A holistic approach to myopia control and prevention

David J. Benkle
Pacific University

Larry D. Ellingson
Pacific University

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A Holistic Approach to Myopia
Control and Prevention

by
David J. Benkle
and
Larry D. Ellingson

Advisor
Dr. Rocky Kaplan

In partial fulfillment of the requirements for the degree
Doctor of Optometry

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Introduction

Myopia is a cause for concern for optometrists for many reasons. It is commonly observed in children, it limits our patient's performance, it has a cosmesis problem, and it generates anxiety for both parents and patients for their weak eyes. Additionally, myopia tends to progress, has widespread prevalence, and has the potential to lead to serious ocular problems such as retinal detachment, simple glaucoma, cataract, vitreous opacities, chroidal thromboses and hemorrhages. Any amount of myopia appears to enhance the possibility of retinal detachment.

In the United States the incidence of myopia among children and young adults has been established between 11 and 39 percent. The great increase in the amount of myopia in the general population is shown by the optical companies data which show in less than 75 years optical companies changed from producing mainly plus lenses to producing primarily minus lenses.

It is imperative that optometry works not only to treat functional myopia but also to control and prevent it!
Epidemiology

Myopia has been found to be more prevalent in China and among Japanese and German, and less prevalent in Scandinavian countries. Jews tend to exhibit more myopia than the general population and blacks tend to demonstrate less. Myopia is extremely rare in illiterate populations, but increasingly common in literate populations.

Of the several types of myopia, the most common type does not occur until age seven or eight. It progresses over time, eventually stabilizing somewhere in the mid or late twenties. The age at which myopia is developed has been decreasing steadily over the years. Where it was once common for children to develop myopia in the 12 to 15 year old age range, now individuals are developing myopia at a much younger age level, as young as 5 or 6 years old. This suggests there is no close relationship between puberty and the development of myopia.

It is well established that during the school years the percentage of myopia increases annually. The earlier the child develops myopia, the greater the amount of total myopia developed. Girls tend to develop earlier and higher amounts of myopia than boys. In addition more girls tend to develop myopia earlier than boys. There is a tendency for boys to catch up to girls, but they never develop the amount of myopia that the girls do.

Although the occurrence of myopia is more common in young individuals, approximately eight percent of the adults in graduate and professional schools become myopic in their twenties.
Theories

The theory of myopia as a normal biological variation fails to explain the increase in myopia incidence through the school years or its association with close work in young adults and students. Patients with higher degrees of myopia show hereditary influences, while those with lower degrees of myopia, with which this thesis is concerned, show little or no hereditary influence.

While it is true that parents with high levels of myopia tend to have children with high levels of myopia, it is not possible to predict the refractive characteristics of children whose parents have mild levels of myopia. The extreme variation in age of onset strongly argues against the development of myopia being solely determined by heredity.

Borish indicates that "other than the genetic and structural factors, the closest association has been demonstrated in the apparent increase of myopia in both incidence and amount with near point stress and fine close work."

Cohn established the use-abuse theory about 100 years ago, and attributed myopia to the repetitive over-use of accommodation, stressing school and intense near work.

It is well established that there is an increased incidence of myopia as well as the tendency for myopia to increase in amount with increasing age during school years.

The literature shows development of myopia in large numbers of graduate students and students in military academies. These people are engaged in long periods of near studies at ages well past those where growth and heredity would be expected to be factors.
Lepard found a tendency for myopia to develop and increase in the habitually fixating eye in strabismic amblyopes during the years of growth, while the amblyopic eye tended to show no appreciable change.

Young, et. al., examined three generations of Eskimo families and found little myopia among the grandparents or parents. They found a very high incidence, approximately 65 percent, of myopia among the younger generation. They attributed this to the beginning of compulsory education, with its reading and near point work. This definitely suggests that heredity itself is not the major variable in myopia determination.

The evidence that bifocals and cycloplegic agents are effective in controlling myopia progression provides further support for the near work theories of functional optometrists. Evidence supporting near work theories are found in animal studies also. Young found monkeys raised in a restricted near point environment develop more myopia than those raised in unrestricted environments. Also, caged cats showed a 68 percent incidence of myopia versus street cats who have an 87 percent incidence of hyperopia.

Bedrossian showed that even though human subjects were capable of converging, the use of atropine stopped the progression of myopia in the atropinized eye by eliminating the process of accommodation. Clearly if myopia were hereditary the atropine should have no effect.

Some functional accommodative theories of myopia etiology ascribe the development of myopia to increased axial length resulting from weakening and stretching of the coats of the globe secondary to accommodative effort.
Stenstrom and Sorsby found axial length to be the most significant component factor in determining refractive state. Young suggests myopia begins as a result of prolonged periods of near point work and the eventual inability to relax accommodation at far. When this state of continual accommodation is reached, an increase in axial length follows in a matter of months. Young demonstrated an increase in vitreous chamber pressure during ciliary muscle stimulation in primates, and he suggests this increase in pressure plays a significant role in axial elongation.

Bell states "physio-mechanical forces may sometimes be facilitated by extended periods of close work. The forces of ciliary contraction stretching the ocular coats as a result of sustained accommodation, and intermittent rises in vitreous pressure, also from sustained accommodation, are the most capable of altering scleral structure. Stress actions on the sclera are capable of altering the refractive state of the eye by altering the sclera."

All of the above suggests the process of accommodation is very involved in the development of functional myopia. Myopia appears to be primarily an increase in the size of the vitreous chamber of the eye and an increase in the total volume of the vitreous.

Functional myopia may develop in a two staged process. The first being an accommodative increase which develops from long periods of near work. The accommodation can no longer relax completely and maintains a level of 0.05 - 1.50 D. This accommodative level may lead to an increase in vitreous pressure, which if maintained over a period of time may result in the stretching of the ocular coats and enlargement of the vitreous chamber developing into true myopia.
It is our contention that this environmental, functional type of induced myopia can be controlled and more importantly prevented. We feel, as do many functional optometrists, that vision is a learned human behavior. We believe heredity starts the visual system with a certain growth pattern the eye will follow that is genetically determined. This growth pattern is subject to significant modifications via environmental influences and factors such as nutrition, near point stress, etc. This is especially true for environmental factors that would or could increase the intra-ocular pressure or decrease the resistance of the scleral coat to stretching.\textsuperscript{72}

Skeffington\textsuperscript{29} believed myopia was a purposeful adaptation to a culturally imposed demand of society. He felt reading was a biologically unacceptable task of culturally recent onset which caused a drive towards overconvergence. Myopia was simply an adaptation to reduce the stress. If our culturally induced "environmental stress is considered a function that has a constant trend toward myopia, it can modify or supplant that which genetics originally determine."\textsuperscript{9}

Given all the data presented, we feel that by modifying or controlling the environmental factors associated with myopia development we can influence the progression favorably, to include control or even prevention.
Types of Myopia

There are several different types of myopia. Malignant myopia is a pathological entity. It is a progressive axial elongation with degenerative fundus changes and sub-acute visual acuities. It presents with degenerative atrophy and thinning of the ocular coats. This condition is almost always inherited and is a genetic problem prevented only by genetic counseling. It is not the concern of this thesis.

Acquired myopia is primarily refractive. It is due to changes in the eye's index of refraction and may be transient or variable. It is generally caused by ocular incipient cataracts or some systemic pathology, i.e. diabetes mellitus. This entity is also not the concern of this thesis.

Functional myopia is the entity we are concerned with. It has many names, low myopia, pseudomyopia, or developmental myopia, all of which have similar traits, signs and symptoms.

Functional myopia attacks hyperopic and myopic eyes. It generally occurs in childhood or adolescence and progresses, but it can occur in adults. We believe it to be a defect in the accommodative mechanism generally as a result of excessive near work and/or poor near habits and/or poor visual hygiene.

There are several stages of functional myopia and we will describe the clinical signs and symptoms presented by each.

Functional myopia begins as incipient myopia. The patient may show any of the following symptoms revealed by a careful case history.
1. Intraocular and supraorbital headaches associated with visual tasks.  

2. Intermittent or increased blurring at far and/or near after prolonged near point work.  

3. General near point asthenopia.  

4. The habitual working distance is less than Harmon's.  

5. History of excessive time spent working at near of possible recent change in near task habits due to increased schooling or job change.  

6. History of poor work habits and poor visual hygiene.  

7. Symptoms above may be worse through habitual Rx in minus.  

8. Patient's parents have myopia of less than 4 to 5 diopters.  

9. Child views television up close because it's clearer than when he sits at far side of room.  

10. Objects appear less clear at night, decreased night vision.  

11. Photophobia.  

The clinical observations following a thorough examination will include many of the following signs for incipient functional myopia.  

