vision, facts as to whether the condition has changed in the last five years, two years, or six months, diagnosis and prognosis of other practitioners, information as to whether patient sees better in the daytime or at night, and which eye he sees best with. It is also important to find out how the patient sees in the theater, how he reads the newspaper, whether he can recognize colors, walk around unassisted, what he can do (play cards, see food, etc.), and what he desires most to be able to do. The case history, however, should take as little time as possible.

The preliminary subjective examination should be started with the static findings (if at all satisfactory). The chart is located at ten feet instead of the usual twenty foot distance and the test are made monocularly. Vision and not comfort is the important thought in the subjective test. The minus should be crowded if better vision is obtained, and high cylinders used even if not indicated by the retinoscope and opthalmometer. A simple trial frame with trial lenses is

used. The subjective routine should then be continued without indicating to the patient in any way that anything different is being done. The telescopic unit, usually 2X, is then inserted in the front cell of the trial frame and the improvement in visual acuity is noted in each eye (the test being made monocularly). Special attention should be given to the illumination of the test card. A lamp with a one hundred Watt bulb and photo-flood bulb is used, and the distance of the lamp from the chart is varied to determine whether the patient requires more or less light for best visual acuity.

While the 2X telescope is still in the trial frame and the distance visual acuity has been noted, the patient is tested at near. The problem of training the patient to read should be carefully studied by the examiner so as to fully appreciate the care that must be exercised during the first examination at near. The examiner then arbitrarily adds a plus six or eight reading addition that fits on the objective of the telescope as a sort of cap. The reading attachment depends on the distance at which the object viewed is held, this distance being equal to the focal length of the reading attachment. Thus, with a plus eight reading atachment (object at 12.5 cms.) the total magnification would be 4X. A special subnormal vision reading card is then placed in the patient's hand. He is then instructed to read aloud very, very slowly, the examiner guiding the card throughout the entire part of the examination. The reading attachment is then changed until least magnification is obtained that enables the patient to do what he most desires (reading, writing, etc.) with due consideration being given to age, the resulting maximum visual acuity at distance and near, and the patient's field of vision. It may be necessary in certain cases to change the telescopic rather than the reading attachment. If the reading lenses are plus fourteen or more, it is advisable to test with microscopic spectacles, when the reading lense is more or less incorporated in the objective of the telescope. The microscope, however, requires considerably less coordination to maintain the field of view than the telescope with high reading add.

The patient is then instructed to return for a second eye examination. This is necessary since there is always a possibility of having overlooked an important point in the previous eye examination. The nervous state of the patient frequently interferes with proper field determinations during the first examination. The patient's attitude perhaps may have given the examiner misleading ideas regarding the use of telescopic spectacles in that particular case. The second examination visit should start with a repetition of the distance and near subjective tests with telescopic spectacles. An effort should be made to refine the distant subjective findings. The rest of the visit should be spent in trying the telescope at practical tasks. In reading books and newspaper print, the lowest possible reading addition should be selected to allow as big a depth of focus as possible,

and as large a field as possible. The patient must be taught to read by moving the printed matter rather than his eyes. If the patient desires to write, he must be taught to do so on paper ruled one inch apart and held at a good working distance. Subnormal vision patients are frequently interested in seeing motion pictures. The examiner should accompany the patient to the theater to observe his responses with different telescopic spectacles and at various distances from the screen.

The only way to be certain that the patient can actually use the telescopic spectacles for walking around is to try it out of doors. The patient should not be instructed in any way as to the particular characteristics of the telescopic spectacles. That is, nothing should be said to the patient as to the field, magnification, and the judgment of distance. The patient should merely be made to understand that this is a lense that is being tried to observe its effect on him. The patient's ability to judge distances, his ability in crossing streets, etc., should be noted. At the end of the second visit, the doctor should acquaint the patient with the practical possibilities of these lenses. The patient should also be advised that he will be required to undergo active adaptation with telescopic spectacles for a period ranging from two weeks to a month. This training period is necessary in order that the patient learn to properly coordinate head, eye, and arm movements. Lack of such coordination will result in the frequent loss of the field and in the inability to maintain sharp focus. The essential element in learning this new coordination is practice.

The psychological complex most usually observed is fear of blindness, because of the horrors associated with being blind, and the fact that most people believe that partial loss of vision will inevitably lead to total loss. This fear of blindness will reveal itself particularly during the first and second examinations, and will persist during the training period, unless the examiner is prepared to eradicate it by assuring the patient, that, all things being equal, his condition will not lead to blindness.

A second marked change in subnormal vision patients that is often noted, is an attitude of dependency that they develop. To help such a patient gain confidence in himself, the doctor must assume the role of an analyst. He must study problems of personality, particularly as they relate to the institutionalized and handicapped.

In almost all these cases, the reading is limited to one eye. The binocular field for near is extremely small and the patient would have to approximately double his convergence. Thus, if the patient normally reads at 25 centimeters then he converges 24 prism diopters (60 mm. P. D.), but with telescopic spectacles, the convergence is 48 prism diopters. This is equivalent to reading at twenty-

five- centimeters with 12 prism diopters over each eye. Reading binocularly with telescopic spectacles can not be done. Usually more than one focus reading addition is required. For example, a plus 6.00 might be used for writing purposes and a plus 10.00 for reading. Telescopic spectacles should be worn as close to the eyes as possible, so that the exit pupil and eyelense are approximated in order to provide the largest field. The telescopic spectacles should never be tilted because of the increase in aberrations.

Perhaps it would be well to emphasize again the two adverse effects produced by the increased magnification of the telescopes. A restricted field with the distance glasses may affect the safety of the patient while he is out of doors. This important fact should be carefull considered by the examiner before prescribing telescopic spectacles for constant distance wear. Another bothersome effect is the apparent motion noticed by the patient. When a patient turns to look at an object with 2X telescopic spectacles, the object seems to move as he "arrives" at the object in one half the time ordinarily expected. The patient will thus overshoot his mark and must "return" in order to see the object desired. When it was necessary to turn the eyes through 60 degrees without telescopics, he must now turn through 30 degrees with telescopes. This muscle sense conflict must be overcome during the training period with these telescopic spectacles.

Investigations with regard to subnormal vision correction show clearly that such problems lie in the field of rehabilitation. The problems presented with the fitting of telescopic spectacles are twofold: the development of the apparatus to compensate for the loss of function and the emotional readjustment. A consideration of these two problems is essential in the fitting of telescopic spectacles.

401 Bland St.