1. Decreased hyperopia or low myopia (-0.25 D.) is subjective endpoint.  

2. The subjective endpoint is generally more minus than the static retinoscopy.  

3. Esophoria or at least decreased exophoria far and especially near except for low AC/A patients generally substantial eso at near.  

4. Visual acuity is 20/20 maximum.  

5. Add of plus in 0.25 D. increments does not produce predictable blur at far.  

6. Near point BI ductions are substantially low, low 17 OEP.  

7. Signs of accommodative insufficiency via disorders in lag, flexibility or stability.  
   a. low PRA OEP 20.  
   b. low amplitude OEP 19.  
   c. low NRA with normal PRA and normal amplitude (can't relax).
The above show that functional myopia is primarily accommodative in nature and appears clinically with signs of accommodative insufficiency, inadequacy, and/or freedom between accommodation and convergence systems. These poor accommodative skills lead to accommodative spasms and excessive effort, which, by accommodation's association with convergence, leads to esophoria at near.

It's important to test the accommodative function as accommodative inertia is often an early sign of functional myopia. One method to test accommodative facility follows. Place a +2.00 D. lens over the subjective OD, and a -2.00 D. sphere over the subjective OS. Use alternate occlusion while the patient fixates a target at 16 inches. The inability to clear either target or if it takes longer than two seconds to clear shows a decreased accommodative facility.

Another method to check for any increase in minus acceptance uses the net binocular cross-cylinder value. If the net binocular CC test value at near is more minus than the far subjective, then we are dealing, at least in part, with a functional accommodative problem.

One final test to differentiate a functional myopia uses a septum on a reading rod. The OD views a set of letters at 16 inches through +1.50 D. over the subjective, while the OS views another set of letters at 16 inches through -1.50 D. over the subjective. The patient views OU and is asked to report which letters are clearer. Normal patients report the OD, while functional myopes report the OS is clearer.
Incipient functional myopia is managed by controlling environmental factors with plus lenses, good visual hygiene, and by visual therapy.

Left untreated incipient functional myopia becomes what we call progressive functional myopia. This is a stage of active ciliary spasm. The patient may still report near asthenopia, but it is quite commonly not present as the symptom tends to be relieved by the developing myopia.

Clinically, your examination will reveal an increase in myopia, a subjective of greater than or equal to -0.75 D. There will still be esophoria present at near and the accommodative problems.

Progressive functional myopia must be treated by lenses, bifocals, and visual therapy. The vision therapy should include BI training, accommodative rocks, and training to improve general visual skills. This will be discussed later.

Progressive functional myopia will eventually lead to stable or true myopia if left untreated. The patient may have no near point asthenopia. The examination will reveal no change in Rx. The static retinoscopy will approximate the subjective and generally be less than minus 4.00 to 5.00 diopters. The best visual acuity will be 20/20 or better. The addition of plus in quarter diopter steps produces the predictable blur at far. The pupils are often larger than normal. There is no esophoria present at near, in fact exophoria is found at all distances, especially at near. There are no signs of accommodative insufficiency and in fact the accommodative findings are generally improved. There is also no indication for the need of plus in the near findings. Finally, as in all of the above, there are no degenerative fundus changes.
Stable or true myopia is no longer purely functional as now adaptation has occurred structurally. Remedial therapy may succeed but only partially. The treatment is with single vision lenses, or possible bifocals, if applicable, and visual therapy. The visual therapy is usually not successful in decreasing the Rx but can often increase visual acuities. BI prism can also be prescribed for full time wear.

The functional myopia syndrome involves a rapid increase in myopia or, decrease in hyperopia, esophoria and inertia of accommodation. The diagnosis may be made while the refraction is myopia or hyperopia. This initial accommodative insufficiency leads to an inadequate ability to relax accommodation, which left untreated and undiagnosed, leads to true myopia.
Treatment

One of the goals of a functional optometrist is not just the treatment of myopia but the control and prevention of it. The greatest causative factor in the increase of myopia in children is the increase in the amount of near work during the growing years. We must design and use therapeutic measures to prevent the accommodative spasm from occurring and to increase the ability of the visual system to withstand and function in this stressful environment.

Prevention requires instruction with understanding and special eyewear. Patients and parents must understand how important the environment is for close work. Programmed approaches and written instructions for children and parents should be developed and used.

To successfully prevent functional myopia all children should receive their first exam during preschool or by age five. This exam will determine baseline data to compare with later findings and help detect a problem at its beginning. Visual hygiene and environmental factors should be discussed during this initial exam. Parents should be given supplemental literature to educate them. In addition, parents could be taught simple tests to perform at home to help detect any changes in their children's vision. This type of education and awareness will create an environment to help in the early identification of those children susceptible to functional myopia.

Most myopias have their origin with some sort of accommodative spasm, even though the patient may still be in a hyperopic refractive state. Our error is in assuming functional myopia exists only when minus lenses are required for clear vision. We may find every
test of accommodation, heterophorias, symptoms, and history strongly indicating the patient who's still manifesting hyperopia, has already fallen victim to the myopia morbidity. As Dr. Manas states "give us a youngster when he is still on the plus side, and in almost all cases we can prevent him from slipping into myopia."

Drucker summerizes the goals of prevention for functional optometrists:

1. Optometrists should be assigned to all schools and complete refractions must be made of all first graders to establish their normal state.

2. Semi-annual (we feel annual) refractions should be made to determine exact time that significant refractive changes are occurring. Loss of 1.00 diopter or more of manifest hyperopia should signal the time to suppress accommodation. The origin of functional myopia is located in the hyperopic starting point generally.

3. All teachers, nurses, parents, as well as school children must be taught the relationship of posture to accommodation, reading distance to myopia, and other environmental factors to minimize and control myopia's growth.

4. We want to prevent a lifetime of dependence on corrective lenses.

One note of caution should be mentioned when prescribing for children. There may be a tendency to overcorrect myopic children by approximately 1.00 diopter so use caution when correcting kids with visual acuities of 20/40 or better or about 1.00 diopter myopic. If you do correct the far vision, advise your patient not to use the lenses while reading.

Bifocals

Since accommodation, its malfunction and spasm during prolonged near work, is the primary cause of functional myopia, we must make every effort to control it. Accommodative effort associated with near work can be reduced by cycloplegics, but this is
obviously not a practical means of therapy. Rehm\textsuperscript{74} developed a myopter, an instrument which decreased both accommodative and convergence demands. We feel this instrument is quite bulky and has a limited usefulness. Therefore, undercorrection or bifocals, are still the simplest and most desirable means of decreasing the accommodative effort during prolonged near work.\textsuperscript{10, 72} They decrease the chance of ciliary spasm\textsuperscript{2} and the overconvergence tendency, which often accompanies excessive accommodation effort.\textsuperscript{6}

Many authorities feel bifocals are useful in the treatment of children.\textsuperscript{3, 4, 8, 11, 27, 29, 30, 32, 38, 40, 41, 48} Roberts and Banford\textsuperscript{47} have stated the number of believers as "several thousand" as of 1967. Oakley and Young did a matched study and showed a 0.25 diopter more annual myopia progression in the control group than the experimental group wearing bifocals.\textsuperscript{8} They also found the rate of the progression of the control groups is higher at the younger ages and drops at the older ages, as did several studies.\textsuperscript{8, 13, 14, 15} A second study showed 0.50 diopter less myopic progression in subjects wearing bifocals.\textsuperscript{8}

The question of who needs bifocals has many different answers. Young\textsuperscript{60} recommends bifocal preventive therapy in all children who are myopic or who appear to be becoming myopic. Birnbaum,\textsuperscript{22} who believes that against-the-rule astigmatism may be a forerunner of myopia, advocates the application of plus lenses for near vision tasks in patients who exhibit against-the-rule astigmatism low in magnitude and of presumed recent onset. Roberts and Banford\textsuperscript{47} found "children exhibiting esophoria at far and near, a high AC/A ratio, and an indicated add in the near point net findings will progress more
rapidly than their contemporaries showing more normal findings, if they are provided with single vision lenses. These are the very children showing the slowest rates of change when provided with bifocals." Many authorities agree that bifocals are best for functional myopes who are more esophoric at near and have a high AC/A ratio.6, 12, 13, 54, 55

The question then arises as to what amount of plus is needed for the best results in treating functional myopia. Malkin13 believes plus should be added until the patient is approximately six exophoric or slightly more, providing there is a good duction balance on either side of the induced phoria, primarily the adduction. Greenspan7 recommends cutting the minus, 0.50 to 1.00 diopter of minus from the subjective for far, depending on the patient’s task demand and old prescription. He recommends prescribing bifocals of plus 1.50 to 2.50 diopters for myopia control with the seg height well into the pupillary one. Lake15 feels that plus, which increases the exophoria at the near point, is contra-indicated unless all other near point findings show it to be acceptable.

Currently there is no universally accepted rule regarding the power of near lenses. Tiant76 recommends full distance correction with an add of +1.00 or +1.50 diopters. Oakley and Young8 undercorrected distance vision by 0.55 diopter and used +0.75 diopter to +1.00 diopter adds. Roberts and Banford47 did not undercorrect distant vision and they used near prescriptions indicated by near point findings. The most effective adds tended to be +0.75 to +1.00 diopter. We agree with this latter approach. We recommend using the number seven at far with the best near add suggested by
the individuals near point findings.

It's been proposed that when the accommodative spasm is already present one may use the fogging technique to eliminate it. This is the use of lenses that create a slight blur at near while reading. The slight blur produces a situation where accommodation is actually eliminated for all practical purposes.

When bifocals are prescribed for young functional myopes the position of the seg height is of critical importance. In order to insure they are used they must be positioned so that the patient can not look over or around them. The seg height should be at least into the pupillary zone and as far up as midway into the pupil. Bifocal size should be such that the patient can not look around the seg.

With young functional myopes, bifocals will work much better if they have well fitted frames that are checked and adjusted regularly.

There are times when bifocals are contra-indicated. A myope with high exophoria who is well adapted to his lenses and has stopped progressing is contra-indicated for bifocals. Bifocals are also contra-indicated in myopes with a large esophoria at far with a less amount of eso at near. Watch for patients where the link up between the accommodation-convergence system causes problems. Some patients have systems where the act of converging on the book stimulates accommodation even though the bifocals are attempting to eliminate it. This upset can cause fatigue and double vision. These patients must be taught to hold their material as far away as possible.

Watkins summarized list of findings for and against the use of bifocal lens in myopia control. The favorable findings which
indicate bifocals are:

1. retinoscopy shows spasm
2. esophoria at far
3. esophoria at near
4. unstable phoria
5. OEP 14B gross up in plus
6. OEP 14B gross 1.00 diopter or more above 7A
7. progressive rate high (0.50 to 1.00 diopter per year)
8. myopia of short standing
9. can get some plus in seg
10. patient jerky, tense, halatosis, tonsils
11. patient has unbalanced diet or no milk
12. myopia crescent absent
13. young person with much myopia
14. parents enthusiastic
15. child gives verbal approval

Findings which Watkins believes contra-indicate the use of bifocal lenses are:

1. rigid retinoscopy findings
2. exophoria at far
3. exophoria at near
4. phoria locked and very stable
5. OEP 14B gross way down in minus
6. OEP 14B gross same as or little more plus than 7A
7. progression rate slow (0.12 to 0.37 diopter per year)
8. myopia of long standing
9. seg still in minus, even with add
10. patient has no endogenous toxicity
11. patient eats all foods and takes vitamins
12. myopic crescent present
13. older person with little myopia
14. parents tolerate it.
15. child says nothing

Birnbaum mentions several more indicators for the use of plus lenses.

1. When the near point esophoria increases significantly during rapidly repeated measurements.
2. If overconvergence is shown in performance tasks such as cheiroscopic tracing.
3. A production of a longer working distance through plus.
4. If you observe an excessive lag of accommodation using either bell and/or monocular estimate method retinoscopy.
Television Glasses

Many children spend hours watching television. We can use this to our advantage by prescribing a television prescription as an accommodative muscle relaxer that acts to relax any accommodative muscle spasm that might have developed during the day's near work.

Nolan described the television Rx as the maximum plus for maximum visual acuity at the patient's television distant, generally ten feet, with emmetropes or hyperopes to allow the lens and ciliary muscles to be in a complete state of rest. Nolan uses Snellen letters at ten feet and adds plus binocularly in .25 diopter increments while asking the patient if each new addition makes it better, worse or the same. When he reaches the add where the letters get worse, he subtracts +.12 diopter and prescribes this for television viewing. This +.12 diopter fog should be ideal for relieving any ciliary spasm that may have occurred.

These television glasses should be kept on or near the television and used only in the television room so they do not get lost or misplaced.

This "TV Rx" is not like low plus lenses for reading. They are not meant to give some relief while reading. They are meant to use at far only, greater then ten feet, and the patient must be required to look at distant objects and see them clearly for one to two hours each day for these lenses to relax the ciliary muscle. If the patient does not watch television a similar type prescription can be designed for use in gym class, basketball, farming, hiking, or any activity requiring far vision.
Nolan uses the television Rx as a monitoring device for his myopic patients. A sign of progression is a patient reporting decreased vision through his television glasses. When this occurs a re-evaluation of the patient's reading or close work habits should be performed. There may be a need to strengthen or reinforce good environmental habits to the patient.

**Base In Prism**

Years ago Morse-Packham published a paper describing the use of base in (BI) prism for myopes. The paper claimed BI prism can give relief to myopia caused by convergence. They prescribed BI prism using a trial and error procedure described below. They used the procedure on their myopic patients with high links of positive accommodation to convergence.

They began with the patient looking at a distant chart with BI prisms and no minus lenses. The patient should be able to see the largest letter on the chart. This blurred state allows the patient an opportunity to use negative accommodation to see better. The amount of BI prism used is determined by the distance exophoria of the 17B recovery finding. Minus lenses are added binocularly, in .25 diopter steps, until the patient's BVA is reached. Then, slightly more and less prism amounts are checked to see the effect on the amount of minus needed to BVA.

The BI prism is prescribed if the visual acuities are about the same when combined with less minus in the prescription. In addition, when the subjective response is positive, even though visual acuities are the same, BI prism appears to be beneficial.

Morse-Packham advised against using additional prism in the
near add unless the patient is a low myope with esophoria at distant, low distant ductions, low abduction (17) at near, low NRA (21) and sometimes low PRA (20). This patient description fits the incipient functional myope fairly well. They recommend helping this type of patient with a plus add of +.50 to +.75 diopter and an additional 0.5 to 1.0 diopter BI on each add.

Generally, two to three diopters BI prism are prescribed for each eye at far for those myopes who require less minus for the same visual acuities. The prism often did not decrease the myopia but rather gives an increase in comfort. Therefore, some myopic patients who used BI prism prescription with their minus Rx achieve better visual acuities or are able to use a less minus Rx. Granted, not all myopic patients may be benefitted by BI prism, but we should not disregard the possible use of BI prism in the Rx. In fact, when proper patient selection is adhered to, we feel BI prism is a useful addition to a total regiment of myopia management.

**Visual Hygiene**

Proper desk placement is important in not only controlling the visual environment of the functional myope but also for any good vision hygiene program. The desk or study area should be located either directly in front of a window with a far view or positioned so as to face out towards an open room.

Good lighting of the study area is also essential to good vision hygiene. Generally people use too little illumination. Good illumination decreases the need to hold books close in order to read them. It also causes the pupil to stop down and effectively eliminates the use of peripheral lens. Elimination of peripheral
lens use may decrease the amount of accommodation required.²

The patient should avoid any glare⁴ and the light should be positioned in a way to avoid shadows and reflections. Therefore, its best if right handers have the light rays passing over their left shoulders.⁵ Kaplan⁵ recommends the use of a 100 to 150 watt incandescent bulb placed within three feet of the work surface. He also recommends that patients be informed of the availability of full spectrum fluorescent tubes and incandescent bulbs made especially to fill in the near ultraviolet band of energy missing from our traditional lighting sources.

Good lighting should exist over the entire room and not just over the desk, to allow distant objects of interest to be seen when looking up.¹

When watching television, full-room illumination is important since more visible surroundings will enhance occasional glances away from the television.

Maintaining the proper reading distance is essential while doing all near work. Its recommended never to read closer than the distance from the middle knuckle to the elbow (Harmon's distance) and preferably further.¹, ², ⁵ Friedman⁴ suggests no near work inside of 14 to 16 inches.

As we know the closer the child is to his or her reading material the more likely the task will cause ciliary spasm and strain leading to myopia development.

Along with the distance at which our patients read, comes the importance of posture and how they hold their reading material. Patients must be taught that being upright during all activities
enhances the ability to see more than just the television they're watching, the book they're reading, or the hobby they are working on. 1 Sitting upright enhances the peripheral awareness, whereas crouching or laying down may prevent the awareness of other things around the patient. 1 If possible the elbows should not be rested on the desk or table while reading. This creates a posture where the head bends forward and gets too close to the work. 2

The reading material should be held up and tilted to be approximately parallel to the face. 4 This enhances the erect, upright reading posture versus the book laying flat on the table, pulling the head and eyes down into the near work. Birnbaum 78 recommends tilting reading material about 20 degrees from the horizontal. The reading material should be held so that the right and left sides are equally distant from the eyes. 4

Where possible advise the patients to avoid reading extremely small or poor quality print. Have them avoid squinting, squeezing the lids or straining in order to view near work. Objects should be viewed in a relaxed manner. Finally, patients should be advised to avoid reading in moving vehicles where possible. 4

Functionally myopic patients tend to have round shoulders and they tend to stoop forward. If this posture is present, Kaplan 5 believes it should be pointed out so the patient is more aware of his behavior. Kaplan 5 recommends using a check distance method to remind the patient with a tendency to close in on his or her work.

Most hobbies are near work related (models, painting, pottery, etc.) and the patient must be taught the same good visual hygiene during these tasks. A child must be taught to look up regularly, take periodic walks and breaks. 1 As usual the lighting must be
adequate for both the near hobbies work and general illumination in the area surround. If possible encourage outdoor activities with long distance viewing.4

When a child is sick and has a high fever, the visual hygiene rules must be followed strictly. A sick room is generally a perfect environment for the development of functional myopia. The sick child is usually bedridden and in poor illumination. They are given puzzles, books, and games to play at near to help relieve the boredom. Myopia can develop quickly under these conditions.1, 2 The child should not do any reading or close work during this time. The room should be kept well lighted to help encourage distant vision. A television is ideal here and should be placed at 10 to 15 feet away1, 2 and a television prescription used, if available.1 The child should be encouraged to look out the window as often as possible.

It has long been advised to take breaks from continuous near work and stress. These breaks allow for the relaxation of focusing muscles and help prevent the accommodative spasm from setting in. Nolan1 advises looking up at the end of every paragraph. This can be enhanced by using a pointer to keep one's place, and by having something to look up at and observe in the distance. Nolan1 states the looking up procedure would be effective if done 20 percent of the time or every five paragraphs. He suggests an object at least 15 to 20 feet away be cleared for maximum effectiveness. Friedman 4 also recommends looking up breaks, for at least five seconds, during prolonged reading.

The important aspect to realize when working with progressive myopes is they tend to read for long periods of time, 45 minutes and
more, without looking up! We can work to eliminate this reading continuum by educating the patient about the importance of looking up breaks while reading.

We advise using an application of the look up principle that works best for the patient. Whether you advise looking up after every paragraph, page, or some time period (every five, ten or fifteen minutes) is not critical. The important aspect is the patient's compliance with some plan. Only with the patient's cooperation will the therapy be effective.

**Vision Therapy**

Visual therapy is used to enhance the visual system of the functional myope. Birnbaum considers visual therapy as a means for creating a visual system capable of withstanding environmental stress. He further states, "Vision training may also be effective in more actively reducing accommodative stress through the use of plus acceptance training, accommodative inhibition training, and supportive general relaxation, stress reduction, and imagery techniques."

We believe vision therapy should be used to develop PRA, NRA, far to near ability, freedom between the accommodative and convergence systems, and stress reducing relaxation techniques. By improving the entire visual system's facilities we hope to help the visual system withstand the nearpoint environmental stresses which are such major factors in the development of functional myopia.

Kaplan uses a complete holistic visual therapy approach in his myopia treatment program. He recommends that his patients read
Total Vision by Karner and Dusky, A and W Publishers, 1978; The Aerobic Way by Kenneth Cooper; Visionetics by Lisette School, Doubleday Dolphin, 1978; and Eye Power by Ann and Townsend Hooper, Knopf, New York, 1979. He encourages patients to maintain the Harmon distance during all nearpoint related activities. In addition, the patient should be taught how to become aware of maintaining an upright posture. This can be accomplished by incorporating the use of base-down or up yoked prisms in a prescription. There should be specific time periods during the in-office vision therapy sessions where the prisms are worn. The yoked prisms will bring about the awareness of the upright posture by rearranging visual postural space. It is quite exciting to watch the postural changes in the myopia patient after the use of yoked prisms. Remember that many myopic patients tend to have round shoulders and stoop forward. They are not usually aware of it, until someone points it out to them.

Kaplan advises breaks from close work be combined with breathing techniques.

Breaks from close work. When your patients are involved in any form of close work they should take periodic breaks in which they look at distant target. Ideally, they should develop an alarm system that would notify them every fifteen minutes or so. When they look up they should bring the details into focus as quickly as possible. Patients will usually ask how long they should practice this activity. I usually respond by first giving them the next skill, proper breathing. This can best be demonstrated in the form of a saccadic fixation activity. While the patient is
visually involved, breathing efficiency decreases and breathing becomes more shallow thus depriving the myope of the normal levels of oxygen to their visual system.

Have the patient stand in front of a wall and have him choose two fixation points across the room and encourage him to alternately fixate the targets. If this proves to be an easy task, add a metronome beat so that the patient is required to adjust his fixation to the tempo. Lastly, have the patient become aware of his breathing pattern while continuing the previous eye task. This task is quite difficult, which stems from a failure to use full diaphragm breathing during nearpoint activities. This is also related to the undesirability of near work from an evolutionary point of view. Another dimension for this activity is to add blinking to the breathing pattern. Many myopic patients tend to lock themselves into a myopic kind of central "stare". Inclusion of blinking into the therapy might also permit more adequate pupil dilatation and constriction, which if Dr. Ludlam's hypothesis is correct, could reduce the higher degrees of intraocular pressure typically found in myopic patients.

At the thirty minute mark, it is advisable to not only perform the previous activity, but to add a standing phase as well. Some basic stretching and other type of calisthenics can be included. I recommend that the patient take a "window break" for ten breaths. This can be transferred to the real world by asking the patient how many breaths he thinks it will take before the stop light will change, or how many breaths it will take to walk across the room. The goal is to educate the patient about these skills so that they will become automatic in their lives.
Kaplan\(^5\) also recommends that after every thirty minutes of near work during the break, yoga eye movements be performed. The patient should sit or stand in an upright position and coordinate breathing with appropriate eye movements in the cardinal positions. Have the patient begin by turning his eyes to the right and breath. The patient should turn his eyes as far as possible even to the extent of producing tension and a sensation of pain. Then he exhales as he moves his eyes all the way to the left position of gaze. This cycle is repeated five times. A similar cycle involving superior and inferior positions of gaze is also completed five times. Finally, a cycle of diagonal movements completes the exercise. The three part technique is repeated in its entirety while having the patient reverse the direction of gaze in each case.

Kaplan\(^5\) has available for some of his myopic patients, a technique referred to as the modified Bates technique. The basic philosophy of the Bates technique is that eye muscle tension is found in the extracocular muscles rather than in the ciliary muscle or lens. Accordingly, the extracocular muscles require exercise not because they are weak, but because they become locked into rigid positions and consequently do not exhibit fluid movement. Techniques to accomplish this include sunning, palming, swinging, and various visualization activities described below.
CUPPING  
(RELAXATION & STRESS REDUCTION)

10 MINUTES

Sit comfortably at a desk or table and cover your eyes with cupped hands. The heel of the palms should rest on the cheekbones, and the fingers should cross over on the forehead. Sit with your elbows resting comfortably on a cushion, close your eyes, and make sure your eyelids, brows, and fingers are all relaxed. Don't apply any pressure to the eyes themselves, and don't push down on your eyebrows.

Cupping is like a sauna—the warmth and moisture relax the entire visual system, and especially the extrinsic muscles. Concentrate on your breathing and try to keep your mind free of thoughts. **Avoid worrying about your problems. Simply relax and make your mind blank.** If you find it difficult to concentrate on your breathing, try counting your breaths or enjoy the feeling in your eyes. The next step is positive visualization. Here you will remember pleasant scenes and incidents in your life, or will **imagine pleasant fantasies.** Moving mental pictures are important because—whether you realize it or not—your eyes will be scanning as these images pass through your mind. Here are some sample fantasies:

a) Imagine you are by the seaside, walking along the beach. There are people sunbathing, children playing, seagulls flying overhead, boats sailing, swimmers swimming, and fishermen fishing. The sun is shining and there is an ocean liner cruising by in the distance. The surf is breaking gently on the shore, and you come to a rock pool with lots of seaweed and shells.....

b) Remember a pleasant scene from your childhood. You are walking down the street with your friends. There are shops, traffic, dogs, cats, people all going about their business. You are playing with your friends, and you are all having a good time. You are running about, jumping, dancing, playing ball and really enjoying yourself. Everyone is happy, as you play different games with your friends.....

Note: Cupping for children—tell them a pleasant fairy story.  
Cupping for religious people—finish up with prayer.
SUNNING SWINGS
(STRESS REDUCTION & NUTRITION)

10 MINUTES

Stand or sit comfortably in direct sunlight. Close your eyes and swing your head from side to side in a slow rhythmic motion — forming a "lazy 8". Keep the movement going, and breathe in harmony with the swings. Now do some neck rolls, then move your head from side to side and up and down. Now back to the lazy 8s. Now some more neck rolls etc. . . . . If the sun isn’t out, do the exercise with your eyes open. Alternatively, you can stay indoors and use a 150 watt lightbulb about 2 feet away. Some doctors recommend an infra red bulb which gives out a warm red light. These can be purchased from your local drugstore for under $10 and appear to be especially beneficial for relaxation and circulation.

WARNING: Never look directly into the sun with your eyes open, otherwise your retina will be damaged. People who are photosensitive — allergic to sunlight — should pay particular attention to doing sunning swings as often as possible. If you have this problem, sunning swings will quickly eliminate it. Avoid wearing sunglasses unless absolutely necessary. Gently persevere, and any discomfort will soon disappear.
LONG SWINGS (RELAXATION & SCANNING)

Body rhythms are very effective in relaxing the mind and eliminating stress. The long swing in particular is helpful in vision improvement, because it releases the tension in the neck, shoulders, and lower back. In addition, the long swing is important because it reactivates the scanning mechanism and helps get the eyes working properly again. Long swings have the unusual property of helping to cure insomnia. In addition to your regular exercise sessions, do 5 minutes of long swings before going to bed.

Stand with your feet about 9 inches apart. Let your arms hang loosely at your side. Then, keeping yourself as relaxed as possible, gently swing your whole body back and forth—first one way, then the other. Back and forth, back and forth . . . . Keep the movement smooth and easy—in harmony with your natural body rhythm. You can raise each heel alternately from the ground, but not the whole foot. Keep your breathing regular and rhythmical.
Let your head move with your body, and don’t look at anything in particular. Just scan the horizon, and watch the world go by. Long swings loosen up the visual system, and you will soon see the world slipping past you in the opposite direction. This may make you dizzy at first. If this happens, swing more gently for a shorter time. Persevere with the exercise every day, and the dizziness will soon go away.

Once you feel comfortable doing this exercise, you can try this variation: Place the large Snellen chart 10 feet away from you, and stand with your side to it. Now do the long swing, and when your eyes are facing the chart at the end of each swing, glance at one letter. Don’t stop to read the letter, but keep up the continuous movement. Systematically make your way down the chart, letter by letter. Then repeat the exercise with the chart on your other side. A helpful variation is to repeat the exercise using the far chart, going down the chart word by word. Finally, repeat the exercise with the Snellen chart upside down going from bottom to top, then the far chart upside down...
EYESTRETCH
(RELAXATION & COORDINATION)

Sit or stand with your eyes open, preferably out of doors. Now look up as far as you can—then look down as far as you can. Take your time, and try to look at specific objects as far above or below you as possible. Repeat this up/down/up/down motion a dozen times, blinking and breathing as you go. Make sure your face and shoulders are relaxed. Now close your eyes and do some sunning swings. Now repeat the exercise—going from side to side a dozen times: left/right/left/right etc. . . . Look as far as you can in each direction, and try to focus on specific objects. Stay relaxed and don't strain. Now close your eyes and do some more sunning swings. . . . Now diagonally in both directions: lower left/upper-right/ lower left/upper-right etc . . . . lower-right/upper-left/lower-right/upper-left etc . . . . Do a dozen in each direction, looking at specific objects. Take your time, and don't strain. Remember your blinking and breathing, and make sure your face and shoulders are still relaxed. Now do some more sunning swings. . . . Now roll your eyes in a circle—a dozen times in each direction. Don't look at anything in particular. Just concentrate on getting the movement as smooth and regular as possible. Finally, some more sunning swings.
HOW TO GET RID OF BODILY TENSIONS

ARMSWINGS: Stand upright and relaxed. Let your arms hang limp at your side. Now let them swing slowly, forwards and back. Now let them come all the way up and over to form a complete circle. Now swing them some more, then start circling the opposite way. Take it easy—this is relaxation, not gymnastics. Vary the movement so that the arms swing in a horizontal plane, gently clapping your hands as they come together.

NECK RELAXER: Close your eyes, relax your neck, and allow your head to slump forward onto your chest. Now gently ease your head all the way back. Then lower your head again to your chest. Now bring your head back to an upright position again, keeping your eyes closed. Take it easy, and concentrate on slow gentle movements. Now gently turn your head all the way to the right—as far as it will go without straining. Now all the way to the left. Do this a few times. Then, slowly and smoothly, do some neck rolls. Take it easy, and watch for painful tension spots. Never force your way through a tension spot—always ease your way around it. Don’t force the movement—this is relaxation, not gymnastics.
Close your eyes, sit quietly, and relax. Place your thumbs in the position indicated by the dots in the diagram above. These dots represent what are known as the Tian Ying points. Support your forehead with the other four fingers of each hand. Firmly press and rub the Tian Ying points for a few minutes. Make sure you are not pressing against the eyeball. Then open your eyes and look at a distant object.
Kaplan uses the following visual therapy methods on his myopic patients.

Training monocular skills. Monocular skills should always be trained at the nearpoint first, progressing to intermediate ranges and finally to distant positions. Since the myope functions most effectively at near distances there is a noticeable falloff in his performance as the target is moved away from him. During monocular skill training the use of minus lenses is most appropriate. Minus lenses are not to be used during binocular training since they would stimulate accommodation and convergence activities that myopia control programs are attempting to reduce. Dr. Kaplan recommends the use of loose lenses of -2.00 D and -4.00 D which can be given to the patient so that he can begin monocular rock activity at home. The patient should be instructed to begin with the -2.00 D lens, progress to the -4.00 D lens and end with a -6.00 D system (by combining the two lenses). The accommodative rock is most effective when performed during reading tasks, or using the "Montreal Chart".

The "wide-wall" and/or "baseball" fixations can be included (refer to a standard vision therapy text). Again, remind the patient to begin at near distances and progressively move the target out to far positions. The purpose is to increase the demand on accommodative inhibition through the utilization of plus lenses which substitute for the patient's accommodative mechanism. The Van Orden "deep wink" as well as the "deep blink" would be appropriate at this stage of monocular skill training. At any point during the use of visual hygiene or monocular skill training yoked
prisms base-down would also be suitable. Myopes, once they have mastered monocular skills, have the balance board activities added to the regimen.

Accommodation and vergence facility training. At this stage the patient is given what I refer to as a placement test to determine the particular accommodative and vergence training appropriate for the present facility of the patient's systems. For example, when training divergence skills some patients may be unable to work successfully with the vectogram, chiastopic or orthopic fusion devices. Those patients should begin training in a handheld stereoscope using base-in cards from the Keystone Company, training ranges from the most dissociated state (stereoscope) to the least dissociated state (Chiastopic fusion devices, eccentric circles and lifesaver cards). Intermediate to these extremes devices are as the aperture rule, mini-vectogram (both red-green and polaroid) and the space vectogram.

An entire session may be required to evaluate the level which the patient should begin vergence and accommodative training. The goal is to have the patient develop skills so that he can appropriately inhibit the vergence and accommodative mechanisms. Often it is necessary to demonstrate to the patient that accommodation and vergence are two different systems even though they function together during many vision activities. I suggest that early in the training program the myopic patient should be taught that when he is in a diplopic state his vergence system is either over or under responding to a stimulus (i.e. turning his eyes in too much or too little). Most often the myope over converges which causes
the accommodative system to likewise over respond. The patient learns to look for doubling of images and blurring of images as signposts that the two systems are not functioning optimally, and ideally, begins those skills that he has found successful in relaxing the two systems.

**Bi-ocular accommodative facility.** The monocular accommodative facility is now transferred to the bi-ocular level. Under red-green or polaroid dissociation (mini-vectogram) with the use of a $\pm 1.50$ to $\pm 2.00$ D flipper the patient views a target with both eyes while having an acuity demand presented to one eye only. The accommodation is rocked for that eye only. The conditions are then reversed with the other eye receiving the stimulus demand and the accommodative rock activity. The patient should be instructed to keep a timed record for each eye's performance. This can be done by having them read the letters 'say ten time forward and then ten times backwards.

**Binocular accommodative facility.** The next step is the binocular training. Again under red-green or polaroid dissociation (mini-vectogram) with the use of a $\pm 1.25$ thru $\pm 1.50$ to $\pm 2.00$ D flipper, accommodative rock training begins under binocular conditions. This is effective since a demand is made upon the vergence system while the accommodative system receives the rock training. This has proven more effective than accommodative rock alone. During this process the patient learns to identify and use the SILO effect (smaller in-larger out) cues. This leads to the state where the patient begins using the right hemisphere initiative spatial mode of processing which allows important changes to occur while using plus/minus flippers.
When the patient is able to fuse on a target at any distance and when the sensory system has developed to its peak level, balance training is added to the therapy. A typical technique has the patient jogging in place and alternately fixing two objects that are placed side by side on a table. Another technique uses the mini-vectogram or two of the eccentric circles attached to a window and the patient fuses in the chiastopic mode (BO), switches to the orthopic mode, changes fixation to an intermediate target and finally, returns his fixation to a distant target. This training assists the patient in developing the skills to project his visual system further into distant space as the desired method to relax the accommodative and convergence systems.

Kaplan uses tachistoscopic training to aid some of his myopic patients.

Tachistoscopic training. Within the first three months (about twelve office visits) most myopic patients are ready for tachistoscopic training, a technique designed to encourage the patient to transfer much of his mental processing from the left hemisphere to the right hemisphere. That is necessary to be able to recall visual impressions that are flashed for very short periods of time. The kinds of stimuli that can be used include: numbers, abstract shapes, arrows, tic-tac-toe, words, sentences, paragraphs, and the last level would be internal images, where the patient actually creates the images himself. The training should start at the lowest level which would probably be arrows which are flashed between 1/10th and 1/100th of a second. Again a placement test is conducted to determine the therapy level for each patient. One technique is to flash an arrow and have the patient tell you
what he saw. The patient will most likely use his verbal-logic-
left hemisphere system in processing the image. He translates the
shapes in the image into word descriptions before internalization
occurs. The typical circumstance would have the patient replying,
"I just saw an arrow pointing to the left", and that is the form
of the image which is most likely to be remembered and used for
recall purposes later on.

The goal of tachistoscopic training however, is image process-
ing and internalization that does not involve the verbalization
step, so that during recall the patient would mentally "see" the
image as direct replication of the target pattern. Tachistoscopic
training should be introduced during the binocular phase of
vergence-accommodative training where it provides a synergistic
effect and it should progress from targets of minimum verbal-
simple design to those with more complex patterns with verbal cues.

Kaplan also uses self-hypnosis as a follow up of tachisto-
sopic training as he feels it further enhances the patient's
ability to visualize his world.

Self-hypnosis. Self-hypnosis is a logical follow up of
tachistoscopic training since it further enhances the patient's
abilities to visualize his world. The therapist provides positive
suggestions designed to encourage confidence in the self-hypnotic
method, and these same suggestions should be available on tape for
patient use at home in the near future.

The techniques include the suggestion that the patient program
himself before sleep by thinking, "Tonight I am going to be very
comfortable. I am to have pleasant dreams. During my dreams I am
going to repeat several times that 'my sight and vision are
improving and all my eye muscles are becoming very relaxed and very comfortable. I will be encouraged to do my vision training each day at a specific time since I know the value of regular training to improved vision. I know that with this training program my vision skills and visual efficiency will show improvement. This can lead to my needing glasses that are weaker than the ones I am now wearing, and that I will see improvement on a daily basis by seeing things more clearly than ever before."

The use of this positive feedback approach draws on the potential of self-healing which resides in each of us. This is particularly useful for those myopes who through their prior habits have found themselves becoming more myopic. It is theoretically possible for them to change behavior patterns that could reserve the myopic direction their eyes and being have been following for so long. This personal self-healing therapy represents the highest level of vision training available for the myope.

Further information on the use of hypnosis can be found in Carl Hillier's thesis paper. Giddings and Lanyon did an experiment attempting to self heal by reversing the subject's behavior patterns visually. Their experiment showed a nonsignificant increase in acuity but a significant decrease in refractive error when adult myopes were subjected to contingent reinforcement.

As part of the holistic vision care program myopes, Kaplan has his patients spend a certain time viewing light frequencies while they listen to visualization and selected tapes. In addition, central visual fields will be plotted every third or fourth visit.
Photoretinology/Syntonization/Syntonics/Photosensitization, basically is a belief that by having a patient view specific frequencies of the visible range of the spectrum, a restoration of imbalances between sympathetic and parasympathetic systems will result. It is thought that environmental stresses brings about a disruption of the autonomic nervous system control, such that dysfunctions occur in the endocrine system to name but one of the many systems. Via color light therapy, the equilibrium is restored by virtue of the visual pathways that don't travel to the striate cortex.

It is thought that one of the ways of demonstrating the changes produced by conventional and sytonic therapy is the plotting of visual fields using a stereocampimeter.

Friedman summarizes a myopia management visual therapy program that requires a patient to actively apply learned techniques and behavioral responses during training and daily activities. The proper use of correction and training spectacles and adherence to visual hygiene rules are emphasized. The program consists of 10 to 12 weekly, one hour, in-office sessions, plus 30 minutes of daily home training.

Patients are taught that "on accommodation" represents active accommodation which occurs for near targets or any blurred or obscured target that requires more identification. "Off accommodation" represents a state of maximum relaxation of accommodation. All accommodative training teaches patients to stimulate and inhibit accommodation and they learn that clearer vision is produced by maximum inhibition.

Tasks involve minus lenses and include:

1. Minus lens - Clear/clear. The patient views a letter chart monocularly at eight feet through his proper correction. He learns
### Visible Spectrum Breakdown into Specific Frequencies

<table>
<thead>
<tr>
<th>Color</th>
<th>Frequency</th>
<th>Name</th>
<th>Code</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>431</td>
<td>Alpha</td>
<td>a</td>
<td>Sensory stimulant.</td>
</tr>
<tr>
<td>Orange</td>
<td>473</td>
<td>Delta</td>
<td></td>
<td>Respiratory stimulant; Thyroid energizer; Depresses parathyroid; Lung builder; Anti-spasmodic.</td>
</tr>
<tr>
<td>Yellow</td>
<td>510</td>
<td>Theta</td>
<td></td>
<td>Motor stimulant; Lymphatic actuator; Nerve builder.</td>
</tr>
<tr>
<td>Lemon</td>
<td>547</td>
<td>Sigma</td>
<td>S</td>
<td>Cerebral stimulant; Antacid.</td>
</tr>
<tr>
<td>Green</td>
<td>554</td>
<td>Mu</td>
<td></td>
<td>Muscle and tissue builder; Bactericide; Germicide antiseptic disinfectant.</td>
</tr>
<tr>
<td>Turquoise</td>
<td>621</td>
<td>Mu Upsilon</td>
<td></td>
<td>Cerebral depressant; Acid; Tonic; Skin builder.</td>
</tr>
<tr>
<td>Blue</td>
<td>658</td>
<td>Upsilon</td>
<td>U</td>
<td>Pain reliever; Vitality builder; Soother.</td>
</tr>
<tr>
<td>Indigo</td>
<td>695</td>
<td>Upsilon</td>
<td>UR</td>
<td>Parathyroid stimulant; Thyroid depressant; Respiratory depressant; Edative.</td>
</tr>
<tr>
<td>Color</td>
<td>Frequency</td>
<td>Name</td>
<td>Code</td>
<td>Characteristics</td>
</tr>
<tr>
<td>--------</td>
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<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Violet</td>
<td>731</td>
<td>Omega</td>
<td>W</td>
<td>Splenic stimulant; Cardiac depressant; Lymphatic depressant; Motor depressant; Leucocyte builder.</td>
</tr>
<tr>
<td>Purple</td>
<td>756</td>
<td>Upsilon Omega</td>
<td>UW</td>
<td>Venous stimulant; Renal depressant; Antimalarial; Vasodilator; Narcotic; Hypnotic.</td>
</tr>
<tr>
<td>Magenta</td>
<td>584</td>
<td>Alpha Omega</td>
<td>aW</td>
<td>Cardiac energizer; Diuretic; Emotional equilibrator adrenal stimulant.</td>
</tr>
<tr>
<td>Scarlet</td>
<td>507</td>
<td>Alpha Upsilon</td>
<td>uW</td>
<td>Arterial stimulant; Renal energizer; Genital excitant; Aphrodisiac; Vasoconstrictor.</td>
</tr>
</tbody>
</table>
to get clarity of the letters using a series of minus lenses from -2 to -12. Initially speed of clearing is stressed both through the minus lens and after removal, but later patients are coaxed to focus and unfocus gradually, smoothly, and gently to teach them to control their accommodative system. Patients must maintain clarity for ten seconds, with and without the lens for ten cycles before moving on to the next lens.

2. Minus lens - Clear/blur. Following the above procedures patients now alternately clear and hold for ten seconds and then unfocus or blur and hold for ten seconds the target through minus lenses. Patients begin at -6 to -8 diopter level and progress down to -1 and -2 diopter level where accommodative inhibition is very difficult.

3. Maximum blur with over minus. This monocular and binocular procedure uses -4, -6, and -8 diopter lens over an uncorrected myopic eye. The patient first clears a letter chart at eight feet through the minus lens and holds it, followed by removing the lens, resulting in a very blurred image. This demonstrates how accommodation blurs vision at far.

Using the same lens, the patient attains a maximum blur by inhibiting accommodation. The lens is removed and the patient notices a short enhancement of his unaided acuity which demonstrates the eyes unaccommodated ability.

As the patient advances, they begin to substitute eye closure for the maximum blur through minus lens phase. Here they try and achieve maximum inhibition of accommodation by closing their eyes and imaging a clear, far away outdoor scene. After five to ten seconds of eye closure successful patients open their eyes and notice brief clarity previously achieved with the maximum blur.
through minus lens. Over time they may increase this clarity period to more than 30 seconds and learn to adopt this relaxed accommodative viewing for regular activities.

4. Selective clarity with minus overcorrection. The patient views monocularly through proper correction and additional minus lens (-6, -4, -2 diopter) while moving around the room. He maintains a relaxed accommodation (blur) except for brief moments where an object is fixated and cleared, followed again by relaxed accommodation (blur) and resumed randomized eye movements around the room. Higher achievement comes using lower minus lens. The technique is also performed binocularly with minus lenses under 3.5 diopters.

5. Home reading through excessive minus. Patients use -1 to -2.5 diopter clip on lenses or flippers over their distant correction spectacles and read for up to one hour before bedtime to help enhance positive relative accommodation. This procedure may cause asthenopia but helps achieve maximum relaxation of accommodation and improved unaided visual acuity afterwards in some myopic patients.

Additional monocular and binocular accommodative training procedures mentioned by Friedman include using the Tel-eye Trainer, Telebinocular, and flip lens holders (plus/minus flippers).

Friedman demonstrates and discusses visual suppression with his patients so they develop an understanding and so they can learn to counter any suppression factors. Binocular awareness instruments like the Telebinocular, Chrome Orthopter, Cheiroscope or simple hand held mirrors allow the patient to observe and experiment with spontaneous patterns of central suppression.
Patients are first taught that active suppression represents binocular inefficiency and then they attempt to achieve maximum binocular blending or luster under various conditions. Patients using lenses and prisms are taught to maintain maximum binocularity in varying conditions. Using the Chrome Orthopter, vectographic slides, Brock String, binocular base-in and base-out prisms (in four lens flippers) viewing targets in open space, Telebinocular, colored circles, aperture rule, etc., the training provides many suppression and binocular techniques using various ACA manipulations.

Patients are taught to use eye closure for ten seconds to suspend active suppression. They avoid precision viewing tendencies after opening the eyes and learn to maintain longer periods with no suppression eventually needing only brief eye closure to maintain binocularity.

Patients use plano prisms, 5 to 30 diopters in four lens holder (flippers) with one pair base-in and one pair base-out. They view a stationary Marsden Ball at four to six feet as the prisms are introduced. First, the patients are allowed to notice the diplopia of rapid insertion and removal without allowing fusional eye movements. Gradually the patient attempts to resist the fusion response and maintain diplopia while the prisms stay in place longer. Finally, the patient is taught to fuse and hold for ten seconds and then unfuse and hold diplopia for ten seconds while the prisms remain in place. During diplopic stages the images should be equally blurred and separated from the center.

The whole goal is for patients to practice this response—nonresponse viewing using monocular and binocular prism insertions and minus lens blurs. Friedman feels recorded instructions of
visual manipulations and styles, and visual imagery tapes are helpful in guiding closed-eye patients to relaxed visual states. Friedman feels it's essential that patients understand their myopia is not a weak or lazy eye condition, but rather, an optical condition where their eyes develop too much power. They must realize visual therapy follows a relaxation approach and not a muscle strengthening approach. This helps patients avoid eye straining, squinting, or intense vision concentration during or after the program.

All patients are given written visual hygiene instructions and advice on study or near habits that include ideas previously mentioned.

Generally, monocular accommodative rocks are designed to improve the ability of each eye to accommodate and relax and perform equally. Binocular accommodative rocks develop the ability to shift accommodation ahead of or behind convergence without suppressing.

Dr. Parker has a corrective-protective program he operates on an annual basis. He sees patients initially weekly, then twice monthly, and monthly as their performance ranges improve. He develops the following skills:

1. Ocular motilities with rotations, fixations and versions.

2. Accommodative facility with plus and minus rocks.


4. Alignment of the visual axis whether esophoric, exophoric, hyperphoric, and near point of convergence.

5. Silo effects with smaller and in through minus lenses or base-out prism, and larger and out through plus and base-in prism. He manipulates the patient's visual space to make them more aware.


8. Fusion; first, second and third degree using the Vodnoy home training kit.

9. Perceptual span with the tachistoscope.

10. Reading rate and comprehension.

He used figures and graphs to present his program. He shows parents and patients graphs indicating the usual increase in minus lens power over time with the traditional minus lens distance correction versus the leveling off or slight decrease in minus lens power using his P-C program. Parker describes his corrective program as the combination lens providing adequate distant vision, initially 20/30, which he states generally improves with the program, and comfortable near vision. His reading lens is usually +.50 to +.25 diopters more plus than the near findings, depending on the patient's response to the add.

The protective part is for the remaining acuity. His results show possible checking of the progressive tendency and improved visual achievements, better grades and work performance reported by his patients. His system shows no restoration of any lost acuity.

Barax 20 uses an orthoptic corrective procedure also. He decreases the interdependence between accommodation and adduction by increasing the numbers 9, 16A and 17A findings using accommodative rocks and plus acceptance techniques. He further stimulates and exercises adduction ahead of accommodation using the following techniques:

1. Ocular rotations and accommodative rocks.

2. Plus acceptance techniques at near while holding convergence fixed.

3. Base-out prism training at near on a roroscope to build 16A and 16B findings, and base-in prism training at near to increase the independence of accommodation and convergence functions.
4. Base-out and base-in prism through added plus at far tech-
niques.

5. Absolute insistence of no near work inside of 16 inches.

6. Avoids all acuity training to decrease confusion.

7. Use of single vision Rx for all distances when needed.

Dorothae Carter uses therapy to reduce myopes resolving power
at far. She uses a four-step program. The first phase involves
monocular and binocular rotations and fixations. The second phase
consists of monocular and binocular accommodative rocks, projected
ductions and versions at near without any Rx, using plus lenses for
all near work. The third phase involves non-suppression techniques
and stereopsis training. The final stage uses tachistoscopic train-
ing beginning at near and gradually working out.

She believes the key is proceeding at a pace the patient gets
satisfying results from, and that most myopic patients with willing-
ness and cooperation will improve their farpoint resolving power.
Nutritional Considerations

The authors realize that as optometrists we are not specifically trained in nutrition or the nutritional affects of our twentieth century diet on the visual system. This paper will deal primarily with myopia and nutrition. It is of paramount importance that each of you realize the time for neglecting the affects of our diets on vision is over.

The information in this manual is for your investigation and although it is intuitively sensible, the hard data for proof is not all in. In fact, at Pacific University, Rocky Kaplan is at this time compiling nutritional profiles of many of the myopic patients seeking help in our clinics.

Deficiency in diet has long been considered a possible variable in the development of myopia. Gardiner believes that diet deficiency played a major role in the development of myopic refractive characteristics. Price looked at the Eskimo population and found a very small incidence of myopia and theorized that their diet must be a major factor. Cass took the theory one step further and reported a higher incidence of myopia in Eskimo subjects who were fed a high carbohydrate diet characteristic of Caucasians in the western hemisphere. It should be mentioned that we are not talking about dietary deficiencies. Extreme malnutrition was found to be of little or no significance in the development of myopia. What we are concerned about is the quality of the diet.

We have considered many factors dealing with the control and prevention of myopia and we will now present some information on myopia control and nutrition.
Tissue strength and tone are vitally important in the growth and stability of the eyes. The vitamins and minerals necessary for increasing tissue strength and tone are: vitamins A, B, E, calcium, phosphorus, potassium, sodium, manganese, and chromium. Vitamin A is of special significance for its role in vision. In the rods of the retina the light sensitive pigment, visual purple, is made up of molecules of the protein, opsin, each linked to a molecule of retinal. Retinal is an active form of vitamin A. In addition to its obvious role in the biochemical reaction of light with the retina, it is stored in the liver and has as one of its chief functions, the purification of the blood. Foreign poisons often collect there to be detoxified, and it is believed that vitamin A plays an important role in dealing with such deleterious substances as pesticides and industrial poisons. It is also being recognized as a preventive vitamin in its capacity for strengthening the body's resistance to respiratory infection.

In addition to the effects of vitamin A on the visual system, other vitamins and nutrients are important in ocular health. Riboflavin or vitamin B₂ is a component of an enzyme necessary for the anaerobic glycolysis phase of corneal metabolism and is essential for corneal respiration. In terms of tissue clarity of the crystalline lens, riboflavin has been explored as a possible answer to providing relief of cataracts by producing increased lenticular clarity. A proper balance of vitamin B₂, B₆, and various amino acids are necessary in helping to maintain lenticular clarity. The lens has also been shown to contain large amounts of vitamin C in health eyes whereas vitamin C is greatly diminished in lenses of eyes that have developed cataracts.
Nerve function leads us to looking at vitamins B-1, B-6, B-12, B-3, vitamin D, vitamin E, and the minerals, magnesium, manganese, phosphorus, potassium, sodium, sulphur, and calcium. With proper nerve functioning, improved ability to perform daily tasks, less distress and more control of environmentally induced tension should be expected. With increased or improved nerve functioning the groundwork is laid for total muscle and organ performance.

Circulation is affected by vitamins B-1, B-6, folic acid, niacin, vitamins C, D, E, and the minerals, calcium, chromium, copper, iron, magnesium, potassium, sodium, and zinc.

Coping with stress requires ample amounts of all vitamins and minerals listed under nerve function with special emphasis on all B vitamins. Pantothenic acid is a primary ingredient as a protective agent against stress.

Stress plays an important role in myopia. The type of myopia that this paper deals with is often considered a direct result of near point stress, so it stands to reason we want to help our body as much as possible in dealing with the stress induced at near point.

Ben Lane, a New Jersey optometrist who has done extensive research in nutrition and vision, has proposed that a deficiency of chromium, a metal found in trace amounts in human tissues, and overconsumption of denatured or overcooked protein are linked to the development of myopia. He supports the idea that excessive accommodation results in the elevation of the baseline pressure within the eye, and hence in the elongation of the eyeball. In addition to accommodative stresses, Dr. Lane found that IOP changes are influenced
by nutritional deficits.

IOP elevation is triggered by repeated sustained accommodation in the absence of any preventive measure (lenses or visual therapy). The IOP elevates and in young persons the eyeball may elongate reducing the need for continuous strong contraction of the ciliary muscles. When chromium deficiency occurs in the body, there is an accompanying rise in IOP. Ingestion of sugar and other refined carbohydrates helps deplete the body's storage of chromium. Sugar also forces the body to use its storage of vitamin B, which, in addition to helping with stress, also plays a role in the regulation of fluid pressure in the eyes.

With excessive consumption of denatured or overcooked protein, body reserves of pyredoxine (B-6), pantothenic acid (B-5), and folic acid (B-9) are depleted and a calciuretic affect occurs.

This calciuretic affect (documented in a series of studies since 1968) results in the spilling of calcium into the urine and presumably into hair. So what we end up finding is a relationship of excessive protein consumption and the accumulation of calcium in the hair of persons whose eyes are changing in refractive power toward myopia.

It is not going to be enough just to counsel your patients on proper nutrition. You should explore the advantages of getting a complete food intake diary and requiring one week of total compliance. In addition to the diary, a nape hair sample taken from your patient could turn out very valuable when properly analyzed. Remember, hair sample studies indicate that myopes have a dramatically lower concentration of chromium and that calcium is significantly elevated in myopes.
This section of the manual is presented to enhance the vision care practitioner's knowledge of general psychological socio-economic traits that have been reported to be correlated with myopia. It is important when dealing with a patient that as much information as possible is learned, not only the exam findings, but also an understanding of background motivations and feelings. This particular information would not be important to a doctor only interested in treating symptoms, but when considering a patient for vision therapy we must consider all aspects of that life. Vision therapy with the right set of circumstances can change a person's whole life. It can change the way a person feels about himself and others that he interacts with. These are not changes that should be dealt with lightly. There are many doctors with patients who, no matter what therapy is performed, seem to get little or no improvement, while others with only the slightest intervention get dramatic changes. These two patients could be similar in optometric data, however, there is something very different going on psychologically with each. In the case of the first patient, you might ask yourself, does this person really desire to change his or her visual system or is it a convenient tool to help in coping with daily life.

There is a growing interest by some optometrists in the potential contributions of psychology in general, and behavior modification in particular, to understanding and treating some visual disorders.

It is important to distinguish two different emphases in psychological literature on myopia. The first involves the development
of myopia, and the degree to which psychological variables are relevant. The second is concerned with the treatment or modification of myopia and the extent to which that can involve psychological factors. These are two very different questions and should not be equated together. It should be understood that because a disorder is based on behavioral or environmental factors, it is not necessarily modifiable behaviorally. Conversely, it is sometimes possible to bring about changes using behavioral methods in disorders that do not have behavioral causes.

There is a fairly consistent core of personality characteristics attributed to myopic individuals. In general, they may be seen as introverted and shy, socially awkward, and as having relatively few friends. They are also characterized in the literature as being self-centered, optimistic, euphoric, ardent, selfish, tyrannical and egotistical. Rice gives a description of the kind of behavior one might expect of myopic children, emphasizing interest in near work rather than outdoor activities. The last behavior is probably more relevant to us than others mentioned but it is important to be exposed to most of the ideas previously published.

The descriptive personality studies tend to support the core description in which myopes tend to be more introverted, shy and inhibited. Mull found that myopic college students scored higher than emmetropic students as measured by the Bernreuter Personality Inventory. Schapero and Hirsch, studying optometric findings with the Guilford-Martia Temperament Test found a tendency for myopia to be associated with an inhibited disposition, over-control of the emotions, inertness and disinclination for motor activity. Remember, these are only reported generalizations and each patient should be
evaluated on his or her personal findings.

The differences in intellectual characteristics have also been explored extensively and rather consistently show myopic individuals to be superior in areas related to intellectual achievement. It is important to note that almost all the studies in this area cannot be used for any cause and effect relationship. It is possible to conclude that certain personality characteristics do appear to be related to myopia, such as introversion, need for achievement, higher scholastic aptitude and academic performance.

The one area that must be researched further is whether the personality traits lead to myopia or is the myopia the cause for the psychological findings. There is no answer at this time, but we, as optometrists interested in controlling myopia, should not let this bother us. It will be important to answer these questions, however, now it is more important to accept the fact that myopic individuals may exhibit some or all of these traits. It may be very important in our total therapy program to explore the patient's psychological traits. We may or may not want to advise the patient to seek professional psychological help before starting optometric vision therapy.

To this point we have dealt primarily on psychological correlates appearing with myopia. We can now include some speculation on the possible manipulation of myopia by psychological means.

The idea that psychology might have some relevance for altering myopia is revolutionary and being aggressively explored in research by B.J. Seymour (social worker) and Rocky Kaplan, O.D., at Pacific University's College of Optometry. Reviewing the current studies and other informed observations by optometrists, it can be seen that
a myopic individual, under certain conditions, may perform visually far better than his or her accessed visual acuity. Even though others are measured changes in visual acuity after psychological counseling and visual therapy, we are really concerned with the patient's visual performance and his or her perception of how well they "feel" they can see. Of most importance is how much better they "feel" they can see since therapy.

So with regard to the modification of myopia by psychological means, the evidence at this time is limited to demonstrations that significant though minimal and temporary improvements can be brought about through positive reinforcement and counseling. These changes appear to involve changes in refractive error as well as changes in subjectively accessed visual acuity.

In terms of what we, as vision specialists, should include in our holistic approach to myopia control, the authors will try to make some suggestions. Those persons who you can identify has having some or all of the personality traits mentioned previously should, in addition to aggressive vision therapy, be encouraged to receive counseling to deal with the traits that may be contributing to the myopia. The thought here is that in providing counseling to deal with such things as introversion, along with all of the vision therapy and nutritional education, we can possibly increase the potential for more dramatic and long term changes in his or her visual efficiency.
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